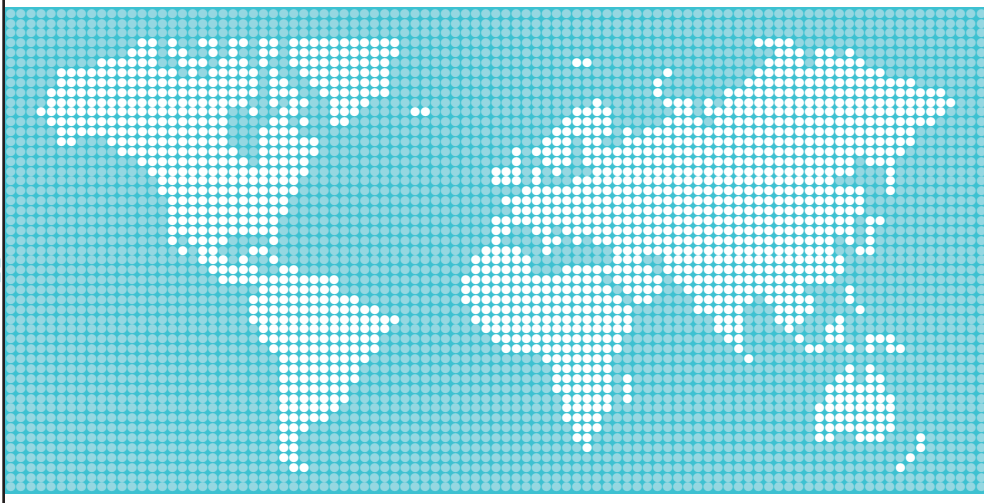
OECD

ENVIRONMENTAL PERFORMANCE REVIEWS

DENMARK



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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996) and Korea (12th December 1996). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

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EXAMENS DES PERFORMANCES ENVIRONNEMENTALES
DANEMARK

FOREWORD

The principal aim of the OECD's environmental performance reviews is to help *Member countries improve their individual and collective performances in environmental management*. The primary goals for this programme are:

- to help *individual governments* assess progress by establishing baseline conditions, trends, policy commitments, institutional arrangements and routine capabilities for carrying out national evaluations;
- to promote environmental improvements and a continuous policy *dialogue among Member countries*, through a peer review process and by the transfer of information on policies, approaches and experiences of reviewed countries; and
- to stimulate *greater accountability* from Member countries' governments towards public opinion within developed countries and beyond.

Programme efforts are directed at *promoting sustainable development*, with emphasis on developments in domestic and international environmental policy, as well as on the integration of economic and environmental decision-making.

Environmental performance is assessed with regard to the degree of achievement of *domestic objectives and international commitments*. Such objectives and commitments may be broad aims, specific qualitative goals, precise quantitative targets or a commitment to a set of measures to be taken. Assessment of environmental performance is also placed within the context of historical environmental records, the present state of the environment, the physical endowment of the country in natural resources, its economic conditions and demographic trends.

These systematic, independent and periodic reviews are organised and conducted in a way similar to the OECD's economic reviews. The report is peer-reviewed by the Working Party on Environmental Performance, composed of officials from Member countries who have responsibility for national environmental policy development and implementation and a broad competence recognised at national and international levels. The conclusions and recommendations of the report are approved by the Working Party.

Joke Waller-Hunter
Director
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GENERAL INTRODUCTION

This review of Denmark's environmental performance *examines results to date* in the light of domestic objectives and international commitments. Three countries assisted with this review: Greece, Sweden and the United States.

The report is organised in three parts according to the strategic goals identified by OECD Environment Ministers in January 1991:

- Part I is entitled ''Pollution Control and Nature Conservation'' and focuses on water, air, chemical products and waste management, and nature conservation;
- Part II is entitled ''Integration of Policies' and focuses on institutional aspects and on how policies concerning economics and agriculture are integrated with environmental policies;
- Part III is entitled ''Co-operation with the International Community'' and focuses on international environmental topics concerning Denmark.

The OECD extends its most sincere thanks to all those who helped in the course of this review, and especially to the examining countries (Greece, Sweden and the United States) and their experts. The OECD is particularly indebted to the Government of Denmark for its co-operation in expediting the provision of information and the organisation of the experts' mission to Denmark, and in facilitating contacts with many individuals both inside and outside administrative and governmental structures of the country.

The OECD Working Party on Environmental Performance conducted the review at its meeting in November 1998 and approved its conclusions and recommendations. This report is published under the authority of the Secretary-General of the OECD.

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Part I

POLLUTION CONTROL AND NATURE CONSERVATION

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ABBREVIATIONS AND SIGNS

Abbreviations

AAU	Agricultural area in use
AEPS	Arctic Environmental Protection Strategy
AMAP	Arctic Monitoring and Assessment Programme
BOD	Biochemical oxygen demand
CAP	Common Agricultural Policy
CFCs	Chlorofluorocarbons
COD	Chemical oxygen demand
DAC	Development Assistance Committee, OECD
DANCED	Danish Co-operation for Environment and Development
DANIDA	Danish International Development Agency
DESF	Danish Environmental Support Fund
EDRF	Environmental and Disaster Relief Facility
EIA	Environmental impact assessment
EMAS	European Eco-management Audit Scheme
EMEP	Environmental Monitoring and Evaluation Programme
EPA	Environmental Protection Agency
GEF	Global Environment Facility
GHG	Greenhouse gas(es)
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
IEA	International Energy Agency
ISO	International Organisation for Standardisation
IUCN	International Union for Conservation of Nature
LU	Livestock unit
MARPOL	London Convention on Prevention of Pollution from Ships
Mt	Million tonnes
MTBE	Methyltert-butyl ethyl
Mtoe	Million tonnes of oil equivalent
NEFCO	Nordic Environment Finance Corporation
NGO	Non-governmental organisation
NPEOs	Nonylphenolethoxylates
ODA	Official development assistance
ODS	Ozone-depleting substance(s)
PCBs	Polychlorinated biphenyls
PIC	Prior informed consent
POPs	Persistent organic pollutants

PPPs	Purchasing power parities
PVC	Polyvinyl chloride
SEA	Strategic environmental assessment
SFA	Sensitive farming area
SNS	National Forest and Nature Agency
SPA	Special protection area
TFC	Total final energy consumption
TPES	Total primary energy supply
TSP	Total suspended particulate matter
UNCED	United Nations Conference on Environment and Development
UN-ECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNGASS	United Nations General Assembly Special Session
VOCs	Volatile organic compounds
WHO	World Health Organisation

Signs

The following signs are used in Figures and Tables:
.. : not available
– : nil or negligible
. : decimal point

Country Aggregates

OECD Europe: All European Member countries of the OECD, *i.e.* countries of the European Union plus the Czech Republic, Hungary, Iceland, Norway, Poland, Switzerland and Turkey.

OECD : The countries of OECD Europe plus Australia, Canada, Japan, Korea, Mexico, New Zealand and the United States.

Country aggregates may include Secretariat estimates.
The sign * indicates that only western Germany is included.
The sign ** indicates that not all countries are included.

Currency

Monetary unit: Danish Krone (DKr)
On average in 1997, DKr 100 = US$15.14

Cut-off Date

This report is based on information and data available up to August 1998.

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CONCLUSIONS AND RECOMMENDATIONS*

Denmark's *open economy* thrives on trade and provides the country with high average incomes and extensive welfare benefits. Its landscapes are almost entirely shaped by human activities, notably the intensive agriculture that supports its large agro-food industry. Other major environmental pressures stem from its transport sector and from its energy supply structure, which relies mainly on fossil fuels. In addition to the national dimension, environmental issues in Denmark have a strong international one. This is due to regional economic and environmental interdependencies (Nordic co-operation, North Sea and Baltic Sea pollution, transfrontier air pollution). Denmark is also strongly involved in global environmental issues and environmental aid.

In the 1990s, economic growth and participation in the European Union have provided the context for economic and environmental decision making in Denmark. Denmark has a well established practice of national environmental planning, and the implementation of environmental policies is largely devolved to local authorities and is widely supported by public opinion. *Environmental policies* currently focus on the following themes: acid deposition, nutrient discharges and groundwater contamination, biodiversity, chemical substances, and global issues such as climate change. Measures to address these issues rely on a broad range of diverse and in some cases innovative policy instruments. In particular, the green tax reform introduced in the 1990s has made it possible to reduce taxation on income and labour, whilst increasing fiscal incentives to protect the environment.

This OECD report sets out the baseline for assessing future environmental progress and examines Denmark's environmental performance in three areas:

– implementation of environmental policies;
– integration of environmental concerns and economic decisions;
– international co-operation on environmental protection.

* Conclusions and Recommendations discussed, amended and approved by the Working Party on Environmental Performance at its meeting in November 1998.

It also assesses the extent to which Denmark's *domestic objectives and international commitments* are being met, based on environmental effectiveness and economic efficiency criteria. A number of recommendations are put forward that could contribute to further environmental progress in Denmark.

1. Implementing Environmental Policies

Achievements and further progress

Building on the solid institutional and regulatory foundations laid in the 1970s and 1980s, Denmark has in recent years taken stock of the remaining and new environmental challenges it faces and has extensively revised and upgraded its *environmental legislation*. Environmental regulations continue to play a major role in environmental policies. Budgets and staffing have regularly and substantially increased in line with expanding responsibilities and policy priorities. The implementation of environmental responsibilities which are significantly *devolved to municipal and county authorities* has likewise improved. Land use regulations, particularly those applicable to rural and coastal areas, are rigorous; municipal and county administrations contribute to ensuring that *spatial planning* is an effective instrument for the protection of the environment, nature and landscapes. Danish environmental democracy is one of the most advanced among OECD countries. Policy making is *open and consultative* and a wide range of measures are in place to ensure public participation and stakeholder involvement, provision of and access to environmental information, as well as the right of administrative and legal appeal.

Denmark makes extensive use of *economic instruments* for environmental management: environmental charges, environmental taxes and other economic instruments (e.g. deposit-refund). Overall, the green tax reform, and more generally the use of economic instruments for environmental management, has led to important results: the environmental incentive effect of taxation has been improved and the changes have been revenue neutral, with taxes on income and labour being reduced to compensate for higher environmental taxation. *Pollution abatement and control expenditure* in Denmark amounts to about *1 per cent of GDP*, a level comparable to that of other Nordic countries and lower than in a number of other OECD countries. Overall, public environmental expenditure is covered by environmental charges and taxes, and the polluter pays principle is applied to households and industry.

The 1990s have confirmed the *effectiveness* of this approach in continuing to control and reduce pollution from point sources. In particular, significant progress has been achieved in reducing atmospheric emissions of conventional pollutants and discharges of organic substances, nutrients and heavy metals into water from municipal and industrial sources. Though this achievement is not always apparent at ecosystem level, air quality has improved, contaminated sites have been identified and are being cleaned up, and surface water quality is well above what it was in the 1970s. On the other hand, trends in waste generation and CO_2 emissions are not favourable. As the Danish economy continues to grow in the 1990s, environmental pressures from energy, agriculture and transport in particular are still strong.

There are opportunities to *improve and refine environmental taxes* applied in Denmark. The carbon tax should be reviewed with a view towards simplifying it and strengthening its environmental effectiveness; transport taxes need to be further modified to influence emissions and fuel consumption through both fixed and variable transport costs; pesticide taxes are based on the price of the product and do not necessarily reflect the toxicity of the chemical used; a tax on water should be applied to all other users of water, not only households. Recent moves to improve the *conservation of coastal areas*, notably the prohibition of construction within 300 metres of the shoreline, must be maintained and properly implemented. In the absence of a systematic *national inventory of land use* and the legal status of protected areas, it is difficult to assess precisely the actual results of policies developed since the early 1970s, notably in coastal areas that have been subject to the highest development pressures. Detailed information is available on public environmental expenditure, but there is no knowledge of the structure of and trends in private environmental expenditure.

It is *recommended* to:

- ensure that the licensing process systemically considers waste prevention, and the efficiency of energy and other material inputs, in order to accelerate the move towards *cleaner technologies and processes*;
- continue to monitor the enforcement of and compliance with *environmental regulation*, with particular attention to agriculture and fish farming;
- further pursue the green tax reform, calibrating *environmental taxes* to ensure their full environmental effectiveness and economic efficiency, notably those applied to CO_2, water, pesticides and transport;
- strengthen the use of *economic analysis* and *economic instruments* as part of environmental decision making, particularly with respect to decisions relating to pollution from agriculture;

– complete a systematic inventory of land use and land use changes, in order to assess the effectiveness of *spatial planning policies* in terms of nature and environmental protection;
– improve the availability of data on *private environmental expenditure*, particularly by industry.

Water management

Awareness that Denmark's *water resources* are an asset that need conserving and protecting has grown in the last ten years. Denmark aims to continue to be able to use untreated groundwater for drinking water supply throughout the country. Substantial investments in improving *waste water treatment by municipalities and industry* have made it possible to meet the discharge reduction objectives set for point sources in the Action Plan for the Aquatic Environment. Plans to address nutrient and pesticide loadings have been elaborated, reviewed and regularly updated, with quantitative targets and deadlines, supported by a coherent institutional and planning framework at national, county and municipal level. The target reduction of the 1986 Pesticide Action Plan for pesticide amounts was almost met in 1997. These achievements have been made through a range of *mutually supporting regulatory and economic instruments*, including licensing, strict discharge standards, and charges and taxes on water supply and waste water discharges. The protection of areas used for water supply and recent efforts to better define and protect water abstraction areas are beginning to have an effect on groundwater quality. Attention and work have been devoted to improving and *restoring watercourses and other aquatic ecosystems*. Much effort is being put into monitoring water quality, particularly for tracing pesticides and understanding their effects on drinking water.

Despite reductions in discharges of organic matter and nutrients from municipal and industrial point sources, most *watercourses and lakes* are a long way from meeting the quality objectives, *pollution of groundwater* has reached a level that threatens the current system of water supply based on small scale and simple treatment, and *coastal waters* are affected by eutrophication. Continued pollution from *agricultural sources* is the main cause for such modest results: the quantity of *manure* produced by Danish agriculture has not fallen significantly in the last ten years and increasingly exceeds field application capacity of individual farms, especially pig farms, which saw their production increase by 30 per cent between 1987 and 1996. To what degree Danish watercourses, lakes, groundwater and coastal waters actually further improve depends largely on the success of meas-

ures adopted in 1998 to reduce the nutrient load from field fertilisation and those to reduce *pesticide* loadings.

It is *recommended* to:

- ensure the *full implementation of the second Action Plan for the Aquatic Environment*, including economic measures aimed at reducing agricultural nutrient loadings, and closely monitor their effectiveness;
- strengthen the *enforcement of existing environmental regulations* relating to water pollution, notably for fish farms;
- consider the *extension of the water tax* to water users other than households;
- further develop *watercourse maintenance improvement and restoration*, notably for private watercourses, and upgrade their ecological condition;
- continue efforts to upgrade *pesticide monitoring of groundwater and drinking water*, as an essential input into priority setting in pesticide management policy;
- elaborate a *national water management plan* that would take a *catchment area approach* to both pollution and water resource issues;
- give more attention to the economic analysis of water management measures, and carry out a comprehensive assessment of the *economic and environmental effectiveness* of measures in different sectors (municipal, industrial, agricultural).

Air management

Denmark has made significant progress over the last two decades in reducing or containing emissions of *conventional atmospheric pollutants*. Between 1980 and 1995, while GDP increased by 36 per cent, SO_x emissions dropped 67 per cent and those of NO_x fell by 11 per cent. Such emission reductions have made it possible for Denmark to meet its national and international commitments, and have had a positive impact on local air quality. Urban air quality is generally good, though pollution episodes have been observed in unfavourable climatic conditions. These achievements result from a range of abatement measures, notably fuel quality standards, regulatory and economic instruments, as well as greater integration of environmental concerns in energy and transport policies. Many municipalities are committed to reducing air pollution and other environmental impacts of transport. With the support of the Danish EPA, a major shift in *local transport and spatial planning policies* is under way. Over the last two decades, Denmark has almost *stabilised energy use* during a period of continued economic growth. It has almost tripled the contribution made by *renewable energy*

sources to the country's energy needs, and Danish industries have become leaders in environmentally favourable energy technologies such as wind turbines, which are now considered as a viable alternative to coal based power plants.

Nevertheless, Danish emissions of SO_x and NO_x per unit of GDP are relatively high in Europe and *further reductions in emissions of atmospheric pollutants* are necessary, particularly to reduce ozone levels and reduce acid deposition. Transport emissions play an increasingly central role in air pollution management and CO_2 emission reduction policies. Many of the measures will have to be directed at controlling the increase in road traffic and related emissions. With the support of the Danish EPA, two-thirds of the 90 largest municipalities have elaborated Traffic and Environment Action Plans, though only a few have been implemented. The balance of taxation between the ownership of cars and the use of cars must be reviewed regularly. High purchase and annual taxes, which are now correlated with vehicle fuel consumption, along with attractive public transport, have proven to act as a disincentive to car ownership, while road traffic growth has remained in line with OECD averages. Nevertheless, measures to reduce the average emissions of the car fleet should be considered. Energy efficiency should be further improved and energy substitution reviewed. Given the international context, renewables will remain only marginally competitive without appropriate policy support. As a result, Denmark may incur costs by seeking to move faster than other countries on their rapid deployment. Nevertheless, the environmental benefits of such a deployment may outweigh the economic costs.

It is *recommended* to:

- carefully monitor the effect of measures designed to reduce *NO_x and VOCs emissions* to ensure that they can contribute to meeting national and international objectives and are sufficient to provide a long term improvement in air quality, notably with respect to *ozone levels*;
- continue to reduce emissions resulting in *acid deposition* both in Denmark and elsewhere;
- ensure that efforts to support *renewable energy and energy conservation* are targeted at the most cost-effective measures to reduce atmospheric emissions;
- consider the environmental effectiveness and economic efficiency of influencing variable transport costs, including the use of higher *taxation of gasoline* and *road use pricing systems* such as tolls;
- provide further support for the development of *sustainable transport policies at county and municipal level*;

– continue to ensure that *public transport* can compete with private car use through vigorous policy measures designed to discourage car use and support local and regional public transport.

Chemical products and waste management

The Danish system for the *safe management of chemical products* has been most successful for substances of concern in identified product uses (such as lead in gasoline, cation-active surfactants in detergents or chromium in wood impregnation products) and has used a combination of regulatory measures, voluntary agreements and economic incentives. Denmark has made a good start in setting priorities for action on *unassessed existing substances*, by establishing a list of unwanted substances and making best use of international co-operation. It has also made significant progress in *pesticide management;* in particular, the approval system for pesticide use has been improved, with the re-assessment of 209 active ingredients and the prohibition (or strict regulation) of the 29 ingredients of most concern. Denmark is developing an environmental product policy that aims to reduce environmental impacts over the whole life cycle of products.

To pursue its efforts to control chemicals, Denmark should maintain and improve the quality of the information in its *chemical product database* and reinforce its efforts to promote its *initiatives internationally*. As the decline in pesticide use seems to be largely due to improved low-dose products and a reduction in the arable land in production, the cost-effectiveness of general measures to reduce pesticide use and specific measures of the *pesticide approval system* should be reviewed.

Danish waste management policy has largely met its objectives. Since the mid-1980s, there has been a substantial reduction in landfilling, and recycling/ reuse has more than doubled over ten years, to 60 per cent of waste in 1996. Regulatory measures have been successfully supplemented by economic instruments. In particular, the waste tax, waste charges and taxes on packaging have provided the incentive needed for reuse and recycling, while collection and recycling is mandatory for some waste. Deposit-refund systems have been effective in ensuring the reuse of bottles and could be usefully extended to the recycling of cans. Hazardous waste collection and treatment are well managed, with such waste increasingly being recycled. Denmark is addressing the problem of contaminated land; the proposed amendment of the Contaminated Sites Act should close remaining loopholes in the regulatory approach and ensure that progress in cleaning up all types of contaminated sites can resume.

Nevertheless, recent waste data show *no trend towards a reduction in waste generation at source*. In the absence of new measures aimed at waste reduction, stabilisation is unlikely, particularly if the economy continues to grow as it has since the early 1990s, largely driven by buoyant private consumption. To achieve waste reduction at source, a product policy to reduce waste generated and improve the quality of the waste, and medium to long term changes in both production and consumption patterns, are needed.

It is *recommended* to:

- maintain and improve the quality of information in the *chemical product database*;
- consider how best to renew international efforts to identify priorities for action amongst *existing chemical substances* which have not yet been assessed;
- examine and take account of the relative cost-effectiveness of general measures to reduce *pesticide use* and measures to improve the *pesticides approval system*;
- make more use of economic instruments (e.g. waste taxes and charges, deposit-refund) to encourage *waste reduction* at source, as well as recycling and reuse;
- develop a medium to long term policy to change *production and consumption patterns*, geared to reducing the amount of waste generated at source and influencing its composition, notably through the implementation of an environmental product policy;
- consider options for funding clean-up measures for *orphan contaminated sites*.

Nature conservation

Denmark has adopted and is implementing an extensive body of nature conservation legislation in an effort to stop habitat loss and improve conditions for biodiversity. A large part of its territory is placed under *various forms of protection* (general habitat protection, conservation orders, protection zones along coast lines, Ramsar sites, EU bird protection directives), covering almost all types of terrestrial ecosystems. A number of lakes, coastal meadows, humid permanent grassland, bogs, watercourses, uncultivated dry grasslands and heaths have undergone *restoration* since 1989. For a small number of species, suitable habitats have been re-established together with breeding and re-introduction programmes. The establishment of peri-urban forests and eco-schools are additional achievements. Denmark plays a significant part in *international efforts* for *conser-*

vation of biodiversity, and has ratified all major conventions concerning wildlife and biodiversity, except the Convention on the Law of the Sea.

There is, however, a great need for additional and continuous efforts for nature restoration and biodiversity protection. *Freshwater ecosystems* as well as *marine ecosystems* are often affected by agricultural pollution and little conservation of marine areas has been implemented. About 97 per cent of watercourses have been channelled or otherwise modified. Monitoring of changes in habitat quality and species richness is generally not well developed, and due to a *lack of national comprehensive area statistics*, it is difficult to get an overall view of protected habitat area and land use changes. More attention should be given to nature management as part of *agricultural practices*, including traditional grazing and hay harvesting. Ambitious domestic efforts at county level could be more effective if supported by a *national ecological network concept*. Denmark is not on the way towards fulfilling its afforestation objectives (including those for ''re-creation''), which should give higher priority to deciduous forest plantations.

It is *recommended* to:

- continue the implementation of the national *strategy for biological diversity* and formulate a *national action plan for nature protection*, including quantitative targets and deadlines;
- develop a *national ecological network* in support of county efforts to develop ecological networks;
- continue the development of *management plans* for areas under conservation orders;
- continue to improve and extend the conservation of *marine areas*, and improve the integration of biodiversity concerns in fisheries policy;
- accelerate the implementation of the 300 metre *dune and beach protection zones*;
- investigate the possibility of establishing a *network of national parks*, which could include some of the most valuable coastal ecosystems, such as tidal flats, dune areas, cliff coasts and heaths;
- improve the integration of nature, landscape and biodiversity concerns in *agricultural policies* and practices;
- strengthen efforts to meet the objectives for *afforestation* and natural forest protection, and promote sustainable forestry practices;
- develop *comprehensive nationwide area statistics* for all protected areas and improve the co-ordination of *biodiversity knowledge* and nature *monitoring* as part of a comprehensive nation-wide monitoring programme.

2. Integrating Environmental Concerns in Economic Decisions

Despite much progress in decoupling the generation of some environmental pressures from GDP (e.g. SO_2, NO_x, water abstraction, nitrogenous fertiliser use), Denmark's national objectives and international commitments (e.g. waste generation, nitrate pollution of surface waters, GHG emissions) call for not only cost-effective environmental policy but also a significant strengthening of the integration of environmental concerns in economic and sectoral decision making. Such integration is seen as a key to improving environmental performance and moving towards sustainable development. This is because economic forces and changes in major economic sectors, such as transport, energy, fishery and agriculture, strongly influence environmental conditions and trends, and thus can enhance or counteract the benefits of environmental policies and technical progress.

Environmental and economic policies

Denmark's *general development objectives*, presented in the 1997 government report ''Denmark 2005'', provide goals for 2005 concerning employment, public debt, environment and international action. The report recognises several dimensions to sustainable development, including concern for the welfare of future generations in Denmark, and for development in central and eastern Europe and in developing countries. The 1995 white paper on the environment stresses the need for more sustainable agriculture, forestry and fisheries. Although there is no formal interministerial mechanism to deal with sustainable development in general, work is done at sectoral level and through environmental planning to translate sustainable development concepts into concrete action. The Danish local *Agenda 21* campaign was launched in 1994.

Much progress has been made in sectoral integration at planning, budgeting and project levels. *Sectoral plans* such as the Energy 21 action plan, the 1991 Action Plan for Sustainable Agriculture and the Traffic 2005 plan are important steps towards integration. *Environmental planning* in the form of general goal setting by periodic white papers on the environment and specific action plans (concerning, for instance, water, waste and pesticides) supports and extends these integration efforts. The next white paper on the environment is due in 1999.

Efforts made by Denmark to apply *strategic environmental assessment* (SEA) to *government bills and proposals* and to the *national budget* are innovative and exemplary. The greening of government operations was one of the major elements in the SEA of the 1998 national budget. With green auditing, action

plans by many State institutions and public procurement plans, progress is real in Danish administrations. While the environmental evaluation carried out on the 1998 budget focused on the marginal effect of changes in the budget, it would be useful to also consider the whole structure of public funding and expenditure in terms of its environmental impact, notably for natural resources such as energy.

The strong link between project-related *EIA procedures* and spatial planning does not in principle lead to excessive flexibility and inconsistency in land use planning. However, the rigour and precision of planning procedures need to be balanced by the possibility of applying for exemptions that will require an EIA, to ensure that amendments to regional or municipal development plans do not undermine planning procedures, particularly in rural areas.

There is no evidence that environmental measures and expenditure in Denmark have to date adversely affected its economic growth or *international competitiveness*. On the contrary, environmental protection has become an important selling point for Danish industry. The Danish *eco-industry* has a combined annual turnover of DKr 2 billion (50 per cent for export), and the Danish wind turbine industry has an annual turnover of over DKr 5.7 billion (70 per cent for export).

It is *recommended* to:

- pursue and further develop *strategic environmental assessments*, notably with respect to sectoral policy proposals and the national budget, in order to promote and evaluate progress towards sustainable development;
- continue and strengthen the integration of environmental concerns in *planning and policies* relating to agriculture, transport, energy and fisheries, as well as in new spatial planning concepts;
- ensure cost-effective *implementation* of sectoral plans with respect to environmental targets; review the cost-effectiveness of environmental actions in an *intersectoral context*;
- strengthen efforts to improve the *environmental performance of government*, including the implementation of environmental action plans by public institutions, sustainable public procurement, and the management of buildings and offices;
- carry out a comprehensive *review of existing fiscal and other subsidies* in terms of their environmental impact, particularly for natural resources.

Integration of environmental concerns in agricultural policy

Over the last ten years, the structural adjustment of Danish agriculture has led to higher *concentration and specialisation of agricultural production*, particularly in the livestock sector. Livestock, with 11 million pigs and 13 million broilers, makes up 70 per cent of the value of agricultural production. There has been a decrease in the number of farms (by 40 per cent) and cattle (by 30 per cent), but the agricultural area has only decreased by 4 per cent and still accounts for almost two-thirds of Denmark's total area, and the density of pigs per hectare has increased by 20 per cent. Two-thirds of agricultural production is exported and agriculture represents 22 per cent of total exports. Overall, agriculture has had adverse impacts on the environment: extensive *loss of biodiversity* due to farm amalgamation, the drainage of wetlands for farming and widespread pesticide use; high levels of *nitrogen discharges* into surface water; high contribution to eutrophisation of surface and coastal waters; contamination of groundwater from *pesticides* and nitrates; and *ammonia* volatilisation due to over-fertilisation with manure.

Some environmental objectives relating to the agricultural sector have been met. In particular, progress has been made in reducing ammonia emissions from agriculture and the phosphorus discharge reduction target has been met. Objectives have also been met for the reduction in the consumption of active pesticide ingredients. Less distortion in agricultural production through the reduction of market price support, in the context of *Common Agricultural Policy reform*, should contribute to promoting a more efficient use of natural resources. The measures implemented have included very detailed regulations and standards and, increasingly, economic instruments, such as a tax on pesticides, direct payments linked to environmental outcomes, and, more recently, administrative fines on excess consumption of nitrogen. The designation of sensitive farming areas (SFAs) addresses the site-specificity of many environmental issues associated with farming activity. The number of farmers engaged in *organic production* has substantially increased in recent years, partly due to increased incentives to convert; certified organic farms now account for 3.5 per cent of the total agricultural area. Efforts have been made to include an environmental dimension in *research*, training and advisory services.

Environmental objectives in the agricultural sector that relate to *water* still require a major effort. The objective of reducing nitrogen discharges to water by 50 per cent by 1997 could not be achieved and the deadline has had to be extended to 2003, with more stringent measures recently introduced. The frequency of treatment by pesticides has remained high. A balance needs to be reached between the targeting of measures to environmental concerns in the

agricultural sector, and the public resources required to implement and enforce such measures. In particular, the cost-effectiveness of economic instruments in agri-environmental policy greatly depends on the transaction costs involved (implementation, *enforcement and monitoring* costs). The level of incentives associated with SFAs has not always been attractive enough to reach voluntary agreements with farmers in groundwater protection areas, which raises the issue of the costs and benefits associated with agri-environmental measures. Little has been done on *nature conservation* as part of agricultural policies, although the protection of semi-natural grassland against agricultural intensification or abandonment has contributed to enhancing biodiversity and wildlife habitat.

It is *recommended* to:

- develop a *comprehensive agri-environmental strategy* regrouping all the various environmental objectivesand existing strategies associated with farming activity, and providing a framework for the designation of sensitive farming areas;
- give greater attention to *nature conservation* and *biodiversity protection* policy objectives;
- continue efforts in integrating environmental concerns in *research, training and advisory services*;
- ensure that *policy measures are more closely targeted* to the desired environmental outcomes;
- give greater attention to the economic and environmental costs and benefits associated with the *implementation of policy measures*, and their compatibility with the polluter pays principle;
- strengthen the *enforcement* of environmental regulations and standards in agriculture, inter alia through the development of environmental farm management;
- improve the *monitoring and evaluation* of the environmental performance of agriculture.

3. International Co-operation

International issues play a major part in Danish environmental policy, and environmental matters are high on the agenda of Danish foreign policy. This is a consequence of regional *ecological interdependencies*, within Northern Europe and as a riparian state of both the North Sea and the Baltic Sea. This is also a consequence of regional *economic interdependencies*, notably within the European Union and with other Nordic States. In addition, Denmark promotes interna-

tional environmental co-operation and environmentally sustainable development world-wide for reasons of *solidarity*. With other like-minded countries, Denmark's proactive stance on protecting the environment through international co-operation has played an influential role in a number of international negotiations. Denmark is particularly active within the EU context to drive European policies towards sustainable development and to influence EU positions in global environmental negotiations.

For its part, Denmark has met or is well on the way to meeting its *international commitments* concerning discharges of phosphorous and heavy metals in the Baltic and the North Sea, and atmospheric emissions of SO_2, NO_x and VOCs. It has taken expensive measures to reduce inputs of nitrogen to coastal waters from waste water treatment plants. It has phased out or reduced its emissions of ozone-depleting substances ahead of internationally agreed deadlines. It is one of the few OECD countries that have introduced a carbon tax on energy products to reduce CO_2 emissions. Denmark is doing its share to reduce marine pollution and control maritime traffic according to MARPOL commitments, and is promoting international agreements to control the spread of persistent organic chemicals in the global environment.

Denmark devotes *the highest official development assistance* effort among OECD-DAC countries: over 1 per cent of GNP in 1996. Including assistance to central and eastern Europe, Denmark's overall aid is well above 1 per cent of GNP. This level enjoys wide public support. The environmental component of bilateral ODA reaches about 20 per cent and is set to increase with the higher budget appropriations planned for the Environmental and Disaster Relief Facility. The facility amounted to 0.25 per cent of GNP in 1998 and is set to increase to 0.5 per cent in 2005. Half these funds are devoted to environmental activities, divided evenly between developing countries and *central and eastern European countries*. Environmental assessment is applied to all development projects. Denmark's contribution to the Global Environmental Facility is high.

Though Denmark mostly lives up to the high standards of international environmental co-operation it strives for, there is scope for progress in a number of areas. Denmark has been slow to *ratify some international agreements* (e.g. 1982 UN Convention on the Law of the Sea). Further significant reductions in *nutrient discharges from agricultural sources* are needed to meet Denmark's international commitments relating to the protection of marine waters. Denmark has *not so far succeeded in limiting its actual CO_2 emissions*, which were well above 1990 levels in 1995 and 1996 and may be difficult to stabilise at 1990 levels by 2000. Denmark therefore needs to review its range of policy options concerning energy

efficiency and substitution, as well as energy and transport pricing and taxation (towards internalisation for all end users).

It is *recommended* to:

- accelerate the *ratification of international environmental agreements* already signed (Annex III), notably concerning the protection of the marine environment;
- closely monitor the implementation of measures to reduce *nutrient discharges* to the marine environment and ensure that Denmark's related international commitments are achieved;
- consider additional measures needed to meet *CO_2 emission reduction targets*, particularly in the energy and transport sectors;
- review the basis for adjusting *CO_2 emission data* according to energy, trade and temperature variations, to ensure compatibility with methodologies used in other OECD countries and internationally;
- continue to play an *exemplary role in development and environmental aid*.

1

THE CONTEXT

1. The Physical Context

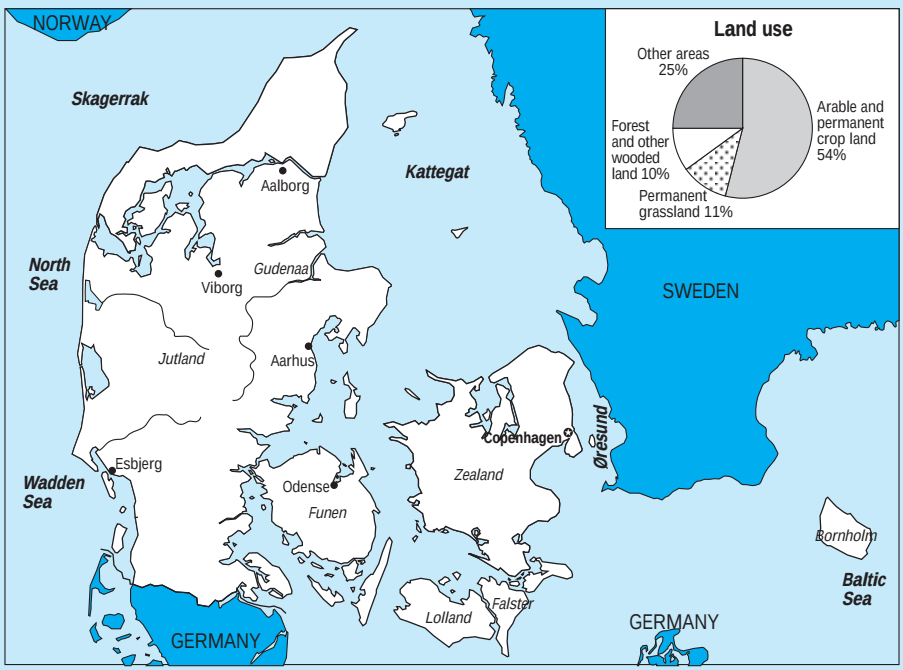
Denmark covers 43 000 km^2 on the *peninsula of Jutland and an archipelago of 406 islands*, of which 81 are inhabited (Figure 1.1). The largest islands are Zealand, Funen, Lolland, Falster and Bornholm. Denmark is surrounded by the North Sea and Wadden Sea to the west and the Baltic Sea to the east. It is separated from Sweden by the Kattegat and the narrow Øresund strait, and from Norway by the Skagerrak. Its only land frontier is with Germany to the south, along 68 kilometres. Denmark's outlying territories are Greenland, the world's largest island (341 700 km^2), which lies east of Canada, and the Faroes, a group of 18 islands in the North Atlantic between Scotland and Iceland.

The Danish *landscape* is made up of plains and low lying hills, moraine from the last two glacial eras. The highest point is only 175 metres above sea level. The landscape is dominated by agricultural land, which accounts for a much larger portion of total surface area (65 per cent) than in other OECD countries. Forest and other woodland cover 10.5 per cent (Figure 1.1).

Denmark's climate is cool and temperate, moderated by the North Atlantic Drift. Annual precipitation averages 715 mm. Though Denmark has abundant *water resources*, most of its watercourses are streams. Its largest river, the Gudenaa in Jutland, is 148 kilometres long. There are several hundred lakes. The largest, Lake Arre, covers 41 km^2. Lagoons have formed behind the coastal dunes in western Jutland. The mostly sedimentary bedrock holds large groundwater resources.

Denmark is self-sufficient in *crude oil and gas*, extracted from the North Sea, with reserves estimated at 20 or 30 years of domestic consumption. It has no

Figure 1.1 **Map of Denmark**



other significant mineral resources except substantial limestone deposits. There is an average wind speed of 7 to 8 metres per second, which is being exploited to generate *wind power*.

2. The Human Context

With a total *population of 5.3 million*, population density averages 122 inhabitants per km^2 (Table 1.1). The population increased by 3.0 per cent between 1980 and 1996.

Table 1.1 **Counties: population, area and density,** 1997

County	Population	Area (km^2)	Population density (inhabitants/km^2)
Copenhagen	609 123	526	1 158
Frederiksberg	356 854	1 347	265
Roskilde	226 683	891	254
West Zealand	290 793	2 984	97
Storstrom	257 776	3 398	76
Bornholm	45 018	588	77
Fyn	471 422	3 486	135
South Jutland	253 639	3 938	64
Ribe	223 335	3 131	71
Vejle	342 597	2 997	114
Ringkøbing	271 483	4 854	56
Aarhus	628 725	4 561	138
Viborg	232 630	4 122	56
North Jutland	492 155	6 173	80
Faroe Islands	43 754	1 399	31
Greenland	55 971	341 700	0.2
Total Denmark [a]	5 275 000	42 996	122

a) Data do not include Greensland and the Faroe Islands.
Source: Statistics Denmark.

Denmark is *urbanised*, with 85 per cent of its inhabitants living in urban areas. Greater Copenhagen has a population of 1.7 million, one-third of the country's total. Other large cities include Aarhus (274 000), Odense (182 000), Aalborg (158 000) and Esbjerg (83 000). About 2 million people live in small cities. In recent decades, urban expansion has slowed while existing urban areas have been renewed. Nevertheless, urban growth has continued in many coastal towns. In the last 25 years, industrial activity has shifted towards the west of Denmark and has tended to be more widely dispersed geographically.

Denmark is a *welfare state* with a high degree of income redistribution, a large proportion of owner-occupiers in the housing market and a universal old age pension system. About 15 per cent of the population, which is ageing significantly, is over 65. Expenditure on education as a proportion of GDP is among the highest in the OECD.

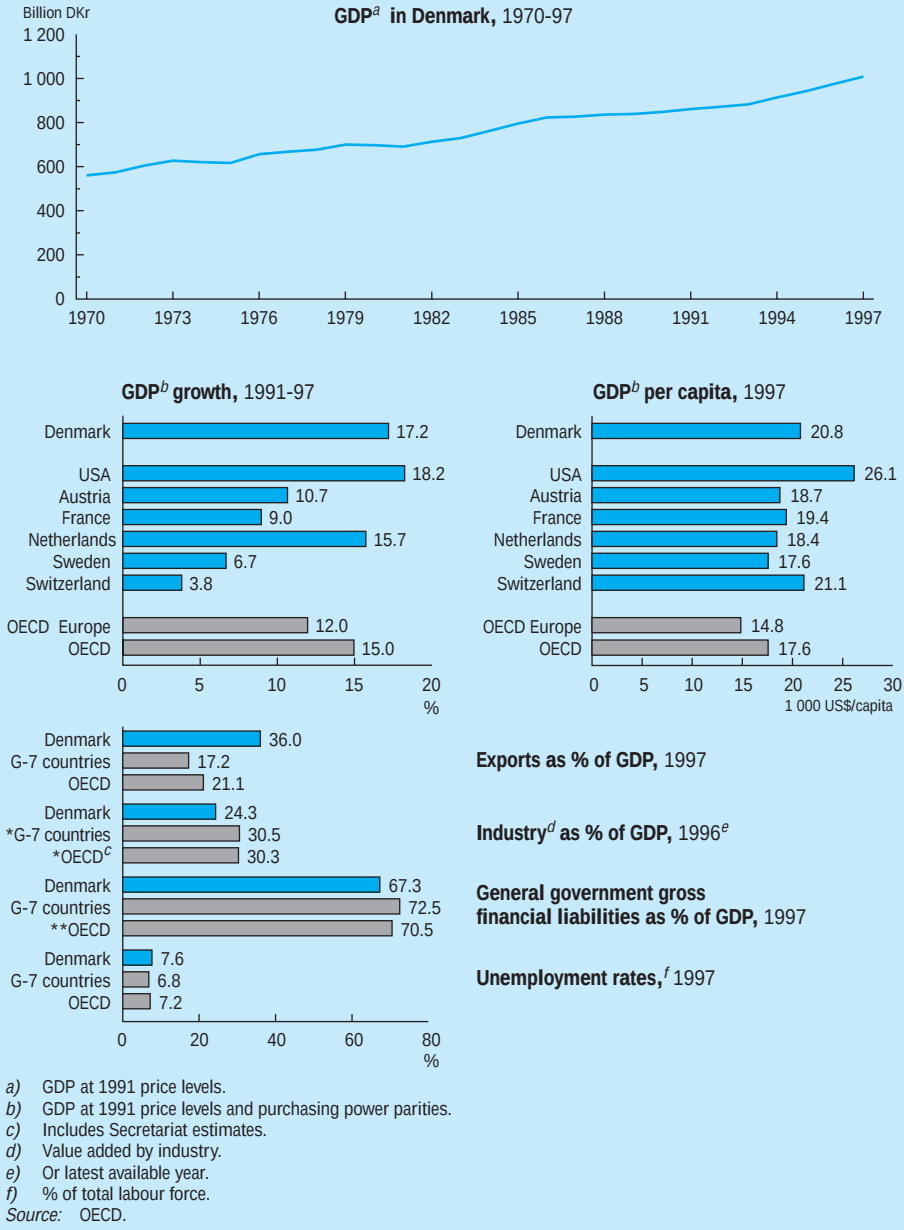
The total labour force has been stable over the last ten years, with 69 per cent concentrated in the service sector; industry accounts for 27 per cent of *employment*. Unemployment fell from a high of 12.1 per cent in 1993 to 7.6 per cent in 1997. Denmark has the second highest rate of female participation in the workforce in the OECD, with over 74 per cent in 1996. Over 75 per cent of wage earners belong to a trade union.

3. The Economic Context

Denmark's GDP reached DKr 1 008 billion in 1997. Converted using purchasing power parities, GDP is 20 800 US$/capita, a relatively high figure in the OECD (Figure 1.2). The Danish economy experienced several years of sluggish growth before it started steadily expanding in the middle of 1993. GDP grew 3.7 per cent in 1997, close to its increase in 1996. The economy is now entering its *fifth year of expansion*, mainly driven by private consumption stemming from solid employment gains, real wage growth and rising household wealth from higher house prices. Monetary developments have played a strong supportive role, as the country has reaped the benefits of a long-term commitment to a policy of exchange rate stability in the form of price stability and falling interest rates. Inflation is currently about 2.3 per cent per year.

Industry accounts for 24 per cent of GDP. The food, alcohol and tobacco industries, together with the chemical and iron and metals industries, account for over 75 per cent of industrial production value. Denmark has few large industrial companies; most are medium and small-sized enterprises. *Agriculture*

Figure 1.2 **Economic structure and trends**



a) GDP at 1991 price levels.
b) GDP at 1991 price levels and purchasing power parities.
c) Includes Secretariat estimates.
d) Value added by industry.
e) Or latest available year.
f) % of total labour force.
Source: OECD.

contributes 4 per cent to GDP. The main agricultural activities are pig (11 million head in 1997) and dairy farming. Fish catches (Greenland and the Faroe Islands excluded) reach 2.2 per cent of world catches; Denmark ranks third among OECD countries in volume per inhabitant.

Denmark has an *open economy*. Its main trading partners are Germany (about 22 per cent of imports and exports), Sweden (about 10 per cent of imports and exports), the United Kingdom (6.5 per cent of imports and 8.2 per cent of exports) and other EU countries (about 20 per cent of imports and exports). Most of its agricultural production is exported; the agricultural sector accounts for 22 per cent of exports. Electricity trading, which is very significant, fluctuates between high net imports in some years and high net exports in others.

The focus of economic policies is on sustaining expansion through structural policies aimed at reducing unemployment and establishing public finances on a sound long-term base. General government gross financial liabilities were 68 per cent of GDP in 1997. Though efforts to improve the structure of *public finances* have been undermined by the lack of sufficient control over local government finances, an overall budget balance is achieved (+0.7 per cent of GDP in 1997).

Denmark's well established welfare state is sustained by the highest *tax level* in the OECD (51.7 per cent of GDP in 1996): corporate taxes and social security contributions are low, but personal taxes are high. Indirect taxes are also higher than in other countries, reflecting a uniform value added tax of 25 per cent. The on-going tax reform, which started in 1993, has broadened the tax base and reduced marginal income tax rates, while green and other indirect taxes have increased.

4. The Institutional Context

Denmark is a *constitutional monarchy*. Under the 1953 Constitutional Charter, legislative power is held jointly by the hereditary monarch (who has no personal political power) and the unicameral Folketing, or Parliament, which has 179 members including 175 from Denmark itself and two each from Greenland and the Faroe Islands, which have been under Danish administration since 1380. Home rule was granted to the Faroes in 1948 and Greenland in 1979.

In January 1973, Denmark entered the European Community (EC), now the *European Union* (EU). As required by the Danish Constitution, ratification of European treaties must be approved by referendum. In 1986, the Parliament

rejected ratification of the Single European Act. Opponents of ratification argued that it would lead to a reduction of Denmark's power to maintain strict environmental controls. A referendum approved ratification, which took place in May 1986. In May 1992, the Parliament approved the Maastricht Treaty; in a June referendum, however, a majority voted against its ratification. As a result, EC heads of government agreed that Denmark should be exempt from those provisions of the treaty it regarded as a threat to its sovereignty. In a second referendum in May 1993, the treaty's ratification was approved. Ratification of the Amsterdam Treaty was approved by referendum in June 1998.

Local government is entrusted to *14 County Councils and 275 Municipal Councils*. Copenhagen and Frederiksberg (an enclave of 80 000 inhabitants in the City of Copenhagen) have a special status as both municipalities and counties. Most municipalities have populations of 5 000 to 20 000 inhabitants. Some 54 municipalities have over 20 000 inhabitants, and 17 have less than 5 000 inhabitants. The average county has 350 000 inhabitants. The National Association of Local Authorities in Denmark represents all municipalities other than Copenhagen and Frederiksberg. There is also an Association of County Councils. Most local public expenditure is funded by local taxes: municipal income taxes range from 14 to 22 per cent, and county income taxes from 9 to 11 per cent.

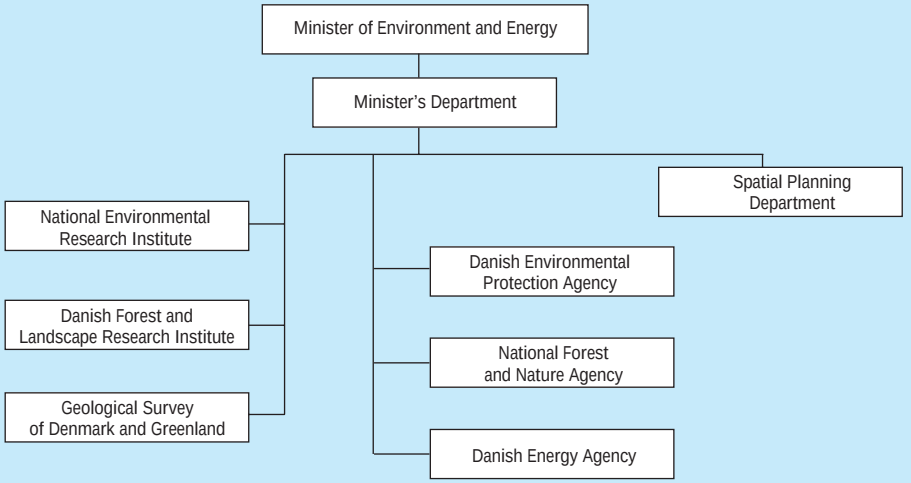
National environmental administration

The Ministry of Environment was established in 1971 and merged with the Ministry of Energy in 1994. The *Ministry of Environment and Energy* directly employs about 160 people. Together with its agencies and institutes, it employs about 3 400 people (Figure 1.3). In addition to the Minister's Department, the Ministry has a Spatial Planning Department which administers planning regulations in co-operation with municipalities and counties, including environmental impact assessments.

The Ministry also has *three agencies*:

– Danish Environmental Protection Agency (EPA), which administers environmental legislation and implements environmental policy measures with the assistance of municipal and county authorities; it employs 450 people and has an annual budget of DKr 1 billion.
– National Forest and Nature Agency, which manages State forests and administers legislation relating to nature protection, hunting, raw materials exploitation and heritage protection; it employs 1 650 people, including 1 350 in 25 State Forest Districts.

Figure 1.3 **Organisation of the national environmental administration**



Source: Ministry of Environment and Energy.

– Danish Energy Agency, which implements Danish energy policy with respect to production and supply as well as consumption and efficiency; it employs 300 people.

The Ministry also manages three independent *research institutes*:

– National Environmental Research Institute, which monitors and provides advice on the state of the environment and the environmental impact of human activities; it employs 425 people, and about one-third of its funding comes from extra-budgetary sources.
– Danish Forest and Landscape Research Institute, half of whose funding comes from extra-budgetary sources; it employs 100 people.
– Geological Survey of Denmark and Greenland, about one-third of whose funding comes from extra-budgetary sources; it employs 300 people.

Other ministries with environmental responsibilities include the Ministry of Food, Agriculture and Fisheries (responsible notably for implementing the agricul-

tural aspects of the 1987 Action Plan for the Aquatic Environment), the Ministry of Transport and the Ministry of Business and Industry. International environmental negotiations are conducted by the Ministry of Foreign Affairs with input from the Ministry of Environment and Energy.

At *interministerial level*, though there is currently no Cabinet committee on environmental matters, the Minister of Environment and Energy is a member of nine of the 15 Cabinet committees, including the two foreign policy committees, the Research Committee, the Industrial Committee, and the Summit Committee which prepares meetings of the European Council. *Parliament's work on environmental policy* is concentrated in the standing Committee on the Environment and Spatial Planning.

Municipal and county environmental administration

Pollution prevention and control

Administrative tasks relating to the *implementation of pollution prevention and control* measures are the responsibility of municipalities and counties.

Municipalities are responsible for environmental monitoring, licensing and inspection of smaller polluters (including 6 000 industrial companies and 59 000 farms) and issues relating to discharges to the sewerage system (Table 6.5). They operate the sewerage system, as well as municipal sewage treatment plants and water supply, and are responsible for waste management. Municipal Councils usually have a technical and environmental committee served by a department in charge of environmental matters. In an average municipality of 19 000 inhabitants, this department would employ three or four people.

Counties are responsible for licensing and inspecting larger polluters (about 4 000 industrial companies) and for municipal waste water treatment plants and landfills, as well as issues relating to water extraction planning, monitoring of water quality and contaminated sites. Each County Council has a committee for technical and environmental affairs, and the county administration has an environmental department with a staff of about 75. Environmental matters in Copenhagen are handled by the City of Copenhagen Agency for Environmental Protection, which employs over 100 people.

Appeals against municipal and county decisions, including those relating to environmental permits, are handled by the Danish EPA, with the Environmental Appeals Board as the body of second appeal.

Other environmental matters

Responsibility for the implementation of *nature conservation* policy lies with the National Forest and Nature Agency and County Councils, and to some extent with Municipal Councils. Nature conservation orders are issued by the Agency (mainly for marine areas) as well as by the regional Nature Conservancy Boards established by the Minister of Environment and Energy, who appoints their chairman while Municipal and County Councils each appoint a board member. Appeals are handled by the Nature Protection Board of Appeal (Chapter 6).

Counties are responsible for granting licences to exploit natural resources. Environmental impact assessments (EIAs) are part of legislation relating to *physical planning*, which is also normally handled by counties. The Nature Protection Board of Appeal is the body of appeal for EIA-related cases.

5. Environmental Legislation

Denmark has a *vast body of legislation (laws and statutory orders) dealing with environmental matters*, half of which implements EU directives and regulations (Table 1.2).

Framework legislation can be and often is amended, though it is seldom revised. A so-called ''consolidated'' version of the law, which includes amendments, can be published for information purposes. For instance, the 1973 Environmental Protection Act was amended in 1991, 1994, 1995 and 1996 and a consolidated version bringing together all the amendments made to date was published in 1997. Framework legislation usually empowers the Minister of Environment and Energy to issue statutory orders to implement the legislation. EU directives can normally be implemented through statutory orders.

As a result of an agreement between the Ministry of Environment and Energy and the two associations representing municipalities and counties, *administrative rulings that implement environmental laws are primarily guidelines* rather than statutory orders, giving county and municipal authorities considerable discretionary powers in the implementation of many environmental regulations. In particular, the Environmental Protection Act of 1991 is built on the principle of decentralisation, with affairs managed as close to the people as possible.

The Environmental Protection Act takes an integrated pollution prevention and control approach to *air and water pollution and the management of waste*.

Environmental permits are compulsory for the larger polluters, so-called ''listed'' firms of which there are currently about 10 000, mostly manufacturers. The 1985 Water Supply Act establishes the approval system for use of ground and surface

Table 1.2 **Selected major environmental legislation**

1917	Nature Conservation Act
1969	Nature Conservation Act
1970	Act on Zoning
1973	National and Regional Planning Act
1973	Environmental Protection Act
1975	Municipal Planning Act
1979	Act on Chemical Substances and Products
1982	Watercourses Act
1983	Contaminated Sites Act
1985	Water Supply Act
1988	Marine Environment Protection Act
1989	Planning Act (amended)
1989	Act on the Management of Nature
1989	Forest Act
1990	Contaminated Sites Act (amended)
1990	Act on Waste Deposits
1991	Environmental Protection Act [a] (amended)
1991	Act on the Exploitation of Natural Resources
1991	Act on Subsidies for Environmental Activities in Eastern European Countries
1992	Planning Act
1992	Raw Materials Act
1992	Nature Protection Act
1992	National and Regional Planning Act (revision)
1993	Hunting and Game Management Act
1993	Act on Chemical Substances and Products (amended)
1995	Watercourses Act (amended)
1996	Contaminated Sites Act (amended)
1996	Forest Act (amended)
1996	Act on the Exploitation of Natural Resources (amended)
1997	Planning Act (amended)
1997	Nature Protection Act (amended)
1997	Environmental Protection Act (amended version)

a) Also amended in 1994, 1995, 1996.
Source: Ministry of Environment and Energy.

waters, while the 1988 Marine Environment Protection Act provides for bans on discharges. The 1990 Contaminated Sites Act, amended in 1996, aims to regulate the clean-up of sites and to establish a mechanism providing the necessary funding. The 1979 Act on Chemical Substances and Products, significantly amended in 1993, provides the legislative framework for controlling the manufacture, storage, use and disposal of chemical substances and products (including pesticides).

The Nature Protection Act of 1992 reformed *nature conservation* legislation. It is primarily concerned with habitat protection, while conservation orders protect particular areas (e.g. lakes, permanent grasslands, wetlands, etc.). The Act is supplemented by specific legislation, notably on forests (1989 Forest Act, amended in 1996) and watercourses (1982 Watercourses Act, amended in 1995).

The *1992 Planning Act* covers provisions relating to EIAs. It also defines rules relating to urban planning and rural zoning, as well as the completion of municipal and regional plans consistent with national planning processes and guidelines.

Part I

POLLUTION CONTROL AND NATURE CONSERVATION

2

WATER MANAGEMENT

1. Water Resources

Current situation and trends

Freshwater resources and uses

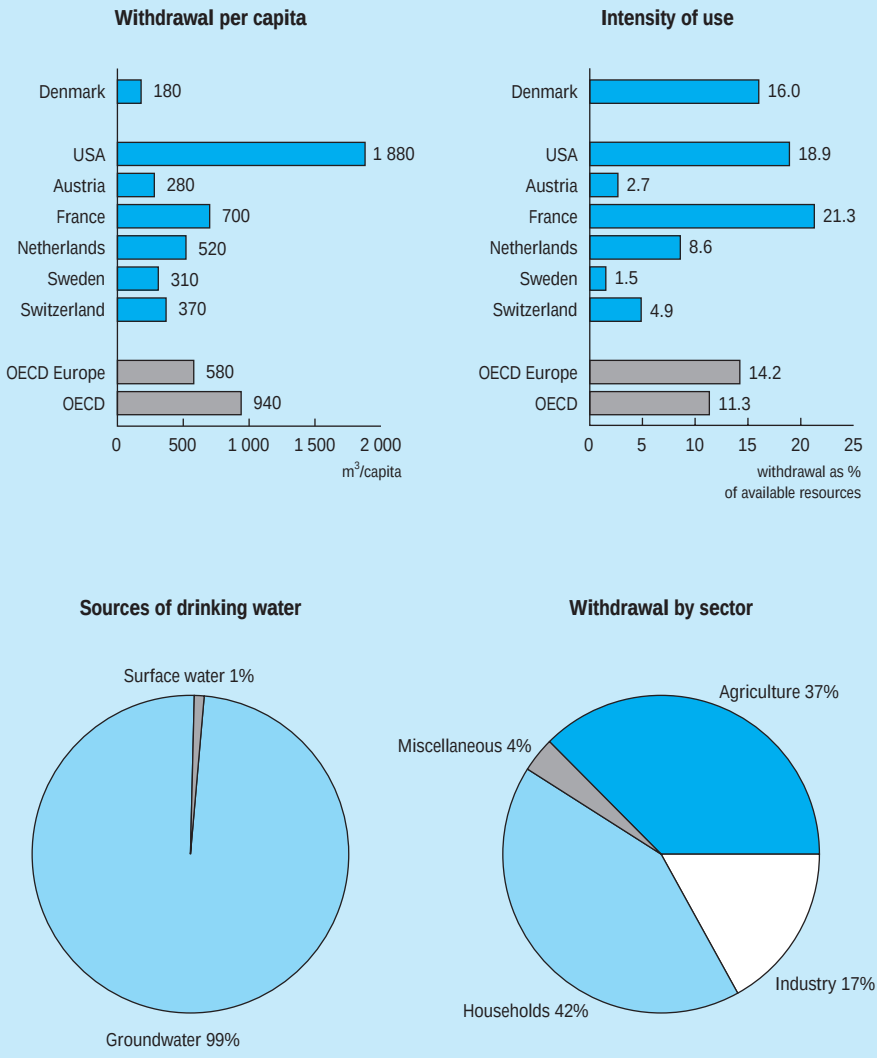
Denmark has plentiful *water resources*. Annual rainfall averages 715 mm and evapotranspiration is low. Watercourses and lakes are numerous though mostly small. In addition to 35 000 kilometres of *streams*, Denmark has 25 000 kilometres of ditches and channels. All Danish natural watercourses have been modified by human activities, notably through channelling, culverting, drainage and damming. *Lakes* cover about 1 per cent of the country, though only about 500 lakes are larger than 5 hectares. Most lakes are less than 3 metres deep. The number and size of many lakes have been reduced by drainage. New lakes have also been formed through damming or, in recent years, restoration. The mostly sedimentary bedrock holds large *groundwater* resources, with an annual exploitable resource estimated at 1.8 billion cubic metres.

In 1996, *water withdrawals* amounted to 961 million cubic metres or 16 per cent of available resources (Figure 2.1). Water withdrawal per capita is relatively low at 180 cubic metres per year. Public water supply accounts for 514 million cubic metres, with groundwater providing 99 per cent of drinking water. Brackish water or sea water is used to cool power stations.

Surface water quality

In 1996, water quality was good in 36 per cent of *watercourses*, fair in 40 per cent and poor in 23 per cent. Only 39 per cent meet chemical and biological quality objectives set at county level. During the summer, many watercourses are dominated by filamentous green algae, leading to low oxygen levels. The main

Figure 2.1 **Water use,** mid-1990s



Source: Danish Water Supply Association; OECD.

causes of pollution are organic matter, nitrogen and phosphorus. The nitrogen concentration in watercourses draining agricultural catchments is seven times higher than in other areas, while phosphorus concentrations are two to three times higher in watercourses draining point source catchments. Pesticides are found in about 30 per cent of surface waters analysed. Load indices show noticeably lower values for mammals, birds and crustaceans than 15 years ago (mainly due to the ban on parathion) but unchanged values for fish. Water erosion from wetland drainage has led to ochre pollution of water bodies in parts of Jutland; such draining is now prohibited.

About 95 per cent of Danish *lakes* are eutrophied and about half have a Sechi transparency of less than 1 metre. In 1996, water quality was good in 15 per cent of lakes. About 34 per cent met county water quality requirements. Acidification affects only a few lakes in limestone-poor middle and western Jutland.

Groundwater quality

With the exception of local pollution related to oil storage and landfills, it was long thought that Danish groundwater was well protected by its depth and the thickness of the overlying clay. In the late 1980s and early 1990s, systematic investigations into *pesticide contamination* produced alarming results showing that pesticides and degraded products were more widespread than expected. By 1997, one or more of eight pesticides analysed in 1 000 wells had been found in 12.5 per cent of these wells.

High *nitrate* levels in groundwater are a major problem in many areas, notably western Denmark where they can exceed 25 mg/litre. Nitrate concentrations have generally been stable in the 1990s. In industrial and urban areas, particularly in the eastern part of the country, several groundwater sources have been contaminated with *industrial chemicals* such as chlorinated solvents, often seeping from abandoned landfills (Chapter 4).

Coastal water quality

The main problem of Danish coastal waters is *eutrophication*, resulting in algal blooms, notably in 1994 and 1997 in the Øresund and the Store and Lille Belts. In the summer of 1997, eutrophication and warm weather conditions caused massive death of fish in the Mariager fjord. Denmark's coastal waters and some fjords experience oxygen depletion nearly every summer. Nutrient concentrations increased most rapidly in the 1970s and 1980s; they have since levelled off and, in the case of phosphorus, fallen due to more efficient waste water treatment. Nevertheless, nutrient inputs would have to be reduced by at least

50-70 per cent to bring nutrient levels back to those of the 1960s. Discharges of *heavy metals* to Danish coastal waters decreased markedly in the 1980s and 1990s, as did loadings of *agricultural pesticides* (Chapters 7 and 8).

Bathing water quality

Bathing water quality is controlled at 1 310 measurement stations, and every year about 16 000 water samples are analysed. In 1997, 97 per cent of samples showed water quality to be acceptable, up from 75 per cent in 1985. The number of bathing bans has fallen in recent years as a result of municipalities' efforts to control polluting discharges; 17 bans were issued in 1997.

Drinking water quality

Danish *water supply* is characterised by a large number of small waterworks and a limited number of facilities with a capacity greater than 350 000 cubic metres. About 8 per cent of the population is supplied by 92 000 private wells. Groundwater represents 99 per cent of supply; surface water is used in only a few of the larger waterworks.

Drinking water quality, which is generally good, has improved over the last ten years as a result of efforts to relocate water abstraction to areas less polluted with nitrate and pesticides. Treatment is usually limited to aeration and sand filtration, though drinking water increasingly needs to be purified by filtering with activated charcoal. About 30 per cent of waterworks supply water with a nitrate concentration above 5 mg per litre. Some 10 per cent of wells used for drinking water have a *nitrate* content above 25 mg/litre, the Danish guideline value; in 3.5 per cent, the *pesticide* concentration exceeds the standards set by the EU drinking water directive (0.1 μg per 10^{-1} litre). Many wells have been closed. For instance, Copenhagen Water, which supplies the City of Copenhagen, closed four large aquifers contaminated above the limit value for drinking water by 2,6-dichlorobenzamide, a metabolite arising from the herbicide dichlobenil, now banned. Lead pipes were never used to distribute mains water in Denmark. *Heavy metal* concentrations are usually due to excessive pumping, which increases nickel and sulphate concentrations.

Pressure on water resources

Withdrawals

Withdrawals by *households*, which increased strongly in the 1960s and early 1970s, have declined substantially since the late 1980s. Manufacturing *industry*

withdrawals represent 17 per cent of total water withdrawals (Figure 2.1). These fell markedly as a result of the adoption of more water-efficient technology in the late 1980s and early 1990s and are now stable. Following a steady increase throughout the 1980s, *irrigation* peaked in 1992. Agricultural abstractions currently account for about 37 per cent of total abstractions.

Discharges from settlements

As much as 87 per cent of the population is served by *municipal waste water treatment plants* (Figure 2.2). There are about 1 500 such plants in Denmark, handling a daily load of 4.5 million population-equivalent from households and another 4 million from industry. As much as 86.9 per cent of waste water is treated in biological or advanced plants and 1.5 per cent in mechanical plants only. A high proportion of the plants have some form of *nitrogen removal*. Municipal waste water accounts for 7 per cent of nitrogen loading and 36 per cent of phosphorus loading to inland and marine waters (Figure 2.3). Sewage sludge increased by 10 per cent to 1.212 million tonnes between 1985 and 1995. Some 78 per cent is spread on agricultural land (up from 55 per cent in 1985), the remainder being incinerated (Chapter 4).

About 358 000 dwellings are not connected to the sewerage system. One-third are summer cottages, and two-thirds house about 11 per cent of the Danish population in scattered settlements and *sparsely built-up areas*. Only about 3 per cent of these dwellings are equipped with containment tanks, while 48 per cent have soakaways and 49 per cent discharge directly into the aquatic environment. Discharges from sparsely built-up areas are estimated to account for 3 per cent of nitrogen loading and about 20 per cent of phosphorus loading to surface waters.

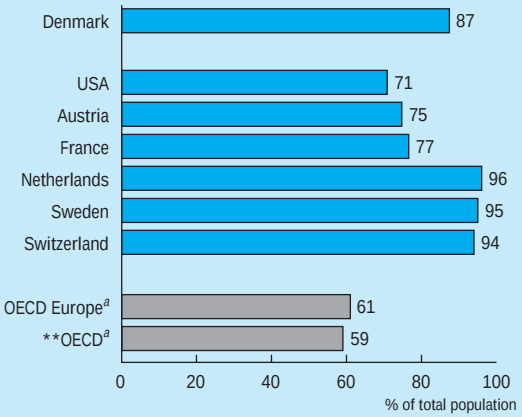
Discharges from industry

Most industries discharge their waste water into the sewerage system, where it is treated along with municipal waste water. Some agro-food industries (dairy industries, breweries, fish industries, etc.) treat waste water themselves prior to discharge to the environment. There are about 100 such plants, of which 60 discharge to the sea and 40 to lakes or steams. Industrial waste water discharges accounted for 2 700 tonnes of nitrogen, 320 tonnes of phosphorus, 54 000 tonnes of COD and 25 700 tonnes of BOD in 1996.

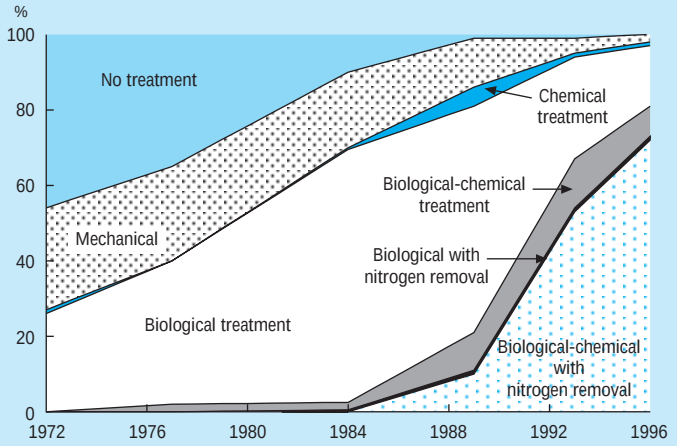
Impact of agricultural activities

Diffuse *nitrogen loading* from agriculture accounts for 76 per cent of nitrogen loading to watercourses and 60 per cent to lakes (Figure 2.3). Between 1980 and 1996, nitrogen supply from fertiliser use fell by 23 per cent (Table 6.1); that from

Figure 2.2 **Population connected to public waste water treatment plants,** mid-1990s

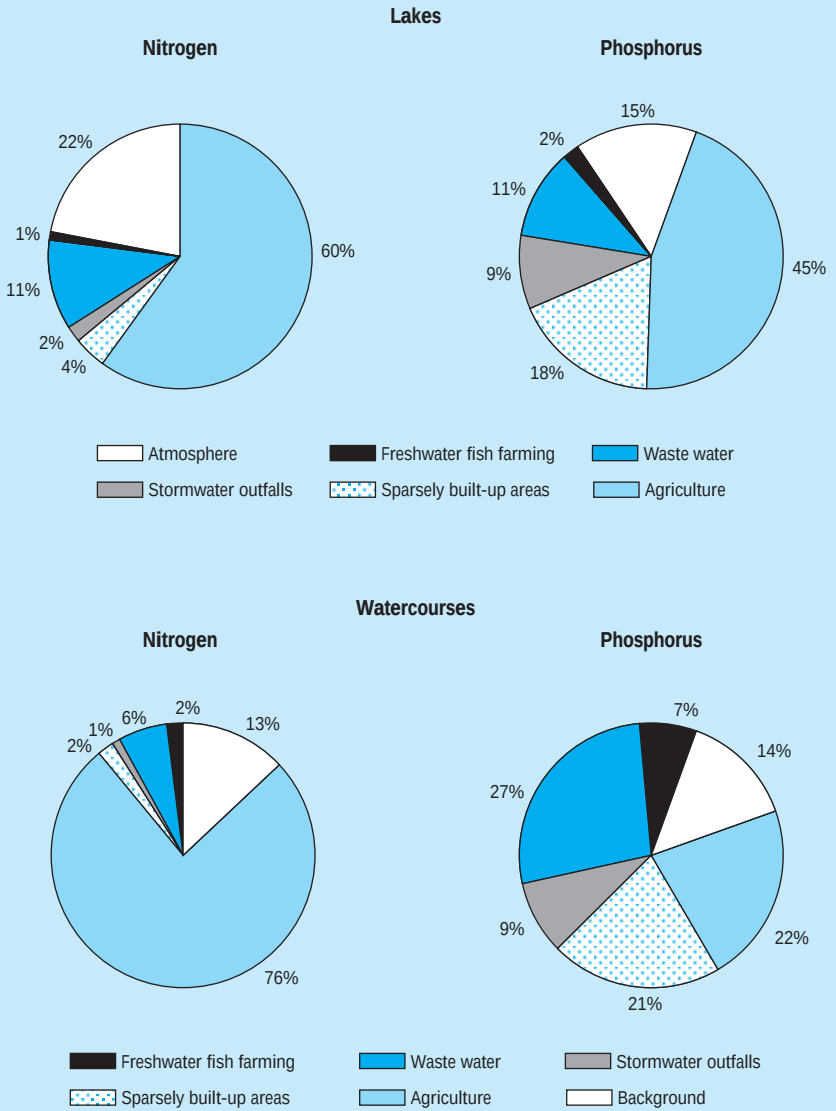


Waste water treatment in Denmark, 1972-1996



a) Secretariat estimates.
Source: OECD.

Figure 2.3 **Nutrient loads on water bodies by source,** 1996



Source: National Environmental Research Institute.

livestock fell by 8 per cent as a result of the fall in the number of cattle and now accounts for half the total nitrogen supply. The intensity of use of nitrogen fertilisers (commercial and from livestock manure) per hectare of agricultural land is among the highest in the EU (Chapter 7).

Phosphorus loading from agriculture accounts for 22 per cent of that to watercourses and 45 per cent of that to lakes (Figure 2.3). Consumption of phosphate fertilisers fell by 64 per cent between 1980 and 1996, by which time the intensity of phosphate fertiliser use per hectare of agricultural land in Denmark was among the lowest in Europe (Figure 7.2). However, phosphorus from livestock has remained stable and now accounts for three-quarters of the total phosphorus load from agriculture.

After a five-fold increase between the mid-1950s to 1984, sales of *pesticides* (active ingredients of all types of pesticides) decreased by 40 per cent between 1985 and 1996, reflecting a shift from products whose use adds relatively large doses of active ingredients to the soil to low-dose products. Agriculture accounts for 90 per cent of pesticide sales. In the mid-1990s, the intensity of pesticide use was about 2.1 kg active ingredients per hectare of agricultural land, less than the EU average and close to the OECD average (Figure 7.3).

There are about 500 *freshwater fish farms*, almost all located in Jutland. They accounted for 2 per cent of nitrogen loadings and 7 per cent of phosphorus loadings to watercourses in 1996. Discharges of nitrogen from fish farms fell by almost 50 per cent between 1989 and 1996, while phosphorus discharges fell by 60 per cent. This reduction was largely due to improved feed conversion ratios.

2. Water Management

The Danish Environmental Protection Agency (EPA) supervises the implementation of national water management policies. *Counties* manage 5 000 kilometres of public watercourses and municipalities 17 500 kilometres. *Municipalities* also supervise 40 000 kilometres of private watercourses. Counties license and control the largest water polluters and municipal waste water treatment plants; municipalities control discharges from other facilities regulated under the Environmental Protection Act (Table 6.5). Under the 1985 Water Supply Act and its amendments, counties are responsible for licensing and controlling water abstraction except in the case of licences to abstract under 3 000 cubic metres per year, which are handled by municipalities. County authorities co-ordinate with

municipalities to produce four-year regional water resources management plans and county water quality plans.

Water supply and waste water services are the responsibility of municipalities and their *water supply companies and waste water treatment companies*. In addition to some 300 water utilities managed by municipalities, private users' co-operatives manage small networks in minor towns and rural areas.

Objectives

Objectives relating to discharges

In 1985, following a public debate concerning a Danish EPA report that showed high nitrate concentrations in groundwater, the government launched an action programme to reduce discharges of nitrogen, phosphorus and organic matter to the aquatic environment (the so-called *NPO Action Plan*), followed up by the 1987 *Action Plan for the Aquatic Environment* and the 1998 second Action Plan for the Aquatic Environment. The following targets were defined:

- *reduction of nitrogen discharges* from municipal waste water, industry and agriculture by 50 per cent by 2003 compared with the 1985 level, as required by the 1991 EU nitrate directive;
- *reduction of phosphorus discharges* from agriculture, sewage treatment plants and industry by 80 per cent by 1993 compared with the 1985 level.

To prevent groundwater contamination, the 1986 *Pesticide Action Plan* set the target of reducing chemical pesticide consumption and treatment frequency by 25 per cent by 1990 (compared with the 1981-85 average) and by a further 25 per cent by 1997, and banning the sale of the most hazardous pesticides (Chapters 4 and 7).

Denmark has also subscribed to various *international commitments* concerning water management, notably relevant EU directives on nitrates and urban waste water. It has undertaken to reduce discharges of harmful substances (e.g. heavy metals, toxic substances) from point sources under the Convention on the Protection of the Baltic Sea, and has made similar commitments relating to the Oslo-Paris Convention and North Sea conferences (The Hague, Esbjerg) (Chapter 8).

Water quality objectives

Watercourse environmental quality objectives are defined in regional water quality plans in both chemical and biological terms (essentially, according to the presence of macro-invertebrates) and are divided into four classes. Watercourses in areas of special scientific interest, salmonid and cyprinid waters, and waters with varied flora and fauna are expected to meet class I or II quality requirements, while those used for drainage or affected by waste water discharges, water abstraction or ochre are expected to be no lower than class II or III. The most polluted watercourses, home to only a few species of macro-invertebrates, are assigned to class IV. Almost all county watercourses have a high quality objective, as does about three-quarters of the total length of municipal watercourses and about 10 per cent of private watercourses.

The counties have also established *environmental quality objectives for 698 lakes*. Some 259 lakes are to remain in or return to their natural state (class A), while 402 should only be slightly affected by human activities (class B) and 37 should only be moderately polluted by waste water discharges or agricultural activities (class C). A similar system of objectives has been introduced for *coastal waters*, which are assigned three levels of environmental quality objectives.

Pollution prevention and control

Most regulatory provisions relating to water pollution management are found in the 1991 Environmental Protection Act and its statutory orders. *Licences* are compulsory for the 10 000 larger polluters. The licensing system takes an integrated pollution prevention and control approach, increasingly based on the use of best available technologies, with a recent emphasis on cleaner technologies. Danish *discharge standards* are generally stricter than those contained in the EU waste water directive for sensitive areas. In addition, some counties apply criteria that are stricter than national standards to discharges from municipal waste water treatment plants.

A *voluntary agreement* signed by the Danish EPA and the soap and detergent producers' industrial organisation set the target of phasing out NPEOs in detergents by 1989 and resulted in their use virtually ceasing in Denmark. A 1993 agreement removed DTDMAC, DSDMAC and DHTMAC from cleaning products and reduced their use in detergents by 80 per cent by 1994.

Regulations concerning *pesticides* have been considerably tightened since the late 1980s. Consequently, a quarter of the products sold in 1993 are now banned. Measures to reduce pesticide use include a tax on pesticides, research and development, information and advice, mandatory training for pesticide users and controls on spraying (Chapters 4 and 7).

Water resource management

In 1994, the Ministry of Environment and Energy and the Ministry of Agriculture and Fisheries issued a ten-point programme on the protection of groundwater and drinking water which emphasised the need to improve the *integration of water resource management and spatial planning*, in order to identify and protect water abstraction areas that can provide secure and clean resources for drinking water supply. In 1997, counties were required to designate areas of drinking water interest, and areas of special or limited interest, based on guidelines provided by the Danish EPA. Areas of interest or special interest are subject to protection measures concerning land use and fertiliser and pesticide application. They are also being used to indicate priority areas for clean-up of contaminated sites that threaten to pollute groundwater (Chapter 4).

In the last ten years, awareness that groundwater resources are not inexhaustible has grown and *water saving information campaigns* have been carried out by several water utilities. Along with higher water prices, these efforts have contributed to stabilising water consumption. In addition, a number of projects under the *Clean Technology programmes* have focused on water saving at process level.

Until 1982, the many versions of the Watercourses Act aimed primarily at ensuring the drainage of surface water from agricultural land. Watercourses were channelled, straightened or culverted and managed in a heavy-handed manner, with few if any habitats for fish and other aquatic species. The 1982 Watercourses Act provided for the *restoration of watercourses* to a more natural state, as well as *improved maintenance* practice. Its implementation relies on counties and municipalities issuing new or updated provisional orders, for which the initial mid-1992 deadline was extended to mid-1996.

Water pollution abatement and control expenditure

Public expenditure on waste water management totalled DKr 4 351 million in 1995 and 4 620 million in 1996 (Table 6.3). It represents the largest single item of

public environmental expenditure. Municipalities account for 94 per cent of public expenditure on waste water management; 90 per cent of that amount is for waste water collection and treatment. This public expenditure can be related to the revenue from water charges, paid by households and industry, which amounted to DKr 3 963 million in 1996.

In the 1990s, public expenditure on waste water management increased considerably. Much of the increase reflects the significant *effort made in municipal waste water treatment* in order to *reduce nitrogen loadings*. Annual expenditure on waste water management increased from DKr 3 billion in the mid-1980s to DKr 4 billion in the mid-1990s (0.4 per cent of GDP). Annual capital expenditure ranged from DKr 250 to 500 million up to 1987 and has since averaged DKr 1 billion to 1.5 billion.

There are no estimates of *private expenditure* on waste water management. Most industries avoid capital expenditure on treatment facilities by discharging their waste water into the municipal sewage system and paying an effluent charge based on flow, BOD, nitrogen and phosphorus content. Only a few industries, mainly dairies, breweries and other agro-food industries, fully treat their waste water prior to discharge to the environment. It is estimated that the 19 largest industries invested about DKr 1 billion between 1989 and 1993 to upgrade waste water treatment prior to discharge to the environment, as required by the Action Plan for the Aquatic Environment. Current operating expenditure is estimated at DKr 200 million annually.

Economic aspects

Municipalities (or user co-operatives) are responsible for setting *water prices*, which must cover all capital and operating costs relating to water supply, sewerage and waste water treatment. There is little subsidisation, mostly for sparsely populated areas. Water prices are composed of a fixed annual fee, a volume-related water charge and a waste water charge. The green tax reform introduced a *water tax* for households at a rate of DKr 1 per cubic metre in 1994, rising progressively to DKr 5 in 1998; industry and agriculture are exempt from the water tax. This tax doubled water prices for households and generated a revenue of DKr 1 279 million in 1997 (Table 6.6).

Though prices can vary considerably throughout the country, they have *sharply increased* in the last ten years, reflecting significant waste water treatment investments and operating costs. Danish water prices are therefore no longer among the lowest in Europe (Table 2.1).

In 1997, the green tax reform also introduced a *tax on waste water discharges* to the environment levied on all economic sectors. It was doubled in 1998. This tax is based on nitrogen (DKr 20 per kilogram), phosphorus (DKr 110 per kilogram) and organic matter content (DKr 11 per kilogram of BOD). The tax raised DKr 140 million in 1997 (Table 6.6).

Table 2.1 **Drinking water prices,**[a] 1996

(US$/m^3)

Denmark	Copenhagen	1.34
	Aarhus	0.89
	Odense	0.98
United States	Los Angeles	0.60
	Washington	0.80
	New York	0.88
Austria	Linz	1.11
	Salzburg	1.59
	Vienna	1.75
France	Lyon	1.78
	Bordeaux	1.39
	Paris	0.93
Germany[b]	National average	1.70
Netherlands	Amsterdam	1.20
	The Hague	1.92
	Utrecht	0.94
Sweden	Stockholm	0.86
	Göteborg	0.58
	Malmö	0.99
Switzerland	Bern	1.22
	Geneva	2.25
	Zurich	2.26

a) Data per household (two adults and two children) consuming 200 cubic metres per year. Excluding VAT. Current exchange rates.
b) Country data refer to 1997 and are provisional.
Source: International Water Supply Association.

Water monitoring

Groundwater monitoring started in 1988. The current monitoring programme is based on measurements of groundwater chemistry in 67 areas and regular monitoring by waterworks. Groundwater levels are monitored at 150 wells, though information on groundwater abstraction is incomplete, particularly for irrigation. The programme costs about DKr 30 million per year, excluding monitoring by waterworks. It includes a national programme to monitor pesticide residues in groundwater, recently extended from eight to 35 pesticides, as well as residues in water leaving the root zone.

Surface water monitoring by counties is carried out at about 7 800 points on watercourses and 292 points on lakes. In order to assess watercourse quality in biological as well as chemical terms, counties monitor the fauna in watercourses at 8 500 stations across Denmark. Following the 1987 Action Plan for the Aquatic Environment, a *nation-wide water quality monitoring programme* was set up to measure the effect of the measures taken through the systematic collection and analysis of water quality data. The programme is also used to evaluate the extent to which other objectives are met, for instance county water quality objectives. It includes monitoring of six agricultural watersheds to provide information on nutrient leaching, as well as the results of the groundwater monitoring programme and monitoring carried out by counties. Costs are about DKr 150 million per year, including DKr 99 million provided to counties for their contribution to the programme.

3. Environmental Performance

Pollution prevention and control

Performance relating to point sources

Overall, *municipal waste water treatment* has more than met the objectives set by the Action Plan for the Aquatic Environment. Between 1984 and 1996, related discharges of nitrogen were reduced by 68 per cent, those of phosphorus by 85 per cent and those of BOD by 92 per cent. These are remarkable results which reflect a high level of equipment in advanced urban waste water treatment infrastructure.

Discharges from *industrial sources* (i.e. the 100 industries with their own waste water treatment) have also been reduced so that the targets of the action

plan were met. By 1996, discharge reductions of over 65 per cent for nitrogen and BOD, and 90 per cent for phosphorus, had been achieved compared with 1984 levels. These remarkable results demonstrate a high level of treatment of its waste water by industry.

Freshwater fish farms have substantially reduced their polluting discharges in recent years, largely as a result of more stringent controls imposed by municipalities. Nevertheless, about half of all fish farms could further reduce their environmental impact on watercourses by complying with existing regulations. The enforcement of such regulations in respect of fish farms should therefore by strengthened.

Following the upgrading and expansion of waste water treatment plants, attention has recently turned to the need to improve waste water treatment in about 32 000 dwellings located in *sparsely populated areas* away from sewerage systems, where it would nevertheless be necessary to reduce phosphorus and organic discharges. An amendment to the Watercourses Act would require these households to install appropriate water treatment in areas where watercourses do not meet the county water quality objectives; this amendment should be implemented by municipalities, which are expected to issue the first injunctions during the course of 1999. Water treatment could cost as much as DKr 40 000 per dwelling, though grants would be made available so that the property owner paid only an amount equivalent to the cost of a sewerage connection (about DKr 12 000).

Performance relating to diffuse pollution

Nitrogen discharges from agriculture were evaluated in 1985 at 230 000 tonnes from field leaching and surface run-off, and 30 000 tonnes from direct discharges from farmyard manure storage. To reach the 50 per cent reduction target set in the Action Plan for the Aquatic Environment, target reductions were set at 100 000 tonnes for the field load and 27 000 tonnes for the farmyard load by 1993. As it became clear in 1990 that the field load target could not be achieved, the deadline was postponed to 2000. By 1997, a status report showed that the target for the farmyard load had been met, but only one-third of the field load target had been achieved. The basic problem is that the *quantity of manure* produced by Danish agriculture has not fallen significantly in the last ten years. It increasingly exceeds the field application capacity of individual farms, especially pig farms, which saw their production increase by 30 per cent between 1987 and 1996 (Chapter 7). An increasing number of pig farms need to establish agreements with neighbours in order to be able to spread manure on fields nearby.

The deadline for the *field load* target was postponed to 2003, allowing time for existing measures to take effect and so reduce loadings by another third. To close the gap and reduce discharges by the final third, a range of additional measures were adopted in February 1998 as part of the second Action Plan for the Aquatic Environment (Table 7.2). In addition to these essentially regulatory and voluntary measures, two economic measures became effective in August 1998:

- administrative fines of DKr 10 per kilogram of excess fertilisation up to 30 kg per hectare and DKr 20 per kilogram beyond;
- a fertiliser tax applied to all purchases of fertilisers, other than those by farmers who prepare fertilisation accounts, at a rate of DKr 5 per kilogram.

The degree to which the quality of watercourses, lakes, groundwater and coastal waters actually improves will depend largely on the *success of these measures*. While the fertiliser tax will not affect farmers, administrative fines on excess fertilisation should prove a strong incentive to improve manure management. They should also contribute to applying the polluter pays principle to agriculture. Their implementation and effectiveness should nevertheless be carefully monitored, as they entirely depend on the way fertilisation accounts are kept by farmers and are checked by the Ministry of Food, Agriculture and Fisheries.

The overall *phosphorus discharge reduction target* of 80 per cent set by the Action Plan for the Aquatic Environment has been met, mainly due to progress in municipal and waste water treatment. Phosphate fertiliser use over the last 15 years has also been cut by almost two-thirds, though fields fertilised by animal manure may still receive excessive amounts. Phosphorus leaching from agricultural land has become a leading source of water pollution due to build-up in soil and reductions in loads from waste water treatment and industrial discharges.

The target reduction of the 1986 *Pesticide Action Plan* for pesticide sales was met in 1995, almost two years before the deadline, but the frequency of application has remained unchanged. Pesticide loading has not therefore been reduced. It is to overcome this problem that the pesticide tax was recently increased (Chapter 4). Protection of areas used for water supply, and recent efforts to better define and protect water abstraction areas, are beginning to have an effect on groundwater quality. Much effort is being put into tracing pesticides in the aquatic environment and understanding their effects on drinking water. Recent work to upgrade *pesticide monitoring* is particularly important in this respect and should help clarify priorities in Denmark's pesticide management policy (Chapter 4).

Performance relating to water quality objectives

Water quality improvements concerning *organic pollution* have been very significant but are lagging in respect of nutrients. Despite the significant reductions in *nutrient* discharges achieved over the last ten years as a result of the Action Plan for the Aquatic Environment, most water bodies are a long way from meeting the related quality objectives. Continued severe pollution from agricultural sources is the main reason for such modest results.

County objectives for the *quality of surface waters* have only been reached for 40 per cent of watercourses and 34 per cent of lakes. In the case of *lakes*, they have been reached for 46 per cent of those in class A, 26 per cent of those in class B and 18 per cent of these in class C; pollution of all other lakes remains excessive. While efforts relating to point sources have improved water quality in a number of lakes, progress has slowed in recent years. This seems due to internal loading releasing phosphorus from lake sediments, with higher nutrient concentrations being found in the outflow than the inflow.

Groundwater contamination is an issue of particular importance in Denmark because of the country's reliance on groundwater for its drinking water supply. *Nitrates* are found in most groundwater, although generally below the recommended limit of 25 mg per litre, and concentrations are still rising, notably in three counties in Jutland. The number of *pesticide* findings in groundwater is expected to continue to increase in years to come, as concentrations peak in young groundwater before seeping further down. Groundwater pollution has clearly reached a level that threatens the current system of water supply based on small-scale, simple treatment. According to a report commissioned by the Ministry of Environment and Energy, 400 waterworks will be closed down because of pollution between 1995 and 2005, and 63 utilities and 163 industrial abstraction facilities will be forced to install advanced water supply treatment, at a cost of DKr 4.4 billion over the next ten years. This would double the price of water.

Overall, there has been little improvement in the quality of *coastal waters*. While some fjords have benefited from reductions in phosphorus loadings, nitrogen is the main limiting nutrient in most coastal waters, including the Kattegat and the Belt Seas. This problem is reflected in Denmark's failure to meet nitrogen discharge objectives contained in its international commitments relating to marine waters in both the North Sea and Baltic Sea (Chapter 8).

Management of water resources

While groundwater resources are large, the amount of uncontaminated groundwater fit for drinking water supply is shrinking. Increases in *water prices* to cover the costs of improved waste water treatment in the last ten years have had a major effect on *household and industrial water consumption*. Such a change is making a substantial contribution to more sustainable water resource development, limiting problems related to the shortage of clean groundwater and to falling water tables. The *water tax* is likely to have a further significant effect on household water conservation. Because it is applied to mains water, it is not levied on agricultural uses such as irrigation for which water is abstracted. In the case of industrial users of mains water, the tax is refunded. The water tax is therefore essentially a consumer tax. Its application to water users other than households should be considered, in order i) to maximise its incentive effect and ii) to contribute to efficient pricing of water resources.

Since the mid-1980s, a considerable amount of attention and work has been devoted to improving and restoring watercourses. The number of *streams maintained naturally* increased from 26 per cent in 1985 to 52 per cent in 1995, and about 900 larger streams have been restored to their natural state. Much nevertheless remains to be done. Concerning *public watercourses*, most counties met the 1996 deadline for bringing provisional orders in line with the Watercourses Act; municipalities have been slower. As a result, the benefits of provisions for restoration and ''gentle'' maintenance in the Watercourses Act are less widespread than first hoped. In addition, a 1995 evaluation showed that where watercourse restoration has been undertaken, in most cases it has aimed at improving fish population. Only a few projects have attempted to achieve a more general improvement of the environmental condition of watercourses, notably through remeandering. Furthermore, there is little information on the integration of environmental concerns in the maintenance of *private watercourses*. It would be useful to extend information efforts directed at those responsible for managing public watercourses to the owners of private ones.

Cost-effectiveness in water management

Despite the successive Action Plans for the Aquatic Environment, the current approach to water management remains largely ad hoc, with pollution problems treated alongside resource management issues, and surface waters managed separately from groundwater. This approach can result in cost-effectiveness being overlooked in pursuit of piecemeal objectives. In addition, it can mean that the value of some water resources, notably surface waters, can be underesti-

mated. It would therefore be useful to elaborate a *national water management plan* that would consider all such issues on the same footing, taking an overall view of Denmark's various *catchment areas*. This would also facilitate the management of catchment areas that need to be protected for water abstraction purposes.

More efforts should be made to examine the *relative economic and environmental effectiveness of water management in different sectors*. Whereas the polluter pays principle (PPP) and the user pays principle (UPP) are fundamental references for water management relating to municipalities and industry, their full application in agriculture raises problems. Concerning nutrients, for instance, the relative merits of upgrading waste water treatment in sparsely populated settlements should be carefully compared with the costs and benefits of developing various nutrient control policies in the agricultural sector (e.g. field and non-field measures). Economic analysis should also be used more fully to assess the cost-effectiveness and environmental effectiveness of achieving reductions in nitrogen discharges through stricter regulation (for instance, crop fertilisation standards) or through economic instruments such as fertiliser taxes.

3

AIR MANAGEMENT

1. The State of Atmospheric Emissions and Air Quality

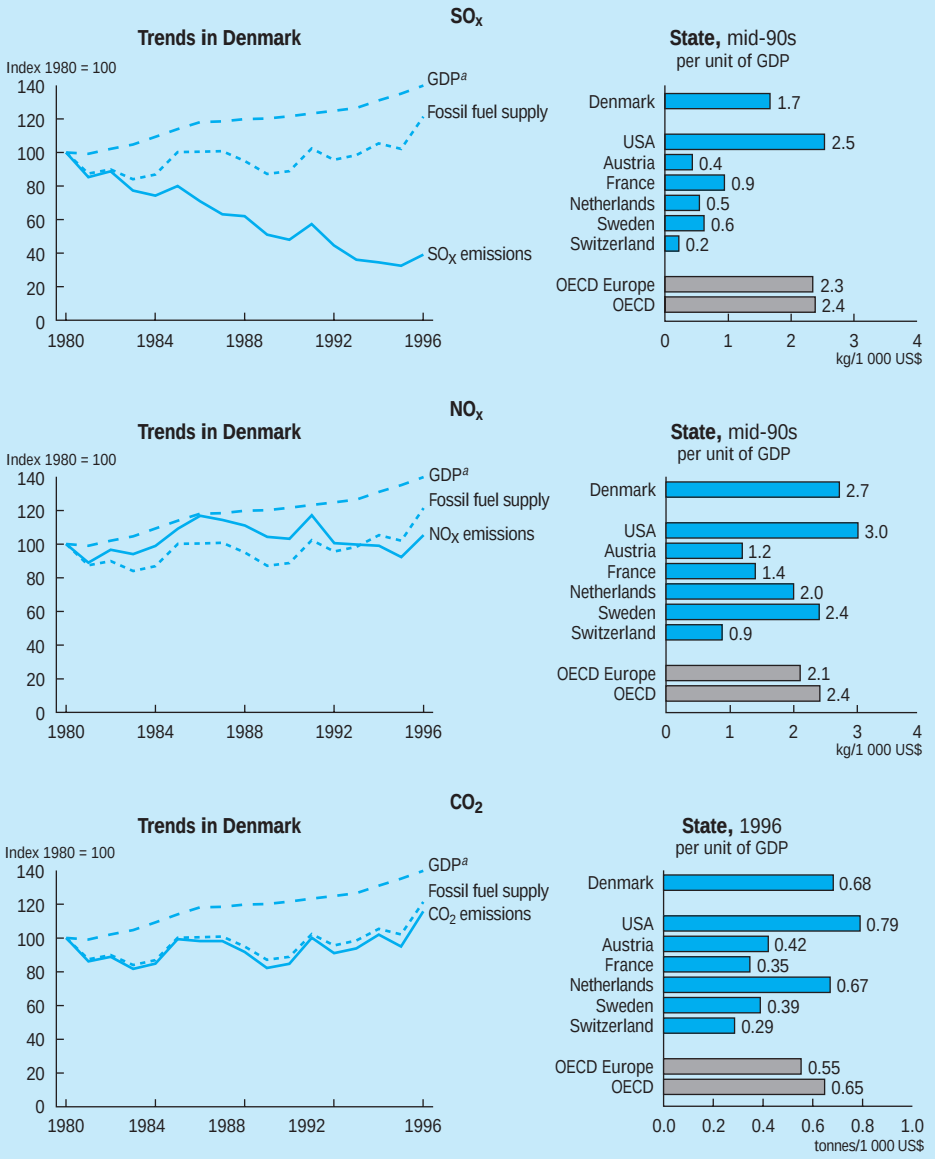
Emissions of atmospheric pollutants

SO_x emissions totalled 176 930 tonnes in 1996, a 62 per cent decrease from 1980. Power generation accounted for 82 per cent of emissions and other stationary combustion sources for 13.2 per cent. Mobile sources accounted for 4.8 per cent. Emissions per unit of GDP are higher than in most other Nordic and EU countries (Figure 3.1 and Annex 1).

NO_x emissions totalled 288 050 tonnes in 1996, a decrease of 5 per cent since 1980. Emissions peaked in 1991 at 320 000 tonnes. Mobile sources contribute 46.9 per cent to total emissions and power generation 44.6 per cent. Emissions per unit of GDP are 26 per cent higher than the average for OECD Europe (Figure 3.1). Fertilisation of farmland is a major source of *ammonia emissions* in Denmark, accounting for 116 000 tonnes in 1995.

In 1996, *methane emissions* were estimated at 425 110 tonnes, mostly from livestock (76 per cent) and landfills (17 per cent), with fugitive emissions from fuel accounting for 4 per cent. Emissions of non-methane *VOCs* totalled 136 360 tonnes, an increase of 7.7 per cent since 1980. Emissions from solvent production and use account for 15 per cent of total emissions, and mobile sources for 53 per cent. Gasoline-fuelled vehicles contribute to 91 per cent of emissions from road vehicles, 59 per cent of which is from exhausts and 41 per cent from evaporative emissions. Emissions of polycyclic aromatic hydrocarbons (PAHs) are estimated at 57 tonnes per year, with mobile sources contributing 21.9 per cent.

Figure 3.1 **Atmospheric emissions**



a) GDP at 1991 prices and purchasing power parities.
Source: OECD.

According to the International Energy Agency (IEA), *CO_2* emissions from fuel combustion were estimated at 72.3 million tonnes in 1996, up from 52.9 million tonnes in 1990, a 37 per cent increase. Emissions per unit of GDP and per capita are among the highest in Europe (Figure 3.1 and Annex 1). *Coal combustion*, essentially for power generation, accounts for a larger share of CO_2 emissions than in most OECD countries: at least 40 per cent compared with about 30 per cent in the OECD as a whole. In some years this share is increased by substantial electricity exports. In 1996, for instance, electricity exports represented 40 per cent of domestic consumption. Road transport contributes 18 per cent to Danish CO_2 emissions.

CO emissions were estimated at 597 950 tonnes in 1996, largely from road transport (69 per cent) and heating in the residential sector (20 per cent). They have fallen by 37 per cent since 1980, with most of the decrease taking place since the introduction of three-way catalytic converters on new cars in 1990.

Emissions of lead have fallen markedly, to 20 tonnes in 1996, because of the reduction in the lead content of gasoline from 1986 and the subsequent phase-out of leaded gasoline, which is now complete. The main source of lead emissions is combustion in stationary sources. Coal and oil combustion for power generation, district heating and industrial activities is the main source of other *heavy metal* emissions.

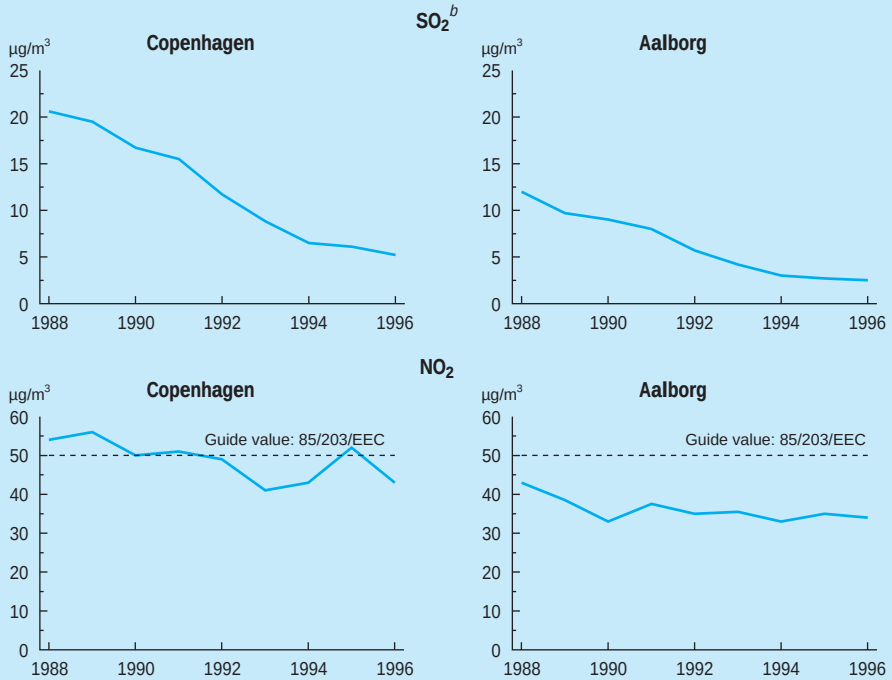
Air quality

Air quality standards for SO_2, NO_2, TSP and lead are based on EU limit and guideline values. In addition, a set of limit values for ozone came into force in 1994. Air quality is also assessed with respect to WHO guideline values.

At all monitoring stations, concentrations of *SO_2* are well below limit and guideline values (Figure 3.2). They have been falling since the mid-1980s, first largely as a result of improved fuel quality standards and other pollution control measures, and more recently due to a shift away from coal for power generation and heat production.

In 1996, measured annual 98 percentile values of *NO_2* concentrations were about half the limit value of 200 ug/m^3 and below the guideline value of 135 ug/m^3 (Figure 3.2) The annual average was close to the guideline value of 50 ug/m^3 and above the WHO guideline of 40 ug/m^3. Concentrations have generally remained stable over the last 15 years.

Figure 3.2 **Trends in air quality,**[a] 1988-96



a) Annual median concentration.
b) Limit values are 80 or 120 µg/m^3 depending on associated suspended particulates (80/779/EEC and 89/427/EEC); guide values are 40 to 60 µg/m^3 for annual mean concentration.
Source: Ministry of Environment and Energy.

At most stations, *ozone* concentrations regularly exceed the threshold values for 24 hours (65 ug/m^3) and eight hours (110 ug/m^3) though not for one hour (200 ug/m^3). Data available for the last five years do not show a clear trend, as changes are largely related to meteorological variations.

Concentrations of particulates measured as *TSP* are under half the limit values, with a slight decrease over the last ten years. This can probably be related to improved combustion control, as well as the introduction of winter crops that limit wind-blown dust.

CO concentrations are below WHO guideline values. The average concentration of *benzene* is about 3 ppb, the planned EU limit value. Current lead concentrations at street level are about 2 per cent of the 2 ug/m^3 annual average limit value. As a result of the phase-out of leaded gasoline, lead concentrations have decreased by a factor of 40 in the last 15 years. Other *heavy metals* are also found in very low concentrations, at least a factor of 10 below WHO guidelines.

Acid deposition in Denmark decreased by about 40 per cent between 1980 and 1995. Deposition of sulphur decreased by 60 per cent, and deposition of oxidised and reduced nitrogen fell by 27 per cent and 22 per cent respectively. Nevertheless, acid deposition is still higher than in other Nordic countries. The critical load for nitrogen eutrophication is exceeded in most of the country, largely due to transboundary imports, though Denmark is a net exporter of sulphur and nitrogen compounds (Table 8.3). Areas most affected are raised bogs, inland heathland and coniferous forests. Between 1987 and 1996, the number of trees with over 25 per cent leaf or needle loss rose from 23 to 37 per cent.

2. Responses

Objectives

With regard to *conventional air pollutants*, Denmark is committed to the following targets under *international agreements* (Table 3.1, Chapter 8):

- reduction of SO_2 emissions from large combustion plants by 20 per cent by 1993, 40 per cent by 1998 and 60 per cent by 2003, compared with 1980 (EU directive on large combustion plants);
- reduction of total sulphur emissions by 30 per cent by 1993 and 80 per cent by 2000, from 1980 levels (Helsinki and Oslo Protocols);
- reduction of NO_x emissions from large combustion plants by 15 per cent by 1993 and 30 per cent by 1998, compared with 1980 (EU directive on large combustion plants);
- stabilisation of total NO_x emissions at 1987 levels by 1994 (Sofia Protocol) and reduction by 30 per cent by 1998, compared with 1986 levels (Sofia Declaration);
- reduction of VOCs emissions by 30 per cent by 1999, compared with 1988 (Geneva Protocol).

As concerns *international commitments on global issues*, Denmark has agreed to phase out or reduce the production and use of ozone-depleting

substances such as CFCs and halons (Vienna Convention, Montreal Protocol and London and Copenhagen amendments) and to take measures to return greenhouse gas emissions to 1990 levels by 2000 (Framework Convention on Climate Change). Denmark has also undertaken to work towards the EU target of stabilising greenhouse gases at 1990 levels by 2000. Under the Kyoto Protocol signed in December 1997 (but not yet in force), the EU region plans to reduce emissions of six greenhouse gases by 8 per cent between 2008 and 2012: CO_2, nitrous oxide, methane (emission base year 1990) and three halocarbon gases used as substitutes for CFCs (emission base year 1995). Denmark's contribution to meeting these targets was set at a 21 per cent reduction of emissions of the six gases taken together, taking account of climatic variation and electricity trading, though this commitment is conditional on the EU taking action collectively on measures such as carbon taxation (Chapter 8).

At *domestic level*, the 1990 *Energy Action Plan* set the target of a 20 per cent reduction of energy-related CO_2 emissions in 2005 compared with 1988. In the 1996 Energy 21 plan, this target was broken down into a target reduction of at least 28 per cent for stationary sources and stabilisation of transport emissions, which currently account for about 25 per cent of total emissions. A further target of reducing transport emissions by 25 per cent in 2030 compared with 1988 levels was also set.

Table 3.1 **National targets for atmospheric emission reductions**

	Emissions [a]				Emission target and deadline	Reduction target (%) and reference year
	1980	1985	1990	1995		
SO_x	449	339	184	148	90 in 2000	80% of 1980 level
NO_x	281	300	276	251	223 in 1998	30% of 1986 level
VOCs	203	208	186	161	146 in 2000	30% of 1985 level
CO_2	63	63	53	61	50 in 2005	20% of 1988 level

a) In thousands of tonnes for SO_x, NO_x and VOCs; in millions of tonnes for CO_2.
Source: IEA-OECD; Ministry of Environment and Energy.

Measures to prevent and control air pollution

Regulatory instruments

Most regulatory provisions relating to air management are found in the 1991 Environmental Protection Act and its statutory orders. In particular, the act defines the *licensing system* which regulates atmospheric and other emissions from stationary sources. Environmental permits are compulsory for the larger polluters, the so-called ''listed'' firms, of which there are currently about 10 000. The system takes an integrated pollution prevention and control approach, increasingly based on the use of best available technologies, with a recent emphasis on cleaner technologies. County and municipal authorities also refer to Industrial Air Pollution Control Guidelines that include atmospheric emission and immission limits for about 250 substances, in order to define licensing requirements. Electric utilities have been allocated SO_x and NO_x emission quotas as part of efforts to reduce emissions from large combustion plants.

Since 1994, only unleaded gasoline has been available in Denmark. All diesel now sold is light or ultra-light. As a result of an agreement between the Ministry of Environment and Energy and the Danish Petroleum Industry Association, the sulphur content of diesel was limited to 0.05 per cent as early as 1992, even though this limit only became mandatory in 1996 in the relevant EU directive. A tax incentive is to be introduced in 1999 to support very low-sulphur diesel. Other *fuel quality* regulations (sulphur content of fuel oil and coal, benzene content of gasoline) also follow EU directives. Since June 1998, 98 per cent of gasoline has a benzene content below 1 per cent (well below the EU value of 2 per cent) as a result of a tax advantage given to low benzene content gasoline.

Vehicle emission standards have in practice made three-way catalytic converters necessary for new gasoline-fuelled cars since 1990, two years before their use became mandatory as a result of EU vehicle emission standards. About half the car fleet is equipped with catalytic converters. NO_x, VOCs and CO emissions are being reduced with renewal of the fleet, which is somewhat slower in Denmark than in many other OECD countries. Until 1997, only cars older than five years were subject to a *mandatory pollution inspection* prior to resale. Since 1 January 1998, all cars older than four years must be inspected biennially under EU regulations.

Economic instruments

Environmental taxes on energy products play an important part in Denmark's policies to reduce atmospheric emissions (Tables 6.6 and 8.1). Since a CO_2 tax

was first introduced in 1992, taxes on energy products have been revised so that they now include:

- energy taxes, which vary according to the energy content of different types of energy and have been used since the mid-1980s to compensate for the effect of the fall in oil prices;
- CO_2 taxes, which vary according to carbon content and energy use: industrial (space heating, heavy and light processes) and residential;
- SO_2 taxes, which vary according to sulphur content and are designed to encourage a shift from high to low-sulphur fuels.

In addition, a *levy* of DKr 0.006 *per kWh sold to households and the public sector* was introduced in 1998 in order to raise DKr 90 million annually for the Electricity Saving Trust, which provides financial support for electricity efficiency improvements.

Based on purchasing power parities, *energy prices for households* are higher in Denmark than in most of OECD Europe for light fuel oil, natural gas and electricity while gasoline prices are among the lowest (Table 3.2). *Energy prices for industry*, based on exchange rates, are in the middle range for OECD Europe concerning light fuel oil, heavy fuel oil, electricity and diesel oil (Table 3.2).

Table 3.2 **Energy prices in selected OECD countries,** 1997

		Denmark	United States	Austria	France	Netherlands	Sweden	Switzerland
Industry [a]								
Light fuel oil	$/1 000 litres	313.45	154.53	247.01	279.75	..	245.45	195.10
Heavy fuel oil	$/tonne	187.46	118.58	125.25	147.46	183.92	204.06	147.45
Electricity	$/kWh	0.064	0.044	0.081	0.049	0.063	0.034	0.102
Diesel	$/litre	0.785	0.313	0.766	0.759	0.771	0.874	0.888
Households [b]								
Light fuel oil	$/1 000 litres	511.5	273.9	340.8 [c]	354.8	383.1	446.0	175.1
Natural gas	$/$10^7$ kcal	518.5	265.2	375.4	383.6	339.3	..	320.6
Electricity	$/kWh	0.149	0.085	0.146 [c]	0.121	0.122	0.078	0.099
Premium unleaded gasoline	$/litre	0.797	0.374	0.870	0.949	1.009	0.837	0.599

a) At current prices and exchange rates. Average prices; actual prices depend on the amount purchased.
b) Using PPPs.
c) 1996.
Source: IEA-OECD.

A range of *economic incentives* are used to support *energy efficiency improvements* and substitution towards *renewable energy*. Renewable energy is exempt from taxes levied on other sources and renewable energy projects can receive a subsidy of up to 30 per cent of investment costs. Non-utility electricity production from wind, hydro and biomass receives a subsidy of DKr 0.17 per kWh produced, plus a DKr 0.1 subsidy for all renewable-based power production. Windmill operators are exempt from about 70 per cent of taxes on electricity delivered to the grid or for their consumption. A three-year programme (1994-96), with a total fund of DKr 30 million, subsidised replacement of obsolete wind turbines with modern units, providing up to 15 per cent of the cost of replacement or alternatively DKr 200 000. No excise tax is placed on use of straw and other renewables for heat production.

A tax incentive is being used to accelerate the implementation of *Stage II VOCs controls* that will apply to existing filling stations with annual sales over 500 cubic metres from 1 January 2000. Since 1995, a tax reduction of DKr 0.03 per litre of gasoline is given for purchases at stations that comply, funded by an overall increase in gasoline excise taxes of DKr 0.01 per litre. The Danish Petroleum Industry Association has estimated the cost of Stage II investments at DKr 0.03 to 0.11 per litre.

Monitoring

Air quality is monitored by the National Environmental Research Institute through the *Danish Air Quality Monitoring Programme*, with an urban network in Greater Copenhagen, Odense and Aalborg and background rural stations in Lille Valby and Keldsnor. In addition, a nation-wide programme monitors nutrient inputs to aquatic ecosystems, notably atmospheric nitrogen inputs to marine waters. In application of the relevant EU directive, a *smog warning system* was introduced in 1987 and expanded in 1994, with threshold values for concentrations of SO_2, NO_2 and ozone. No warnings have been issued to date. The information threshold for ozone was reached once, in 1996. The warning system does not provide for emergency measures to lower emissions from industry or traffic.

The *effects of air pollution on ecosystems* are monitored through international co-operative programmes on forest health and integrated ecosystem monitoring under the UN-ECE Convention on Long-Range Transboundary Air Pollution. Forest health is monitored at 56 plots and integrated ecosystem monitoring at two sites.

Expenditure on air pollution prevention and control

No estimates are available for *total private expenditure on air management*. Expenditure is nevertheless likely to be significant for both industry and households. In the case of industry, the large share of fossil fuels (particularly coal) in heat and electricity generation entails substantial expenditure in air pollution abatement and control. For instance, between 1988 and 2000 investments in the control of SO_x and NO_x emissions from coal-fired power plants, which account for about 80 per cent of electricity production, can be estimated at DKr 2.7 billion. In addition, the Danish EPA has estimated that the implementation of the Industrial Air Pollution Guidelines in manufacturing industry would entail investments of DKr 2 282 million in the 1990s, largely in agro-food industries (DKr 725 million), chemical industries (DKr 606 million) and steel and metal manufacturing (DKr 480 million). In the case of households, the main item of pollution abatement and control expenditure is the large share of cars equipped with catalytic converters.

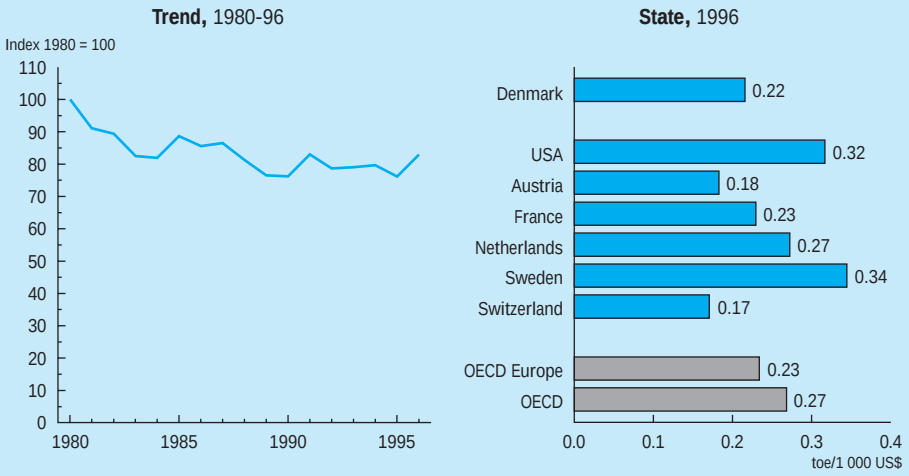
Integration of air management and energy policies

Total primary *energy supply* (TPES) in 1996 was 22.9 million tonnes of oil equivalent (Mtoe), a 16 per cent increase since 1980, while GDP rose 40 per cent. Danish TPES is *dominated by fossil fuels,* which account for 93 per cent, particularly oil (41.6 per cent of TPES) and coal (36.7 per cent). Crude production matches demand for oil products; Denmark is a net exporter of natural gas, which covers about 10 per cent of its energy needs. With no nuclear power and negligible hydro production, Denmark has developed other renewable energy, district heating and cogeneration more than most other OECD countries. Renewable energy use (waste, straw, wood and wind power) has more than doubled since 1980, accounting for almost 7 per cent of energy supply in 1996. Total final *energy consumption* (TFC) has increased by only 5 per cent since 1980. In 1996, industry accounted for 18 per cent of TFC, 7 per cent below its 1980 level. Energy use in transport has increased by 31 per cent since 1980 and now accounts for about 30 per cent of TFC. *Energy intensity* fell by 24 per cent between 1980 and 1990, and has since increased by 10 per cent. It is close to the OECD Europe average (Figure 3.3).

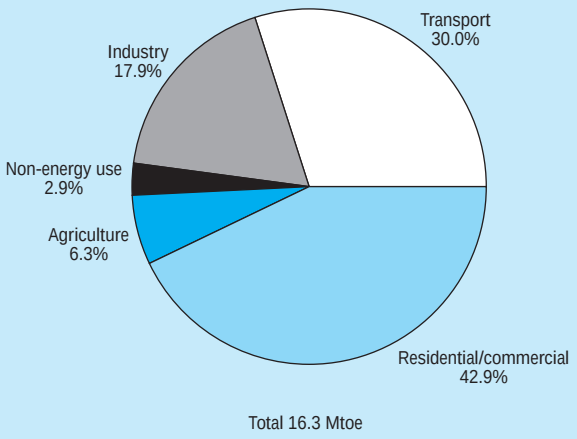
In September 1994, Denmark combined the administrative and organisational *responsibilities for environment and energy* in the Ministry of Environment and Energy. Within the Ministry, the Danish Energy Agency has operational responsibility for implementing energy policy. Together with the central

Figure 3.3 **Energy structure and intensity**

Energy[a] per unit of GDP[b]



Total final energy consumption by sector, 1996



a) Total primary energy supply.
b) GDP at 1991 prices and purchasing power parities.
Source: IEA-OECD.

government, municipalities participate in key local decisions on fuel choice and supply issues.

Current *energy policy* is set out in the 1996 Energy 21 Action Plan, which follows up on the 1990 Energy 2000 plan (updated in 1993). It aims to ensure a reliable, efficient and economical supply of energy, while reducing atmospheric emissions to meet national and international commitments. The Energy 21 plan confirms the target set in 1990 of reducing CO_2 emissions by 20 per cent in 2005 over 1988 levels, notably through doubling renewable energy supply and improving energy intensity by 20 per cent. Other targets include the conversion of all district heating plants to cogeneration by 1998 and the adoption of biomass as a priority fuel for power generation. Following the massive conversion of generation capacity from oil to coal in the 1980s, the construction of coal-fired plants was banned in 1997. Regulations mandate electricity-integrated resource planning and limit the use of electricity for residential heating.

At the end of 1997, there were some 4 700 *wind turbines* with a total capacity of around 1.1 GW, accounting for about 4.6 per cent of electricity production. The aim is to develop 1.5 GW of capacity by 2005 and about 5.5 GW by 2030. After 2005, most wind turbines will be built offshore, both because of restrictions on land use and in order to take advantage of the wind conditions. The Danish wind turbine industry is the largest in the world, with a turnover of over DKr 5.7 billion in 1997 and exports worth DKr 3.5 billion.

The Energy 21 plan sets the target of increasing use of *biomass* for energy purposes to 1.8 Mtoe by 2000. A 1993 parliamentary agreement, revised in 1997, led to the requirement that 1.4 million tonnes of straw and wood chips be used annually in power stations by 2004. DKr 1.5 billion had been spent on biomass R&D by 1997. While major technical progress has been made, notably the completion of a coal and straw co-fired plant, economics remains a problem as straw is three to four times the equivalent price of coal.

Several financial support programmes for *energy conservation* have been introduced since the early 1990s, notably for the industrial and commercial sectors, where subsidies of up to 30 per cent of the total investment or DKr 10 million are available, with a total budget of DKr 200 million per year. District heating is promoted through tax incentives for utilities, subsidies and regulation. Altogether, some DKr 1.2 billion was allocated by public authorities in 1996 to improve energy efficiency. Energy-related building and equipment standards were upgraded in 1995. The government plans to reduce the heat requirement for new buildings by 50 per cent of the 1990 level by 2005 through tighter building codes. The House

Energy Labelling Act, effective in 1997, requires that properties be energy-labelled when sold. Nearly 14 per cent of energy R&D funds are devoted to energy efficiency.

Integration of air management and transport policies

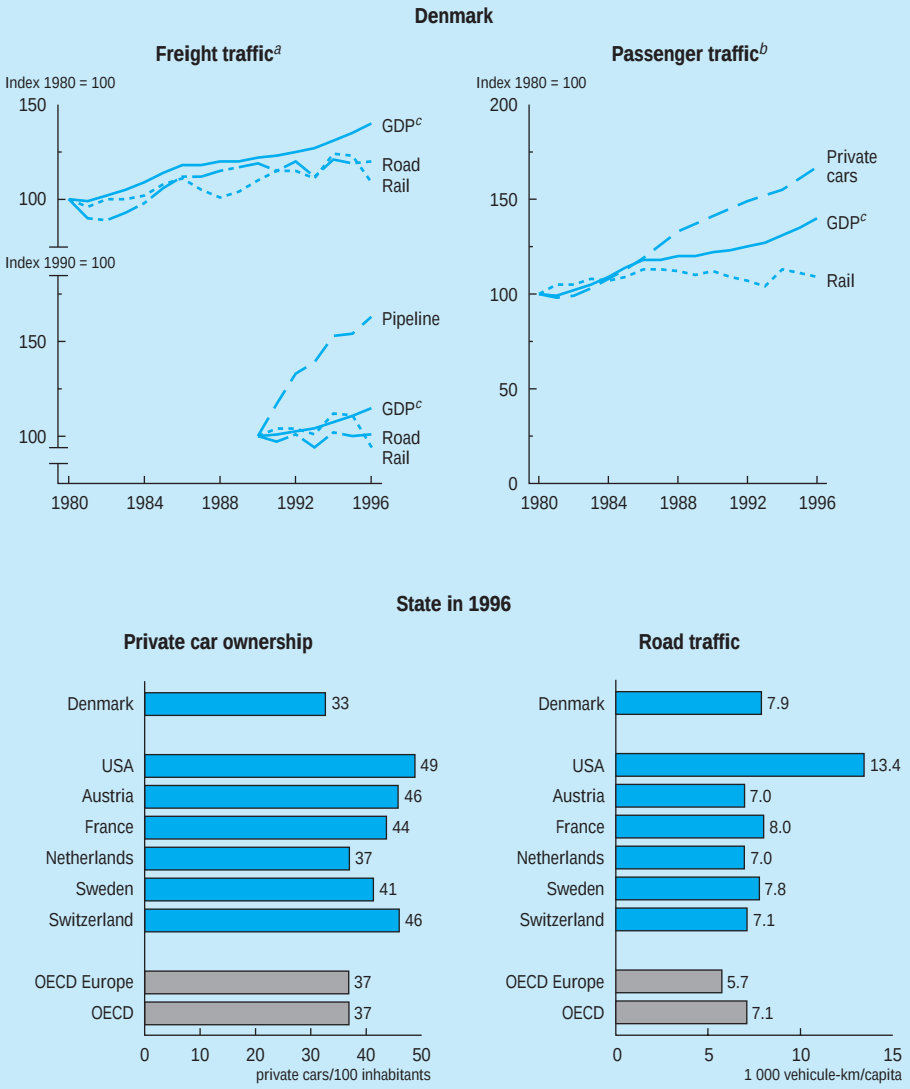
Between 1980 and 1996, while GDP increased by 40 per cent, *freight traffic* grew by 50 per cent (Figure 3.4). Pipelines accounted for much of this increase, due to the development of North Sea oil and gas. Road freight traffic (expressed in vehicle-kilometres) increased by 62 per cent. Most goods are transported by road, as 80 per cent is hauled less than 100 kilometres due to the small size of the country.

Over the same period, *passenger traffic* increased by 59 per cent. Most of this increase was absorbed by road transport, which grew by 64 per cent. Road traffic per capita is 39 per cent higher than the OECD Europe average, whereas ownership remains lower. Though there are fewer vehicles, they are used intensively and longer; a large part (43 per cent) of the car fleet is over ten years old. Cycling accounts for a much larger share of travel than in most other OECD countries (Figure 3.5).

Denmark's transport policy is characterised by some *major infrastructure projects*: a bridge/tunnel linking the eastern and western parts of the country has just been completed and one between Denmark and Sweden is under construction. The 1993 *Traffic 2005* plan is a national transport policy statement that establishes the management of transport demand and curbing traffic growth as policy objectives. Emission targets for the transport sector include a 40 per cent reduction by 2000 and a 60 per cent reduction by 2010 compared with 1988 for NO_x and VOCs emissions, and a stabilisation of CO_2 emissions by 2005 with 25 per cent reduction by 2030. The 1996 *Action Plan for the Reduction of CO_2 Emissions from the Transport Sector* focuses on CO_2 reduction measures, without which emissions are expected to rise by 16 per cent by 2005 and 26 per cent by 2030.

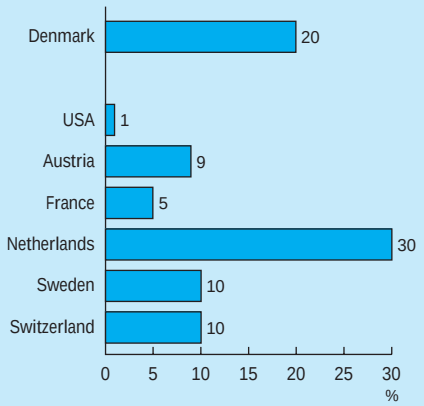
Denmark has the *highest new vehicle purchase* (registration) *taxes in the OECD*: 105 per cent on the first DKr 48 800, and 180 per cent on the balance. Car prices are about double the average for OECD countries. Annual taxes are also high. Until 1997, they were based on the weight of the car and averaged DKr 2 260, with diesel cars paying an additional tax to compensate for low diesel fuel taxes. As part of a reform of car taxation, the annual tax on cars bought after 1 July 1997 rises with the tested fuel consumption of the model; for instance, from

Figure 3.4 **Trends in the transport sector**



a) Based on values expressed in tonne-kilometres.
b) Based on values expressed in passenger-kilometres.
c) Based on GDP values expressed in 1991 prices and purchasing power parities.
Source: ECMT; IRF; OECD.

Figure 3.5 **Share of cycling in travel modes,** mid-1990s
(percentage of total trips)



Source: Carlines.

DKr 400 (for an efficiency of 5 litres per 100 kilometres) to DKr 4 000 (10 litres per 100 kilometres) for a gasoline-fuelled car, with the most fuel-intensive (22 litres per 100 kilometres) liable to a tax of DKr 14 800. Electric cars are exempted from registration and annual taxes.

Gasoline prices are among the lowest in OECD Europe. Even though taxes on diesel are low, the market for diesel cars is limited to 5 per cent of the fleet by high purchase taxes. Freight hauliers could obtain diesel almost tax free until 1993, when fuel tax refunds for vehicles with VAT registration were abolished, which in effect doubled the price of diesel for these users.

Transport and environment issues are given a high priority in *physical planning*, with an emphasis on limiting urban sprawl by increasing population density, extending public transport and cycle lanes and encouraging the decentralisation of urban areas. Two-thirds of the 90 largest municipalities have established *transport and environment plans* which cover issues such as air pollution, visual impact, noise, CO_2 emissions and traffic safety, and define targets in line with those set in Energy 21 and Traffic 2005. On the basis of such plans, the Danish

EPA has provided DKr 150 million of support for planning and project development through its Urban Traffic Project.

3. Environmental Performance

Achieving air management objectives

Denmark has made *progress* in reducing or containing emissions of conventional atmospheric pollutants. Between 1980 and 1996, while GDP increased by 39 per cent, SO_x emissions dropped by 62 per cent and those of NO_x fell by 5 per cent. This achievement results from changes in energy supply and from a range of abatement measures, notably fuel quality standards, licensing and environmental energy taxes.

The main success concerns *sulphur emissions*. Denmark more than met the Helsinki Protocol's target of reducing emissions by 30 per cent by 1993 compared with 1980 levels; emissions declined by 64 per cent during this period and have continued to do so. This reduction has been largely due to regulatory measures, notably SO_x emission quotas for electric utilities. Nevertheless, to meet the Oslo Protocol's 80 per cent reduction target for 2000, substantial reductions still need to be achieved. The incentive provided by the SO_2 tax introduced in 1996 should contribute to meeting this target through a shift to low-sulphur fuels, gas and renewable energy. However, Denmark still has relatively high emissions per unit of GDP and per capita for Europe.

Concerning *NO_x emissions*, Denmark has more than met the target of the Sofia Protocol, as its emissions fell by 13 per cent between 1987 and 1994. Largely because of electricity exports and road traffic growth, it might be more difficult to achieve the target of the Sofia Declaration (30 per cent reduction compared with 1986 levels by 1998); between 1986 and 1996, emissions fell by 10 per cent. The EU's 30 per cent reduction target for NO_x emissions from large combustion plants between 1980 and 1998 should be met, largely through pollution abatement and control measures. However, Denmark has high emissions per unit of GDP and per capita for Europe and trails many other countries.

VOCs emissions fell by 21 per cent between 1988 and 1996. A set of measures based partly on EU regulations has been introduced to bring about a 30 per cent reduction compared with 1988 levels by 1999 (Geneva Protocol target). Denmark is implementing Stage I (reduction of emissions in storage) of the EU directive on VOCs emissions. For Stage II (reduction of emissions at the pump), the current approach relies on a tax incentive for fuels sold at stations

equipped with vapour recovery equipment. This approach has successfully accelerated vapour recovery, which is now in place for over 50 per cent of the market. Denmark is well on the way to meeting its Geneva Protocol reduction target, though the effectiveness of the measures in place will need to be continually monitored.

Because Denmark has no hydro or nuclear power generation and relies largely on fossil fuels, *CO_2 emissions* per unit of GDP and per capita are *high compared to other OECD countries and growing*; compared with 1990, total actual emissions were 14 per cent higher in 1995 and 37 per cent higher in 1996. While much of this increase is related to electricity exports, which can fluctuate considerably from year to year, it is clear that Denmark will find it difficult to meet its international commitment to stabilise emissions at 1990 levels in 2000 and its domestic target of a 20 per cent reduction in 2005 compared with 1988 (set in the 1996 Energy 21 Plan) (Chapter 8).

The significant SO_x, NO_x and lead emission reductions recorded over the last 15 years have had a *positive impact on local air quality*. Urban air quality is generally good, though pollution episodes have been observed under unfavourable climatic conditions. Nevertheless, growth in road traffic could threaten Denmark's cities with the ozone and NO_x pollution problems of concern in other OECD countries. Care should be taken to control this growth.

Falling SO_x and NO_x emissions in Europe have reduced *acid deposition* across Denmark, though the improvement has yet to be felt at ecosystem level and acid deposition needs to be further reduced. Much of the necessary emission reductions will have to be achieved in neighbouring countries; it is important that Denmark, which is also a significant exporter of acidifying substances, set an example in this respect (Chapter 8).

Integration of air pollution concerns in energy and transport policies

Energy

Denmark is implementing vigorous energy policies with broad political and public support and the commitment of a wide range of stakeholders. In the late 1980s, the focus of energy policies shifted from consideration of security of supply, minimisation of energy service costs and local environmental effects to wider environmental considerations, notably sustainable development. As stated in the Energy 21 plan, current policies aim to ''contribute to Denmark maintaining and developing its pioneering role in the achievement of sustainable global

development''. Over the last two decades, it has achieved *some decoupling of domestic energy use from economic growth*. A range of policy measures have contributed to this decoupling, notably efficiency improvements such as better building insulation and the widespread use of cogeneration, particularly in association with district heating. The integration of environmental concerns in energy policy decisions has been supported by a comprehensive range of regulatory and economic instruments. Energy action plans have been regularly updated since 1990 to ensure that new measures were introduced where existing ones proved insufficient to meet environmental goals. However, trends in the 1990s are not favourable and overall total primary energy supply is growing faster than GDP. Further energy efficiency efforts are needed.

Recent policies have focused on increasing the use of *renewable energy*, notably as a substitute for fossil fuels. Supported by a range of economic instruments, development of wind energy has taken place essentially through voluntary agreements with electric utilities, whereas that of biomass has been prescribed through regulation. These measures have been successful: renewable energy (waste, straw, wood and wind power) supplies a growing part of Denmark's energy needs (7 per cent in 1995) and Danish industries have become leaders in some environmentally favourable energy technologies such as wind turbines. Though they require back-up, the best located wind machines can generate electricity at costs comparable with the long-term marginal costs of coal plants, while the use of straw for electricity generation remains uncompetitive. The Energy 21 plan assumes that in the absence of international consensus on large carbon taxes, the development of renewables will remain only marginally competitive without appropriate policy support. As a result, Denmark may incur costs by seeking to move faster than other countries on the rapid deployment of renewable energy. Nevertheless, the environmental benefits of deploying renewables may outweigh the economic costs.

Transport

Transport emissions play an increasingly important role in air pollution management and CO_2 emission reduction policies. The *national transport policy* set out in Traffic 2005 considers taxes as a key instrument for regulating transport demand and achieving environmental objectives. Current taxes relating to vehicle ownership are high and those relating to vehicle use are low. Therefore, vehicle ownership is low, use is high and the replacement rate is slow (Figure 3.4).

Denmark's fleet is older than that of many other OECD countries. More attention should be paid to *limiting pollution from these older vehicles*, notably through mandatory pollution controls, which were until recently little used. In

1994, Denmark tried a policy of accelerated car scrappage based on economic incentives. It was abandoned in 1995 because it was not considered effective in reducing emissions, the oldest cars being driven the least.

The government is continuing the *green tax reform in the transport sector* and is shifting from heavy fixed vehicle taxation to a form of taxation that would be more environmentally effective, in that it varies according to vehicle emission and fuel efficiency levels. Much of the CO_2 emission reduction objective is to be achieved through road fuel taxation. The transport action plan assumes that, as a result of increases in oil prices, fuel prices will increase by 10 per cent by 2005 and that every 1 per cent increase will see car traffic fall by 0.4 per cent (Chapters 6 and 8). Influencing emissions and fuel consumption through the adjustment of variable transport costs should also be considered in terms of other instruments, such as road use pricing systems including tolls.

Many municipalities are giving transport and environment issues a high priority and are committed to reducing air pollution and other environmental impacts of mobility. With the support of the Danish EPA, two-thirds of the 90 largest municipalities have elaborated Traffic and Environment Action Plans, though only a few have been implemented. Nevertheless, as in many OECD countries, public transport has suffered from price developments, with gasoline prices falling 30 per cent between the mid-1980s and mid-1990s while public transit fares increased up by 60 per cent. In recognition of this problem, public transport subsidies were increased so as to reduce fares by 10 per cent from September 1997. There is a need for further central government support for the development of sustainable transport policies in counties and municipalities, as well as in the regional and local public transport sector.

4

CHEMICAL PRODUCTS AND WASTE MANAGEMENT

1. Chemical Products: Current Situation and Trends

The annual *consumption of chemicals* in Denmark is estimated at about 8 million tonnes. This consumption relates to some 100 000 chemical products, comprising over 20 000 individual chemical substances. The most significant industrial users of chemical substances are the chemical industries, the iron and metal industries, and the repairs and service sector (Figure 4.1).

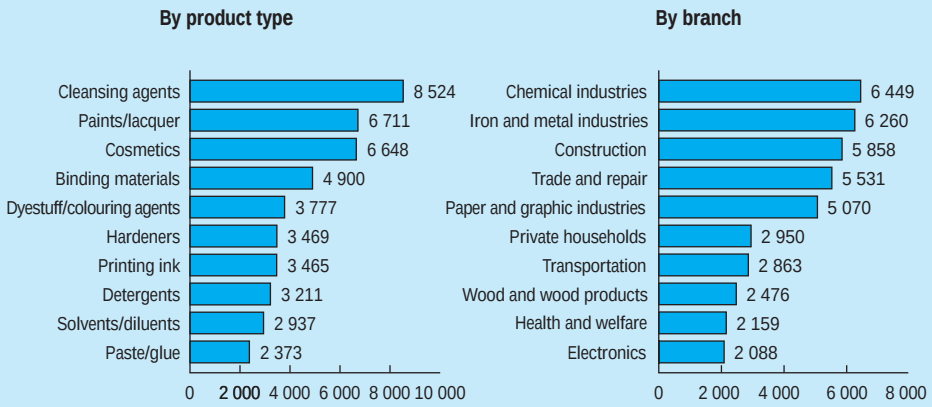
Pesticides include herbicides, growth regulators, fungicides and insecticides. The *agricultural sector* accounts for 90 per cent of all sales of active pesticide ingredients, horticulture and fruit growing 4.6 per cent and private gardens 3.5 per cent. Total annual sales of pesticides for use in agriculture declined from 6 972 tonnes of active ingredients in the early 1980s to 3 675 tonnes in 1997 (Figure 7.3).

2. Chemical Products: Responses

Objectives

The main objective of Danish policy with respect to chemical products and pesticides is to prevent hazards to human health and damage to the environment. In order to achieve this objective, government agencies have focused on a small group of substances posing specific identified problems, including heavy metals, substances known to disrupt the atmospheric ozone layer, volatile organic compounds (VOCs), dioxins and pesticides. In many cases the policy response has been one of either *substitution* or *reduction*.

Figure 4.1 **Use of chemical products by type and by branch,**[a] 1998
(number of chemical products)



a) Excludes pesticides.
Source: Ministry of Environment and Energy.

For most of the estimated 20 000 *existing chemical substances* in products on the Danish market, the major challenge has been to develop specific goals and targets despite the lack of information on their effects on human health and the environment. To overcome this shortcoming, the authorities have focused on developing methods for setting priorities for action among the existing substances.

The 1986 *Pesticide Action Plan* called for a reduction in pesticide application, an objective taken up in the 1991 Action Plan for Sustainable Agriculture (Chapter 7). This policy has comprised two main goals:

– reduction in the overall consumption of, and frequency of treatment with, all chemical pesticides by 25 per cent by 1990 (compared with the 1981-85 average) and by a further 25 per cent by 1997;
– a ban on the sale of the most hazardous pesticides on the market.

Policy framework

The main legislation concerning the manufacture, storage, use and disposal of chemical substances and products (including pesticides) is the 1993 *Act on Chemical Substances and Products,* largely administered by the Danish Environmental Protection Agency (EPA). The Act follows chemical substances from ''cradle to grave'' and places the onus on manufacturers and importers of chemical substances or products to acquire sufficient information to evaluate safety. Its main provisions cover:

– notification of new chemical substances;
– classification, packaging, labelling and storage;
– rules on the sale of toxic substances and products;
– restrictions on the presence and use of chemical substances;
– approval of pesticides.

The Act is based on a *substances-oriented strategy* involving the identification of a substance's properties and potential hazards. It also requires information on the environmental fate of a substance in order to prepare a risk assessment and identify measures to control or limit its use. Chemicals included within or released from goods are covered.

As a complement to this substances-oriented strategy, the Danish EPA has promoted the development of a *product-oriented strategy* which is still in its early stages of formulation. Presented in a 1996 Green Paper on Intensified Product-Oriented Environmental Action, it is aimed at improving the environmental quality of products and goods based on an understanding of the total environmental impact resulting from manufacture, storage, use, transport and final disposal. The goal is to promote the development and marketing of more environmentally benign products. Engaging all stakeholders, including industry, is an important component. This policy is being complemented by the new direction given to efforts to promote cleaner technologies, which have recently shifted from production processes to products.

The *precautionary principle* plays an important part in Danish management of chemicals. It implies that decisions may be taken on the basis of incomplete data, for instance concerning a substance's health or environmental effects. Danish authorities believe more use will have to be made of this principle in the future in order to make progress in the safe management of chemicals.

Policy instruments

New and existing chemicals

Denmark's system for the *notification of new chemicals* is in line with EU requirements. A new chemical substance is defined as one placed on the market after 18 September 1981. *Existing substances* can be identified in the European Commission database (European Inventory of Existing Chemical Substances), which contains data on approximately 100 000 substances. Until recently, the approach in Denmark largely focused on those substances known to be the source of human health and/or environmental concerns.

A typical example of this approach applies to *heavy metals*. The consumption of cadmium and mercury has been reduced by more than 50 per cent since the early 1980s, largely through measures such as the regulation of the cadmium content in fertilisers or the prohibition of mercury treatment of seed grain. Because of the serious health consequences associated with lead, the overall goal has been to phase out all its intended uses. This has been successful in specific use categories, most notably in the case of lead additives to gasoline, on which action began in 1977 with the Act Concerning the Use of Lead for Gasoline. The last lead additives were phased out at the beginning of 1994. Use of lead shot is also prohibited.

In order to identify a mechanism for setting priorities to deal with the majority of existing chemicals whose possible health and environmental effects have not yet been addressed, the Danish EPA published a *List of Undesirable Substances* in 1997. This list comprises approximately 100 chemical substances or groups of substances selected from an *Effects List* of substances known to have harmful effects on humans and/or the environment. Inclusion on the List of Undesirable Substances also depends on information from a chemical product register (PROBAS) covering those chemicals marketed in the largest quantities in Denmark. The List of Undesirable Substances is not a list of prohibited substances, but is intended as a signal to producers and importers regarding substances to be avoided in the future. It will be used to select substances for substitution as well as prohibition. The list is regularly updated.

The PROBAS *chemical product register* is becoming an increasingly important tool in chemicals management. It was established jointly by the Ministry of Environment and Energy and the Ministry of Labour and is managed by the National Working Environment Service. The register is updated on a daily basis and includes information on more than 96 700 products, involving over 138 000 substances and 600 000 chemical names. Data include information on

product or substance identification, chemical composition, physical and chemical properties, and volumes used or marketed in Denmark. The register supports activities such as the development of cleaner technologies, life cycle assessment and fate analysis.

Eco-labelling plays an increasingly important role in chemicals management. The 1992 EU Council Regulation on Eco-labelling allows for the award of the EU Eco-label; the Nordic Swan eco-labelling system was established through a decision of the Nordic Council of Ministers in 1989. Both the EU Eco-label and the Nordic Swan are now used in Denmark.

Pesticides

Legislation passed in 1987 to prevent the use of highly toxic pesticides introduced *pesticide re-registration* for products licensed before 1980. Approvals are valid four years for very toxic and toxic substances and eight years for others. Rules for approval have become more stringent: approval of substances which could be replaced by less dangerous ones can be refused. In 1993, to take account of EC regulation, the Act on Chemical Substances and Products was amended so that substances have to be re-assessed on the basis of *risk assessments*. Revisions in 1994 and 1995 facilitated procedures for the removal of particularly harmful products from the market. A Ministry of Environment and Energy ban on the import and sale of 97 trade name agro-chemicals came into effect in July 1997.

Other measures to *reduce pesticide use* have included: research and development; mandatory education schemes for pesticide users (31 000 farmers have been trained); information and advice to farmers; mandatory inspection of spraying equipment; and mandatory maintenance of spraying logbooks (Chapter 7). In some areas, spraying is prohibited or restricted under the Nature Protection Act.

Economic instruments

A range of economic instruments have been used to reduce the consumption of some chemicals and, in some cases, phase out their use altogether. The tax advantage for *lead-free gasoline* introduced in 1986 was one of the major early instruments used to phase out leaded gasoline. The revenue from the tax on leaded gasoline contributes to the funds available for subsidising industrial energy efficiency improvements (Chapter 6). A tax on the three main types of *chlorinated solvents* (accounting for over 95 per cent of new chlorinated solvents) was introduced in 1996, at a rate of DKr 2 per kilo or about 25 per cent of the current price.

In 1995, a voluntary agreement with producers to collect *nickel-cadmium batteries* was supplemented by a charge ranging from DKr 2 to DKr 8 per battery. The revenue is used to cover some of the costs (about DKr 7.8 million annually) of the collection system established by agreement between the Minister of Environment and Energy and the Association for the Collection of Rechargeable Batteries. The collection rate has tripled since the charge system was introduced.

Taxes on pesticides were introduced in the early 1980s and the revenue was used to finance approval procedures, inspection and testing, education of users, and research and development (Chapter 7). In 1996, to reduce consumption by 10 per cent, the existing 3 per cent tax on the wholesale price (20 per cent for household use) was replaced by a pesticide tax amounting to 37 per cent of the retail price before VAT for insecticides and 15 per cent for fungicides and herbicides. The revenue is returned to the agricultural sector through a reduction of the county tax on agricultural land. Tax rates were recently increased to 54 per cent for insecticides and 33 per cent for fungicides and herbicides.

Voluntary agreements and initiatives

A number of voluntary agreements have been initiated since 1987 concerning the *phasing out or reduction of the use of specific chemical substances*. For instance, an agreement established in 1987 to phase out the use of nonylphenolethoxylates (NPEOs) in detergents by 1989 resulted in their use virtually being eliminated in Denmark. Similar agreements exist on organic solvents in paints and varnishes, PVCs, cation-active surfactants in detergents, and the phasing out of regular (higher sulphur) diesel fuel and of chromium in wood impregnation products. The 1991 Action Plan for Sustainable Public Procurement Policy, which covers cleaning agents and paints, aims at moving away from products that contain the more harmful chemical substances (Chapter 6).

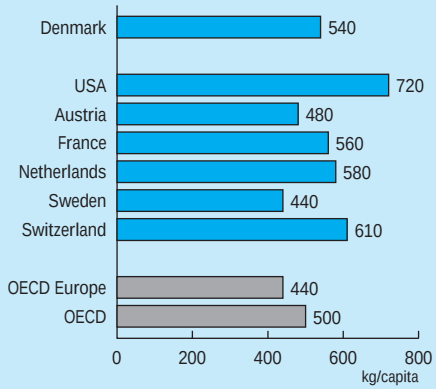
Agreements have also been used to manage *disposal of heavy metals*. A 1990 agreement between the Danish EPA and the relevant industry association established a system for voluntary collection of lead batteries. Similarly, a 1991 agreement between the Ministry of Environment and Energy and the Association for the Collection of Rechargeable Batteries applies to the collection of rechargeable batteries containing cadmium.

3. Waste: Current Situation and Trends

Municipal solid waste generation was estimated at 2.9 million tonnes in 1996, of which 2.8 million was household waste (including 0.5 million tonnes of garden waste) and the remainder was waste from the service sector collected with household waste. Municipal waste generation continued to increase in the 1990s, though at a slower rate. In 1996, it was greater by about 25 per cent than the average for OECD Europe (Figure 4.2).

In 1996, *industrial waste* (from manufacturing industry) amounted to 2.6 million tonnes (14 per cent more than in 1985) and building and construction waste amounted to 3.1 million tonnes (82 per cent more than in 1985). *Sewage sludge* was estimated at 1.2 million tonnes wet weight (10 per cent more than in 1985) or 162 000 tonnes dry weight. *Residual combustion products* from coal-fired electricity generation and waste incineration plants were estimated at 2.3 million tonnes and 0.4 million tonnes respectively.

Figure 4.2 **Municipal waste generation,**[a] mid-1990s



a) When interpreting national figures, it should be borne in mind that the definition of municipal waste and the survey methods may vary from country to country. According to the definition used by the OECD, municipal waste is waste collected by or for municipalities and includes household, bulky and commercial waste and similar waste handled at the same facilities.

Source: OECD.

Hazardous waste amounted to 269 021 tonnes in 1996. Fly ash and flue gas treatment waste from waste incineration plants classified as hazardous waste represented 71 900 tonnes (Table 4.1).

Table 4.1 **Hazardous waste,** 1996
(tonnes)

	Recycling	Incineration	Special treatment	Landfilling	Total
Primary sources (total)	48 400	36 534	88 100	13 600	186 634
Lead batteries	14 200	–	–	–	14 200
Waste oil transported to district heating plants	–	20 734	–	–	20 734
Waste treated at the Kommunekemi plant	–	–	82 500	–	82 500
Asbestos	–	–	–	7 800	7 800
Special hospital waste	–	5 700	3 000	–	8 700
Sulphuric acid	22 000	–	–	–	22 000
Waste from other primary sources	12 200	10 100	2 600	5 800	30 700
Secondary sources (total)	10 487	–	26 500	45 400	82 387
Filter dust from flue-gas cleaning/steel production	10 487	–	–	–	10 487
Fly ashes and flue-gas cleaning from incineration plants	–	–	26 500	45 400	71 900
Total	58 887	36 534	114 600	59 000	269 021

Source: Ministry of Environment and Energy.

4. Waste: Responses

Objectives

Waste management policy objectives are largely defined at national level. Following up on two previous action plans developed since the mid-1980s, the 1993-97 *Action Plan for Waste and Recycling* released by the government in 1992 defined the following targets for 2000 (Table 4.2):

– an overall recycling target of 54 per cent;
– a maximum of 25 per cent of waste incinerated and 21 per cent of waste landfilled;
– residual waste from incineration: landfilling 47 per cent and recycling 57 per cent;
– residual waste from power generation: recycling 56 per cent and landfilling 44 per cent;
– household waste: recycling 40-50 per cent, incineration 50-60 per cent and elimination of landfilling;
– (bulky waste: recycling 25 per cent, incineration 38 per cent and landfilling 38 per cent;
– garden waste: recycling 85 per cent and incineration 15 per cent;
– sewage sludge: recycling 50 per cent and incineration 50 per cent;
– industrial waste: recycling 50 per cent, incineration 40 per cent and no landfilling;
– waste from institutions, trade and offices: recycling 60 per cent, incineration 40 per cent and no landfilling;
– building and construction waste: 60 per cent recycling, 10 per cent incineration and 30 per cent landfilling.

The 1994 EU *directive on packaging and packaging waste* set the target of 50-65 per cent recycling/incineration with energy recovery for packaging waste by

Table 4.2 **Waste disposal trends and targets,** 1985-2000
(thousand tonnes)

	1985		1995		1996		Target for 2000	
	amount	%	amount	%	amount	%	amount	%
Recycling	3 150	35	7 046	62	7 787	60	5 300	> 54
Incineration	2 340	26	2 306	20	2 507	19	2 500	< 25
Landfilling	3 510	39	1 969	17	2 524	20	2 000	< 21
Special treatment	–	–	145	1	95	1	–	–
Total	9 000	100	11 466	100	12 913	100	9 800	100

Source: Danish EPA.

2001; 25-45 per cent must be recycled, and material recovery must reach 15 per cent for each type of packaging.

A 1993 statutory order gives *municipalities* considerable control over the collection and disposal of non-hazardous waste. In many cases they have formed intermunicipal regional waste utilities, often around a common incinerator or sometimes common landfilling facilities. Municipalities are required to prepare 12-year local waste management plans every four years.

Waste prevention, minimisation and reuse/recycling

National regulations oblige municipalities to provide *separate collection for recycling* of paper, as well as glass from households and food waste from industrial kitchens. For other waste streams (e.g. organic household waste, building materials, scrap metal) not covered by such regulations, collection and recycling opportunities depend on a local decision and/or commercial opportunities. In these cases, provision of facilities for separate collection and recycling or reuse by municipalities is encouraged by a weight-based waste tax, particularly for heavier waste.

As a result of this combination of regulation and economic incentive, the *recycling rate* increased from 35 to 60 per cent between 1985 and 1996. The main contributor to this increase was building and construction waste, 89 per cent of which was reused or recycled in 1996. Almost all garden waste is now composted at municipal sites, whereas in 1985 half was landfilled. Some 78 per cent of sewage sludge is spread on agricultural land, up from 55 per cent in 1985. Recycling rates for paper and board and for glass have also increased. Residual products from coal-fired power stations are usually recycled at a rate of about 70 per cent.

Voluntary agreements support reuse and recycling for specific waste streams. Examples include the voluntary return of 95 per cent of used batteries containing lead. An agreement signed in 1995 by the Ministry of Environment and Energy with the various industrial activities concerned set the target of collecting and recycling at least 70 per cent of scrapped car tyres. A voluntary agreement signed in 1991 with the Confederation of Danish Industries set the target of recycling building products by 77 per cent by 2000, and of reducing PVC in packaging by 85 per cent. An agreement on the safe disposal of discarded electric and electronic products is under negotiation.

The first *Cleaner Technology Action Plan* (1987-92) was followed up by a plan for 1993-97. The focus shifted from production processes to products, as experience showed that better results were obtained from considering products as well as processes. This Action Plan includes pilot projects in a number of industries to limit resource consumption, pollution and waste generation from production processes. Results of the projects have been disseminated through agreements with industry. Life cycle analysis has been used to determine where prevention can be most effective. The 1993-97 Action Plan had a budget of DKr 380 million for subsidies of information activities, studies and development projects.

Waste treatment and disposal

In 1996, just over 2.5 million tonnes of waste was landfilled. There is strong public opposition to the siting of new *landfills*. In 1994, the Minister of Environment and Energy agreed with the National Association of Local Authorities that waste suitable for incineration would no longer be landfilled from 1997. In 1996, about 20 per cent of municipal waste not reused or recycled was still landfilled.

Almost as much waste was incinerated in 1996 as was landfilled. It is now compulsory that all waste *incineration* facilities be designed to recover energy, usually for use in municipal cogeneration plants supplying heat to district heating networks and electricity to the grid. The present incineration capacity is considered adequate, though a recent report indicates that in the absence of further initiatives on waste prevention and recycling, and as a result of the ban on landfilling incinerable waste, it may be insufficient in the first years of the new century in some parts of Jutland and in the county of Fyn.

Hazardous waste management

Hazardous waste such as oil and chemical waste from industry and households, as well as pharmaceutical waste deposited with retailers, are collected at municipal level (at least one collection point in each municipality). They are then gathered at 18 municipally-owned receiver stations, where they are sorted before being sent to Kommunekemi, the *national hazardous waste treatment plant* owned by Danish municipalities. The plant, located in Nyborg, was opened in 1971. It treated 82 400 tonnes in 1996, out of a total of 269 021 tonnes of hazardous waste (Table 4.1). The rest is recycled at approved plants, incinerated or landfilled, though some waste that cannot be handled in Denmark is exported.

This is the case in particular for mercury waste treated in Germany, and for car batteries recycled in Germany and Sweden.

Denmark ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal in 1993 and started implementing EU regulations on *waste shipments* in 1994. Exports for final disposal of all waste, and for recovery of amber and red list waste, to non-OECD counties have been banned since 1 January 1998.

Economic aspects of waste management

A general *waste tax* was established in 1987, initially set at DKr 40 per tonne. The tax was first introduced as a result of a shortage of landfill space, particularly in the Copenhagen area. In 1989 and 1992, it was increased to help meet the targets of Action Plans on Waste and Recycling. In 1993 and 1997, it was again increased as part of the green tax reform that shifted taxes from income to pollution. Since January 1997, the rate is DKr 210 per tonne for incineration in cogeneration plants, DKr 260 per tonne for incineration in other plants, and DKr 335 per tonne for landfilling (both municipal and private). The tax is not applied to certain types of waste, including hazardous waste, though since 1998 it has been applied to sewage sludge and fly ash. A tax on raw materials was also introduced in order to reduce the use of sand and gravel and promote reuse of building materials.

Waste regulations specify that *waste charges* should cover all waste collection, transport, disposal and recycling costs. Most municipalities charge households a fixed waste disposal charge that reflects average collection and disposal costs, while the charge applied to industrial and commercial waste generators is proportional to the weight, volume and type of waste. Total waste tax and waste disposal charges currently average DKr 485-585 per tonne for landfilling and DKr 410-560 for incineration. The revenue generated by waste taxes and charges are roughly equivalent. Disposal costs for ordinary hazardous waste average DKr 2 500 per tonne, but can reach DKr 25 000 per tonne for certain types.

Total public *expenditure on waste management* amounted to DKr 604 million in 1996, up from DKr 502 million in 1990 (Table 6.3); municipalities, counties and the national government contributed about 45, 25 and 30 per cent respectively. There are no data concerning private expenditure on waste management.

Denmark's *deposit and refund* system for beer and soft drink bottles ensures a return rate of 99.5 per cent. *Taxes on packaging* for beverages, which support

reuse and penalise the use of throw-away containers, range from DKr 0.15 to 3.20 per container. Paper and plastic carrier bags, as well as disposable tableware, are also taxed (Table 6.6). *Charges* are increasingly used as an incentive in take-back agreements, for instance for lead and nickel-cadmium batteries and tyres.

Contaminated sites

Contaminated sites became a major environmental concern in Denmark in the late 1970s. Systematic identification and evaluation was initiated in 1982; the *Contaminated Sites Act* was adopted in 1983 to deal with cases where contamination had occurred before implementation of the 1973 Environmental Protection Act, which applies the polluter pays principle. A register of contaminated sites was established in 1990, and the problems caused by site contamination were believed to be largely under control. By the mid-1990s, however, it became apparent that the number of sites and the contamination problems had been underestimated. The current Contaminated Sites Act, amended in 1996, makes county authorities responsible for the management and remediation of orphan sites contaminated before 1974. In 1994, the Ministry of Environment and Energy established a Soil Contamination Committee to review the situation and examine the shortcomings of existing legislation, notably for orphan sites contaminated since 1974, for which no funding is provided. Municipalities have had to cover clean-up costs in some cases. In addition, current legislation addresses certain types of contamination (such as airborne) but does not provide for liability in cases where there is no proof of fault or neglect. As a result, an amended Act has been drafted and is due to be presented to Parliament in 1998.

Some 37 000 sites have been identified as potentially contaminated, and the *total number of potentially contaminated sites* is estimated at 40 000. About 4 900 sites need cleaning up either because they are located in areas that can affect water supply or because of land use requirements. There were 3 673 contaminated sites on the register at the end of 1996, with old landfills accounting for 42 per cent. Some 773 sites had been cleaned up, one-third with public funding, which reached DKr 345 million in 1997. Some 16 per cent of sites have been cleaned up under an agreement between the oil industry, the Danish EPA and county authorities concerning service stations closed before 1995, whose clean-up costs are supported by a fund created by the oil industry. Oil companies operating in Denmark have agreed to contribute DKr 0.05 per litre of gasoline sold to the fund, which raises DKr 125 million annually. In addition, a fund established by the 1992 Act on Value Loss contributes about DKr 70 million towards paying clean-up costs incurred by individuals who own family houses on contaminated

land. Due to additional funding, the budget available increased from DKr 50 million to DKr 70 million between 1997 and 1998.

5. Environmental Performance

Chemical products

Denmark has established a *comprehensive system for the safe management of chemical products* which involves a mix of regulatory actions, voluntary agreements and economic incentives. The early policy approach targeted *chemical substances* about which there were human health and/or environmental concerns with specific risk reduction measures. This approach has been largely successful, especially when these measures have addressed specific uses, notably in the case of heavy metals such as lead, cadmium and mercury. Similar measures have been employed successfully in phasing out other substances such NPEOs in detergents.

To ensure that human health and environmental concerns are addressed when *new chemical substances* come onto the market, a new chemicals notification system is in place which works well and is in line with EU requirements. However, Denmark is not a large chemical manufacturer and has inevitably focused increasing attention on the estimated 20 000 *existing chemical substances* in products on the market which have not yet been addressed from an environmental health and safety perspective. No single country, especially a relatively small one like Denmark, can tackle this large number of substances on its own. Consequently, Denmark has always sought to *work co-operatively with other countries* through appropriate international fora such as the EU and the OECD.

However, Denmark has not relied solely on international efforts and has made *important contributions through developing its own mechanisms for setting priorities* to deal with existing substances, most notably the List of Undesirable Substances. This list of priority substances for future action (such as measures to reduce use or promote substitution) has certain important features. It is a mechanism by which substances of concern can be signalled to industry, thereby acting as an early-warning signal concerning those which may be subject to future measures. In addition, it is flexible in that substances can be selected in a systematic way or simply because they have been identified as problematic. The PROBAS chemical product database plays a central role in maintaining the List of

Undesirable Substances as well as in other initiatives; it is important that this database remains adequately financed, so that it can be continuously updated.

Denmark has taken a broad range of measures to control pesticides, largely due to concern about groundwater contamination (Chapter 2). The main objectives of the *1986 Pesticide Action Plan* have been met, i.e. reduction of total pesticide consumption by 25 per cent by 1990, followed by a further 25 per cent reduction by 1997, and promotion of less harmful products. In addition, the *pesticides approval programme* has been improved: the Danish EPA has reassessed 209 active ingredients in the last ten years, of which 29 have been prohibited or are strictly regulated. In 1993, these prohibited substances accounted for 25 per cent of the total quantity of active ingredients intended for agricultural purposes.

Reduction of pesticide use has relied on a broad range of economic, regulatory and information measures. Sales of active ingredients have fallen throughout the period of the Action Plan (Figure 7.3). Agriculture's share in the total quantity of active ingredients is 90 per cent, while the reduction in agricultural consumption amounts to about 40 per cent. However, much of this reduction has been due to a decrease in the amount of arable land in crop rotation and increased use of low-dose pesticide products. Treatment frequency has remained largely unchanged and the target of halving it by 1997 has not been met. It is not clear how effective some of these general measures have been, particularly as they do not target those products of most concern.

Waste management

Until the late 1980s, the emphasis of waste management policy was on ensuring appropriate *collection and disposal of waste*. A comprehensive set of regulations was established to closely manage the operation of the different waste streams and control the activities of the various operators involved; efficient collection and disposal systems were set up and unlawful disposal became very uncommon. Since then, attention has turned to ways of actually *reducing the amount of waste to be disposed*, notably through reuse and recycling. To that end, regulations have been supported and complemented by economic instruments and voluntary agreements.

This policy has been largely successful. The objectives of the 1993-97 Action Plan for Waste and Recycling were met ahead of time (Table 4.2). There has been a substantial reduction in landfilling since the mid-1980s: 20 per cent of waste was landfilled in 1996, down from 39 per cent in 1985. While the amount of waste incinerated increased from 2.3 million tonnes in 1985 to 2.5 million tonnes

in 1996, only 19 per cent of waste was incinerated in 1996 compared with 26 per cent in 1985. Over the same period recycling/reuse more than doubled, accounting for 60 per cent of waste disposal in 1996, a figure already above the 54 per cent target set for 2000. In particular, recycling rates for building and construction waste reached 89 per cent in 1996, as the waste tax provided the needed incentive to use new technologies such as selective demolition and pulverisation on a large scale. Recycling rates for household waste have also substantially increased. Paper and cardboard and waste food from industrial kitchens have been successfully collected and recycled, largely because their collection and recycling was made mandatory. Almost all garden waste is composted. Denmark has already met the overall target for recycling/reuse/incineration with energy recovery set by the EU directive on packaging and packaging waste, as well as the overall target for material recovery. The 15 per cent target for material recovery has been met for glass and steel containers and for paper and cardboard packaging, though not for plastic packaging, which is still mostly incinerated.

There is nevertheless room for *further progress on reducing landfilling and increasing recovery, reuse and recycling*. The recent ban on landfilling waste that can be incinerated is an ambitious one, as some 15 per cent of household waste was still landfilled in 1996. It is in the area of household waste that recycling needs to be increased in order to meet targets, for instance for paper and organic waste. Several pilot projects are testing the technical feasibility of making biogas from a combination of green household waste and manure, which is considered to offer the best opportunity to increase the recycling rate of household waste, at a cost of about DKr 300 per tonne. There is also a need to reduce landfilling of waste from industry, which still amounts to 31 per cent of waste generated.

Recent data show a continuing increase in generation of all categories of waste. Though part of this increase can be attributed to improved data reporting (and, in 1996, to larger quantities of coal ash due to increased electricity exports), there is *not a trend towards reducing waste generation at source*. The Action Plan forecast that waste generation would increase until 1997 and then stabilise until 2000. It seems unlikely, in the absence of new measures aimed at waste reduction, that such a stabilisation will be observed, particularly if the Danish economy continues to grow as it has in recent years, largely driven by buoyant private consumption (Chapter 1). A strategy for waste reduction at source is needed for such growth to be environmentally sustainable. Such a strategy would include economic instruments, green accounting and environmental management systems, as well as licensing procedures, and would also aim at strengthening waste management in order to improve the quality of the waste still being generated.

Danish *waste taxes* produce an annual revenue of about DKr 900 million and are among the highest applied in OECD countries: they more than double the cost of landfilling and increase that of incineration by 70 per cent, providing an incentive to reduce the amount of waste being landfilled or incinerated and to increase recycling and reuse. However, the flat rate used for waste charges by most municipalities tempers the incentive effect of the tax for waste producers. If all private waste producers paid waste and packaging charges and taxes on a weight basis, further progress in recycling or reuse, as well as waste reduction at source, would be possible.

Waste reduction will also need to rely on a new approach to *product policy*, which could not only reduce waste generated but also improve waste quality. Life cycle approaches should be used more systematically, in order to define where waste prevention efforts could be best directed. More generally, such a policy would need to be placed within a *medium to long-term strategy to change production and consumption patterns*. The Cleaner Technology Action Plans have brought about a considerable reduction in water consumption and industrial waste water discharges, and they have contributed to strengthening the competitive position of Danish industries. It is hoped that further plans can successfully address the issue of cleaner products, notably through the development of an Environmental Product Policy.

Awareness of the problem of contaminated sites appeared as far back as the late 1970s, and legislative and regulatory action followed soon after. Today, close to 1 000 of the estimated 40 000 contaminated sites have been cleaned up. The amended Contaminated Sites Act should close any remaining regulatory loopholes and ensure that progress in cleaning up all types of contaminated sites can resume. The funding of clean-up measures for orphan sites currently relies on annual appropriations in the national budget. In order to ensure that the clean-up of these sites is provided for in the longer term, it would be useful to consider other funding sources, such as earmarking revenue from the waste tax for this purpose.

5

NATURE CONSERVATION

1. The State of and Pressures on Nature

Status and trends

The Danish landscape was mainly formed during the *last glaciation*, which at its greatest extent covered the islands and half of Jutland. When the ice receded about 12 000 years ago, plant and animal life migrated from the European continent and a tundra ecosystem evolved, limiting the landscaping forces of water and wind erosion. As the climate became warmer, the land ecosystem gradually turned into virgin nemoral forest dominated by deciduous trees. By the start of the nineteenth century, most of the forest area had been cleared and only 2 per cent of the country was under forest cover.

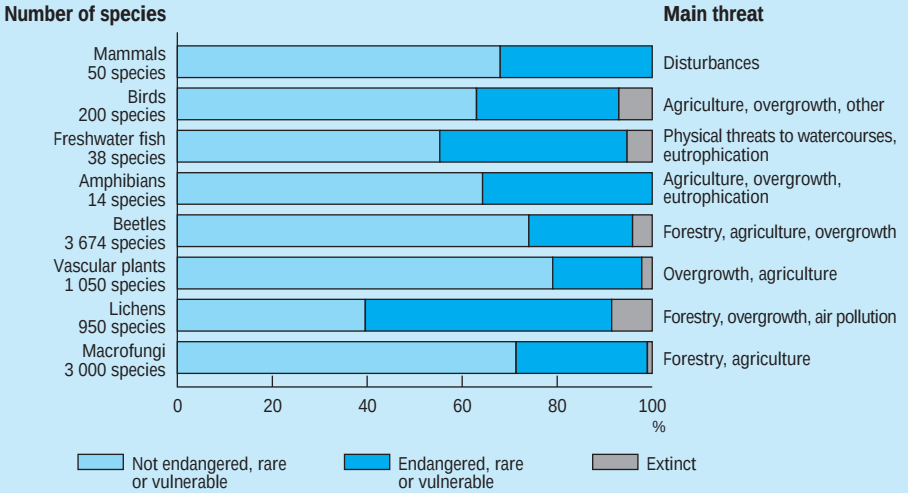
Biodiversity

In Denmark, there are 50 species of mammals, 200 species of birds, 38 of freshwater fish and 14 of amphibians; there are also 1 050 species of vascular plants, 950 of lichens and 3 000 of macrofungi (Figure 5.1).

Including insects, about 30 000 native, introduced or adventive *species of animals and plants* have been recorded. Apart from naturalised species, more than 20 000 other plant species are found in gardens and parks and on agricultural land. There are no endemic Danish species.

Status reports on Danish flora and fauna have been prepared at regular intervals over the last 20 years. The Danish *Red List (Red Data Book)* was reissued in 1998; according to this new version, Denmark has 625 species classified as endangered, 1 011 as vulnerable and 1 141 as rare. Three hundred forty-nine species have become extinct in Denmark since 1850 (Figure 5.1). Given that

Figure 5.1 **State of fauna and flora,** 1997



Source: Ministry of Environment and Energy; National Forest and Nature Agency.

Denmark has about 580 species of mosses, a special moss Red List is under preparation. No Red List has been prepared for algae.

Terrestrial habitats

As a result of gradual deforestation, sheep grazing and climate change, by the eighteenth century the sandy, low-nutrient soil in Jutland had turned into vast *heaths* covering almost half the peninsula. Today some 95 per cent of the heath area has been lost, leaving a remnant of 80 000 hectares. About one-fifth of the former health area is now forested, while the major part has been cultivated.

Meadows and uncultivated dry grassland are, like heaths, predominantly semi-cultural habitats that evolved mainly as the result of agriculture. Between 70 and 90 per cent of these habitats has been lost over the last 100 years, while the approximately 50 000 hectares remaining are in many cases threatened by over-growth, as grazing and hay harvesting on marginal land are less and less practised.

Public and private re-afforestation have increased the *forest area* to 420 000 hectares, or about 10 per cent of the total land area. Today untouched forests make up less than 1 per cent of the forested area and natural forests, i.e. self-sown forests of native trees (mainly beech and oak), less than 10 per cent. For reasons of production, forest plantations are largely composed of non-native species, especially conifers. Only about one-third of the forests are broad-leaf. Forests generate revenue of about DKr 1 billion annually from wood, Christmas trees and greenery. Annual yield amounts to 2 million cubic metres, of which two-thirds from conifers. Foundations and associations own about a quarter of forest land and private individuals nearly half; the remaining quarter is in public ownership (80 per cent belonging to the State, and 20 per cent to local communities and the Church).

Denmark is characterised by its extensive coastline (about 7 300 kilometres) and numerous islands (over 400). Due to the action of sea and wind, some of the most dramatic natural sites are coastal. In a few cases the *coast* consists of sedimentary rock, such as at Möns Klint, or igneous rock, such as on Bornholm Island, though quaternary deposits constitute the major part. Six per cent of the coastline is affected by dikes or included in harbour areas. *Tidal flats* are very important as resting and foraging areas for water birds. The Wadden Sea covers 10 000 km^2 of the shallows and tidal coasts that stretch from Den Helder in the Netherlands to Blåvandshuk in Denmark. Many rare species of plant also grow in the coastal zone. Denmark has over 10 per cent of European *dune areas*; they make up 3 per cent of Denmark's total land area and include a large part of the remaining north-west Atlantic dune heath. They are among the best preserved, even though one-third are affected by forest plantations, summer cottages, camp sites and other tourist facilities.

Aquatic habitats

Since the middle of the eighteen century, the number and size of *lakes* have been reduced by lowering their water levels and draining them. New lakes have also been formed, for instance through damming or, in recent years, restoration. The total area of lakes over 10 hectares covers less than 1 per cent of Denmark's land area, and only 71 lakes are over 100 hectares. About half the total lake area has brackish water; about 95 per cent of lakes are eutrophied. The clean lakes are pondweed lakes (naturally eutrophic) and lobelia lakes (oligotrophic), both exhibiting a rich variety of species, and dystrophic lakes.

All Danish *watercourses* have been affected by human activities such as water withdrawal, wastewater discharges and physical modification (channelling, culverting, drainage and damming). Since 1989, the counties have restored some

57 kilometres of watercourses in order to meet watercourse quality objectives (Chapter 2). The share of *marshes* in the countryside has gradually fallen from about 25 per cent in 1800 to 1 or 2 per cent today, as a result of draining and peat cutting.

Danish *open sea and coastal waters*, which are in the transitional area between the salt water of the North Sea and the brackish Baltic, can be said to constitute a large estuary. Living conditions for plants and animals are difficult, as salinity can vary considerably over short distances as well as over time. Of the total sea area of about 105 000 km^2, 40 per cent is less than 30 metres deep. Danish waters are of great international ecological importance as a resting place during migration and a winter refuge for aquatic birds. Millions of birds, including a substantial part of the total population of species such as the brent goose, common scoter and red-throated diver, use Danish waters in the cooler half of the year.

Pressures on ecosystems and biodiversity

The major threats to endangered species in Denmark are agricultural practices, overgrowth and forestry practices (Figure 5.1). Eutrophication is also a significant threat, especially for aquatic species.

Modern *agriculture* has increased field size, affecting small biotopes, especially wet biotopes: within the last century the total length of open ditches and small watercourses has fallen by 90 per cent, and 40 per cent of dikes and hedgerows have disappeared. Small biotopes such as hedges, ponds and small wetlands have almost disappeared in many parts of eastern Denmark. The population size of many animal species that live in the open countryside (e.g. hares, partridges and lapwings) has declined markedly. The greatest decline has been in wetland species, as about half of present agricultural land has been drained. The widespread use of pesticides has a detrimental effect on wild plant and animal life, affecting not only targeted pests but also many species of insects and micro-organisms. However, there has been some recent improvement; with the introduction of general habitat protection between 1972 and 1992, habitat loss due to agriculture has more or less stabilised though a recent study indicates further loss of ditches and small bogs. The total length of hedgerows is increasing, often with indigenous trees and bushes. Nature management measures include artificial ponds and other wildlife habitats. The area of winter wheat fields has substantially increased since the early 1980s (Chapter 7).

Massive *nutrient leaching* from agriculture has altered biodiversity in watercourses and lakes, many of which do not meet ambient quality objectives (Chapters 2 and 7). A loss of marine biodiversity and an increase in biomass have been observed in the open sea since 1980, probably due to nitrogen discharge. Algal blooms, mass occurrence of macroalgae and local oxygen-free conditions have also been observed more frequently in coastal waters in recent years.

Overgrowth caused by reduced grazing and hay harvesting is the major recent threat to *semi-cultural habitats* such as meadows, uncultivated dry grassland and heaths. Fertilisation often affects small biotopes adjacent to open fields. Lowering of the water table is also a general problem, affecting lime-rich orchid fens in particular. Damage to lichens and immigration of grasses have been observed on heaths and in other habitats on oligotrophic soils, due to nitrogen deposition from air pollution.

Modern *forestry* methods have reduced the number of old, dead or dying trees. Dead wood is of vital importance as a habitat for a number of birds, bats, insects, fungi, etc. About 1 300 forest plant and animal species are red-listed owing to the decline of natural forests and to intensified forestry. To some extent, more nature-oriented forestry cultivation methods, such as self-sowing, and stands with several species or different ages, are used. However, clear cutting normally occurs, even in natural forests. Growing of non-native coniferous trees is widespread, with the result that in certain areas (especially where there are low-nutrient soils) there are significant problems of forest health and stability.

Despite large reductions since 1980, *acid deposition* exceeds critical loads for nitrogen over most of the country. Raised bogs, inland heathlands and coniferous forests are particularly affected. Between 1987 and 1996, the number of trees with over 25 per cent leaf or needle loss rose from 23 to 37 per cent.

Urban development, *transport infrastructure* and summer cottages have claimed large areas of open countryside in the last 50 years, mainly before 1970. Built-up areas grew from 144 300 hectares in 1951 to 354 000 hectares in 1995. In addition to being lost, habitats have been split, fragmenting the landscape and disturbing animal life.

Some 170 000 Danes experience nature through *hunting*. In recent years the annual game bag has been about 3 million birds and mammals. About one-fifth of red-listed birds, but none of the red-listed mammals, are considered affected by hunting practices. Poaching is not regarded as a problem. *Commercial fishing* practices, such as bottom trawling and mussel dredging, injure plant and animal

life on the sea bed and probably threaten perennial seaweed growth. Fishing nets are a threat to sea birds and especially to porpoises.

In the 1990s, the rate of growth of Danish tourism has been among the highest in Europe. Increasing *recreational pressure* on coastal areas has affected dunes and dune heaths, where frequent rambling destroys lichen vegetation. As they are vulnerable to disturbances, some birds have been forced away from foreshores, though recreational pressure is not considered a major threat to red-listed species.

2. Responses

Objectives

Overall objectives are formulated within the Nature Protection Act and other acts, conventions or EU directives. In 1995, the Ministry of Environment and Energy published *Biological Diversity in Denmark, Status and Strategy*, with targets for all major ecosystems. Further important objectives have been adopted within the Action Plan for Conservation, the Strategy for Sustainable Forestry, the Strategy for Natural Forests and Other Forest Types of High Conservation Value, and the Circular on Planning and Administration of Coastal Areas. The 1991 Action Plan for Sustainable Agriculture does not focus on biodiversity concerns.

Quantitative targets are rarely used at the national level. However, targets have been set for:

- *natural forests and forests with traditional management* regimes: 9 000 hectares by 2000, and 40 000 hectares by 2040;
- restoration of *coastal meadows, lakes, fjords and dune areas*: 40 000 hectares by 2025; and
- *doubling the forest area* in one tree generation (80-100 years), implying an average annual afforestation of 4 000-5 000 hectares.

More specific and short-term targets are set by County Councils as part of the regional planning process, within the context of *national guidelines* issued by the Minister of Environment and Energy.

Legislative and institutional framework

Legislative framework

The 1992 *Nature Protection Act* (amended in 1997) provides four main instruments for nature protection, management and restoration:

- *general habitat protection*, which now includes a number of non-forested natural and semi-cultural nature types (Table 5.1);
- *protection zones* along coastlines (100-300 metres deep) as well as for beaches, streams, lakes and ancient monuments (prohibiting almost all changes to their natural state) and around forests and churches (prohibiting building);
- *conservation orders* and regulations;
- *land acquisition* of areas important for nature conservation; *management* of privately owned protected areas; land acquisition of areas for nature restoration and afforestation; and subsidies and loans for agreements on nature restoration and afforestation.

This Act also contains provisions concerning protection of animals and plants, prohibition of billboards and a permit system for pylons and major roads, as well

Table 5.1 **General habitat protection**

Habitat [a]	1972	1978	1981	1991	Area 1996
Lakes	all natural lakes	all > 0.1 ha	all > 0.05 ha	all > 0.01 ha	56 700 ha
Watercourses	public watercourses	public + private	public + private	public + private + 2m zones	28 000 km
Bogs		> 0.5 ha	> 0.5 ha	> 0.25 ha	89 900 ha
Salt marshes, moors and coastal meadows			> 3 ha	> 0.25 ha	43 600 ha
Heaths			> 5 ha	> 0.25 ha	82 000 ha
Humid permanent meadows				> 0.25 ha	103 700 ha
Uncultivated, dry grassland				> 0.25 ha	26 000 ha
Stone walls and dikes				all	unknown

a) Hedgerows, field barriers, ditches, scrub and small plantations are not protected.
Source: Ministry of Environment and Energy; National Forest and Nature Agency.

as regulations on *public access to nature* in public and private areas such as beaches, forests, uncultivated land and dune conservation areas.

State Forest Districts and County Councils have a duty to manage areas under general habitat protection. The *Forest Act* aims to preserve forests, improve forestry productivity, apply the principle of multiple-use forestry, protect all forest habitats and enlarge the afforested area. According to the *Raw Materials Act*, permission to extract raw materials on land or at sea must be obtained from the authorities. The *Hunting and Game Management Act* concerns the preservation and sustainable use of bird and mammal populations.

Institutional framework

The Ministry of Environment and Energy is responsible for legislation concerning nature protection, physical planning, forestry, hunting and raw materials. The *National Forest and Nature Agency* (SNS) is the main implementing agency, with a total staff of 1 650, of which about 190 specifically deal with nature protection issues. About 300 people are employed in its central office in Copenhagen and 1 350 in the *25 State Forest Districts*, which are responsible for State Forest management, nature management, nature restoration and afforestation. SNS provides information to private forest owners and administers subsidy schemes for multiple-use forestry. Information and public awareness have a high priority in Denmark; the SNS co-ordinates the Environmental Interpreter Service, which is well known to the Danish public. Nature conservation orders are issued by the SNS as well as by regional *Nature Conservancy Boards* consisting of representatives from national, county and municipal authorities.

The *14 County Councils* have important responsibilities in the field of nature protection. According to the Planning Act, regional plans should include guidelines for nature protection, ecological corridors for flora and fauna, and location of afforestation projects. County Councils administer zoning provisions and a number of the permits required in rural zones, according to the Nature Protection Act and Raw Materials Act. Other important tasks include nature monitoring and management, within and outside protected areas, and nature restoration. In State-owned areas and in those acquired by the State for nature restoration, the State Forest Districts are responsible for nature management and restoration.

More than 60 ‘‘eco-schools’’ are operated by *municipalities*, or by the SNS in co-operation with municipalities, to give children better opportunities to learn about nature outside the normal teaching framework. Half the eco-schools are situated in State Forests such as Vest-skoven, Denmark’s first peri-urban State

Forest plantation (5 800 hectares), which was established in 1967 near Copenhagen.

Environmental *NGOs* play an important part in nature conservation at both national and local level, where the many local committees gather detailed knowledge and information on nature conservation. Like the Nature Conservation Board, the Danish Society for the Conservation of Nature, which has about 250 000 members, can propose an area for conservation, a process subject to public hearings. Since 1983, it has initiated the conservation of 112 areas covering 34 000 hectares. The Danish Society for the Conservation of Nature, NGOs and members of the public (concerned by a development subject to an EIA or a case covered by the Nature Protection Act, Forest Act or Planning Act) can appeal to the *Nature Protection Board of Appeal* (Chapter 6).

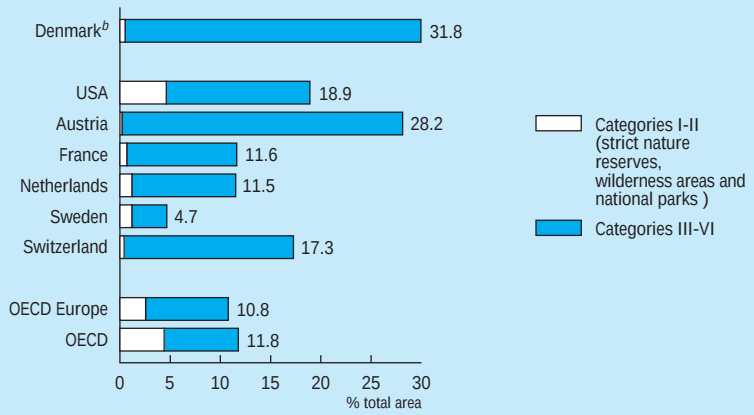
Protected areas and species

Much of Denmark is under some form of protection (Figure 5.2). *General habitat protection* covers most essential nature types (except forests), accounting for 10 per cent (430 000 hectares) of the land area (Table 5.1). Over 1 800 *conservation orders*, partly overlapping with general habitat protection and managed mainly by counties, account for 4 per cent (182 500 hectares) of the total land area. Along *coastlines*, 100 metre wide protection has been in force for some time; this is being extended to 300 metres. There are *no national parks* in Denmark; a small percentage of protected areas fall into IUCN categories I and II (Figure 5.2). In the 1992 Action Plan for Conservation, it was found necessary to increase the priority given to nature protection in general and to provide new guidelines for future efforts. According to this plan, new conservation orders should normally be developed during the regional planning process and used only i) when valuable areas are threatened and ii) when other measures such as physical planning, voluntary agreements or subsidies prove insufficient.

A network of 93 *nature and wildlife reserves* (285 480 hectares at the beginning of 1998) has been established to protect and develop game populations, and to preserve resting and foraging areas for migratory birds. Wetlands make up more than 90 per cent of the reserves, often referred to as ‘‘hunting and other disturbance-free core zones’’. The establishment of 50 more reserves is planned by 2000, especially in coastal zones and fjord areas within coastal EU bird protection areas and Ramsar sites.

The main strategy for protecting endangered species is habitat protection, supplemented by *individual species protection*. According to the Hunting and

Figure 5.2 **Major protected areas,**[a] 1996



a) IUCN management categories, includes only areas above 10 km^2. National classification may vary.
b) Excludes Greenland, which has one national park of 972 000 km^2.
Source: IUCN; OECD.

Game Management Act, all bird and mammal species for which no hunting season is specified are protected. Freshwater and sea fish are protected by general provisions (minimum size, protected seasons, etc.) in the Freshwater Fisheries and Sea Fisheries Acts; protection of other animal groups and plants is governed by the Nature Protection Act. All reptiles and amphibians are protected, as are 70 species of vascular plants and 11 species of invertebrates. Species management plans are being prepared for otter, pink-footed goose and the continental cormorant, as well as for amphibians and reptiles.

International conventions and co-operation

Denmark has designated *27 Ramsar sites* covering 7 400 km^2, a higher percentage of its total area than any other country. As a follow-up to the EU bird protection directive, it has also designated *111 EU bird special protection areas (SPAs)* covering as much as 9 800 km^2, which are given general protection under a special executive order. Within the partly overlapping Ramsar and SPA areas, 93 core areas have been declared nature and wildlife reserves. Denmark has

proposed 201 sites (covering 2 500 km^2, or 5.8 per cent of the total land area of the country) as Natura 2000 areas according to the *EU habitats directive*. The European Commission considers the Danish national list substantial. Denmark's total protection of a number of plants and invertebrates has meant that it has fulfilled its obligations in this respect in relation to the *Bern Convention* and the EU habitats directive.

Protecting the Wadden Sea area is a joint task of the Netherlands, Germany and Denmark. The Eighth Trilateral Governmental Conference on the Protection of the Wadden Sea was held in October 1997, confirming the *Trilateral Wadden Sea Plan* with targets relating to several environmental subjects. An evaluation of protection measures in the Danish part of the Wadden Sea indicates increasing populations of several species and a number of areas for improvement, e.g. pollution prevention, new hunting regulations, and control of blue mussel culture lots and of air traffic.

Denmark has played a significant part in establishing and developing the *Convention on Biological Diversity* and has published its own strategy (the 1995 ''Biological Diversity in Denmark, Status and Strategy''). It actively contributes to the Washington, Ramsar and Bonn Conventions and works to ensure that the Convention on Biological Diversity plays a co-ordinating role in relation to these earlier agreements. Other priorities include promoting the Bern Convention and working within the EU for the appropriation of more funds for nature restoration. As required by the *Washington Convention*, Denmark has banned imports and exports of products from a number of endangered species.

Off-reserve management

Biodiversity is not a priority in *agricultural policies*, and agri-environmental measures are used to only a limited extent to enhance nature protection and biodiversity. These measures reward farmers who go a step further than the environmental regulations imposed on farming practices in the sensitive farming areas (SFAs) sites designated by counties, which cover 13 per cent of agricultural land (Chapter 7). Some counties have excluded from SFAs those areas already protected by conservation orders and have included other areas of high environmental interest; others have included protected areas in order to provide financing for SFA management. A third of SFAs (120 000 hectares) is fully or partly covered by the EU bird protection directive.

Natural forests are mainly protected by internal State forest conservation regulations or by agreements with private land owners, as laid out in the Forest

Act. In 1997, 4 500 hectares of untouched forest (0.1 per cent of total land area) were regarded as protected, while traditional management systems such as selective felling, coppices and grazing forests were established in over 8 600 hectares of natural forests (or another 0.2 per cent of the land area). Deforestation is prohibited in most private forests and in all State forests. Economic incentives are partially aimed at nature protection and include State subsidies for sound *multiple-use forestry*, for instance through planting of broad-leaved species.

State ownership and acquisition of areas of high biological interest are regarded as useful tools for use in large nature restoration and afforestation projects. The SNS manages 180 000 hectares of State forests, nature sites, lakes and arable land, including many areas of biological interest. Two-thirds of State forests are wooded and managed through multiple-use forestry, with the remainder, such as lakes, meadows and heathlands, in the open countryside. Since the early 1970s the SNS has acquired a number of areas and sites of national and recreational interest, where nature restoration projects have been completed since 1989.

The need for and interest (both public and private) in *nature restoration* are high. Restoring destroyed ecosystems is regarded as contributing to the protection and increase of biodiversity. A number of lakes, coastal meadows, humid permanent grasslands, bogs, watercourses, uncultivated dry grasslands and heaths have been restored since 1989. About DKr 1 230 million was spent for this purpose between 1989 and 1997.

Expenditure on nature protection

National government expenditure for nature protection totalled DKr 275 million in 1996, or about 2.6 per cent of public environmental expenditure (Table 5.2). In addition, total *expenditure by County Councils*, including on nature protection, restoration and compensation, rose from DKr 57.6 million in 1993 to DKr 80.8 million in 1996. Relatively limited funds are administered by the Ministry of Food, Agriculture and Fisheries as direct payments for environmentally friendly farming (DKr 80 million of direct payments in 1997) and for planting windbreaking hedgerows (DKr 20 million in 1997) (Chapter 7).

Private expenditure plays only a minor role in nature conservation and is essentially devoted to joint venture nature restoration projects. It amounted to a total of DKr 7.6 million between 1989 and 1996. Other private expenditure

includes that on information activities and on species protection projects run by non-governmental organisations.

Table 5.2 **Public expenditure[a] for nature protection**

(million DKr)

	1993	1994	1995	1996
National government expenditure:				
Nature protection[b]	37.9	67.8	70.4	59.4
Acquisition and nature restoration	22.7	35.7	33.7	33.4
Compensation	8.3	9.5	6.2	18.4
Administration – Nature Protection Act	47.7	43.8	46.0	50.6
Administration – Hunting and Game Management Act	42.9	49.2	64.1	64.5
Subsidy scheme for forest care	0.2	1.2	4.1	9.3
Subsidy scheme for broad-leaved forest	6.4	8.6	15.0	21.0
Nature Protection Board of Appeal	16.9	16.4	17.6	18.3
Total national government expenditure	183.0	232.2	257.1	274.9
County expenditure	57.6	69.1	70.0	80.8

a) At current prices.
b) Management of state-owned areas included.
Source: National Forest and Nature Agency.

3. Environmental Performance

Mankind has influenced biodiversity heavily in Denmark over the centuries, and there are almost no virgin ecosystems left. However, over the last decades the country has developed and implemented an extensive legislative and regulatory framework for nature conservation in an effort to stop habitat loss and improve the conditions for biodiversity. Even though the downward trend has been slowed and in some respects reversed, there is a great need for further efforts concerning nature restoration and biodiversity recovery. Current nature conservation policy relies on an essentially decentralised and ad hoc approach, which needs to be reviewed and formulated as an *action plan for nature conservation* in the context of the 1995 biodiversity conservation strategy. This action plan

would include objectives and targets for the protection, restoration and management of areas of national ecological interest, as well as for species management and conservation of biodiversity.

Habitat protection

Ten per cent of the Danish land area, covering almost all essential nature types, is effectively protected by *general habitat protection* under the Nature Protection Act. Including areas designated for other forms of protection (e.g. conservation orders, protection zones along coastlines, Ramsar sites, EU bird and habitat directives), *protected areas cover a very large part of the country*. However, no precise survey has been carried out that could provide accurate figures and a full assessment of the level of nature management and landscape protection. With little wilderness, most of the areas protected in Denmark are semi-natural. Protection has aimed at maintaining an ecological balance in often highly humanised habitats; in particular, it has benefited habitats such as hedgerows which are extending their area and has also limited habitat loss due to agriculture and infrastructure development.

The proportion of protected areas in IUCN categories I or II is small. As a complement to general habitat protection in semi-natural areas, and as a further step towards preserving important natural habitats, the authorities should investigate the possibility of *establishing national parks*, which could include some of the most valuable coastal ecosystems such as tidal flats, dune areas, cliff coasts and heaths. The importance of ecological networks is well recognised, and Denmark makes great efforts to contribute to the international networks of protected areas (e.g. Ramsar sites, Natura 2000). However, ambitious domestic efforts at county level would be more effective if they were supported by a *national ecological network concept*.

Denmark has only recently undertaken to extend the conservation of *marine areas*. The recently adopted statutory order provides for a significant level of conservation, despite the possibility of exemptions in some cases. Such efforts need to be sustained, while the integration of biodiversity concerns in fisheries policy should be improved.

At the national level, there is a lack of *accurate and systematic information on land use and land use changes*. Without national *comprehensive area statistics* for all types of protected areas, it is difficult to obtain an overall view of protected habitat areas in Denmark. Monitoring of changes in habitat quality and species richness is generally not well developed.

Nature conservation outside protected areas

There is considerable scope for improving the integration of environmental concerns in *agricultural policies* (Chapter 7). Many *freshwater ecosystems* and some coastal waters are affected by eutrophication and massive inflows of nutrient run-off from agriculture. In many protected semi-cultural habitats, nature and landscape management concerns are mostly absent from agricultural practices, including grazing and hay harvesting.

Since a very large part of Denmark's red-listed species are mainly threatened by forestry, *protection of natural forests* urgently needs to be enhanced and all remaining stands of untouched forest should be protected. In addition, more could be done to meet the target for natural forest area earlier than 2040. State Forest Districts and County Councils should improve their co-operation on nature management. The co-ordination of different *nature protection measures in forests* should be improved.

Species management

The Danish Red List shows that 625 species are endangered, 1 011 vulnerable and 1 141 rare; in addition, 349 species have become extinct since 1850. For a few species, such as the fire-bellied toad and the Alpine newt, efforts to re-establish suitable habitats together with breeding and *re-introduction programmes* have been successful. Re-introduction programmes could be used for larger groups of extinct and other red-listed animals and plants.

Because its coastal landscapes, archipelagos and shallow waters are of international importance for many bird species, Denmark has designated a comprehensive *network of Ramsar sites and EU bird SPAs*. A network of core areas is particularly well protected as wildlife or nature reserves with hunting bans. Nevertheless, the Hunting and Game Management Act allows a small number of wader species to be hunted outside reserves.

Conservation of biodiversity

Denmark plays a significant role in *international efforts to conserve biodiversity*. It has made a considerable contribution to the Convention on Biological Diversity as well as to Pan-European and EU co-operation. The country has ratified most major conventions concerning wildlife and biodiversity, and has

followed up with often ambitious domestic implementation, such as the designation and protection of RAMSAR sites.

The implementation of the 1995 biodiversity strategy is well under way. As a result, it is increasingly apparent that the accumulation of *biodiversity knowledge* should be better co-ordinated and that a comprehensive nation-wide environmental monitoring programme should be established.

Restoration of destroyed ecosystems is a key dimension of Denmark's efforts to protect and enhance biodiversity. DKr 1 230 million has been spent on restoring lakes, coastal meadows, humid permanent grasslands, bogs, watercourses, uncultivated dry grasslands and heaths since 1989. The establishment of peri-urban forests and eco-schools is another successful part of these efforts. However, Denmark seems to be falling behind in achieving its *afforestation* objectives. To increase the priority given to re-creation of natural forest ecosystems, more ambitious targets with shorter deadlines should be set for deciduous forest plantations.

The zoning system established in 1970 has successfully limited urban sprawl and preserved rural zones for farming, forestry and nature protection purposes. Considerable attention is being given to coastal landscapes. The *Coast Conservation Commission* is in the process of reviewing coastal areas to define the layout of the new dune and beach protection line, which is expected to extend as far as 300 metres. Such a process should be accelerated, as should implementation of the 300-metre protection zone where appropriate.

Part II

INTEGRATION OF POLICIES

6

ENVIRONMENTAL AND ECONOMIC POLICIES

1. Towards Sustainable Development

Environmentally sound economic development

Economic and environmental trends

Denmark's GDP rose by 39.8 per cent between 1980 and 1996 and by 15 per cent between 1990 and 1996 (Table 6.1). While growth was sluggish in the early 1990s, in recent years (1993-97) it has averaged slightly over 3.3 per cent per year. Over the period 1990-96, *industrial production* has grown by 53 per cent and total primary *energy supply* by 25 per cent, though largely as a result of electricity exports. Energy intensity improved markedly in the 1980s, but has since deteriorated. With a 64 per cent increase between 1980 and 1996, *road traffic* has grown at over one and half times the rate of GDP. *Agricultural production* rose by 26 per cent between 1980 and 1996, and by about 0.5 per cent annually in recent years.

Several *environmental pressures* have been reduced (Table 6.1): emissions of SO_x and NO_x fell significantly between 1980 and 1995; fertiliser and pesticide use has been reduced, particularly in the 1990s; water abstraction has decreased significantly and has levelled off recently. Several other environmental pressures have not been reduced: municipal waste generation has grown more or less in line with economic growth and shows no sign of stabilising; VOCs emissions continued to increase throughout the 1980s and have only been reduced in recent years; CO_2 emissions have increased by 37 per cent since 1990.

These trends suggest a *partial decoupling* of economic growth and environmental pressures. Nevertheless, positive trends in some environmental pressures have not necessarily been translated into proportional improvements in environmental quality, notably at the ecosystem level. This is due to the accumulation of

pollutants leading to high background levels, as well as to the persistence of transboundary pollution.

Denmark still faces a number of *pressing environmental issues* relating particularly to the high growth of *industry, transport and energy supply* and to *agriculture*: for instance, notable acid deposition and nutrient discharges as well as concerns about biodiversity and global issues such as emissions of CO_2.

Institutional integration of environmental concerns

Denmark's *general development objectives* are presented in the 1997 government publication ''Denmark 2005'', which sets out goals for 2005 relating to

Table 6.1 **Changes in GDP and environmental pressures,** 1980-96
(% change)

	1980-96	1990-96
Selected economic trends		
GDP [a]	39.8	15.0
GDP [a] per capita	36.2	12.3
Population	2.7	2.4
Industrial production	17.0	53.0
Agricultural production	26.0	3.0
Total primary energy supply	15.9	25.0
Energy intensity	–17.1	8.8
Road traffic (vehicle-km)	57.8	14.4
Selected environmental pressures		
SO_x emissions	–61.6	–18.5
CO_2 emissions from energy use	15.7	37.0
NO_x emissions	5.4	2.1
Water abstraction	–20.2	–18.1
Municipal waste	36.3	..
Nitrogenous fertiliser use	–23.0	–27.1
Pesticide use [b]	–40.0	–35.1

a) In 1991 prices and exchange rates.
b) 1981-96 and 1990-96.
Source: OECD.

employment, public debt, environment and international action. This document recognises several dimensions of sustainable development, including concerns for future generations' welfare in Denmark and for development in central and eastern Europe and in developing countries. The 1995 white paper on the environment stresses the need for more sustainable agriculture, forestry and fisheries. Although no formal interministerial mechanism has been set up to deal with sustainable development in general, work is done at sectoral level and through environmental planning to translate sustainable development concepts into concrete actions. The Danish *Agenda 21* campaign was launched in 1994 as a joint project between the Ministry of Environment and Energy, the National Association of Local Authorities and the Danish Association of County Councils. Since then, 50 per cent of Danish county and municipal authorities have initiated Agenda 21 projects.

According to a 1993 government circular (known as Circular 31), all bills presented to Parliament which have major environmental effects must include an assessment of their environmental impact. The ministries that prepare a bill or policy proposal presented to Parliament carry out the assessment themselves. They use guidelines from the Ministry of Environment and Energy to establish whether such a *strategic environmental assessment of government bills and proposals* (SEA) is relevant and how it should be completed. A check-list addressing 11 different topics has been drawn up for the preliminary analysis of potential impacts, and impacts are then examined in greater detail in a full assessment. In the 1993/94 parliamentary year, the procedure was applied to 26 per cent of government proposals. This share increased to 77 per cent in 1996/97 (Table 6.2). Of those proposals subject to an assessment, 59 per cent had no major foreseeable environmental effects; 18 per cent had significant effects and were subject to a full assessment. An interim report including examples of SEAs was published in 1994 and the SEA policy is currently being evaluated.

In principle, Circular 31 also applies to the national budget. In practice, it has been difficult to carry out a thorough and full strategic environmental assessment of the budget as such: the budget is a 2 500-page document containing a variety of proposals and bills, many of which have already been assessed under Circular 31. In addition, much of the expenditure associated with the budget is in the form of transfer payments, affecting environmental matters only indirectly. Nevertheless, the government carried out an *evaluation of the environmental impacts of the 1998 national budget*. This interdepartmental project was co-ordinated by the

Ministry of Finance, along guidelines agreed with the Ministry of Environment and Energy. The following criteria were used:

- the budget's contribution to meeting existing targets concerning the main atmospheric pollutants, CO_2, noise, waste, drinking water, pesticides, nature protection, and ecological production in agriculture and in building and housing;
- trends in appropriations between 1990 and 1998 in regard to different areas of environmental protection, including R&D;
- the greening of government operations.

All ministries were required to contribute an environmental evaluation in their area of competence. A summary report prepared by the Ministry of Finance was followed up by a seminar in May 1998 to consider the lessons learned and how the evaluation procedure could be improved, which should be applied to future budgets.

The green tax reform adopted in 1993 has made it possible to initiate a major effort to integrate environmental concerns in *fiscal policies* over several years. It is also playing a central part in sectoral integration, as it has a significant effect on policy choices in a broad range of economic activities and policy areas, notably transport, energy, agriculture and industry.

The integration of environmental and sustainable development considerations in areas such as *development assistance and foreign affairs* has been

Table 6.2 **Strategic environmental assessments of government bills,** 1993-97

Parliamentary year	Total number of bills	% of total bills		
		No assessment of environmental effects	No major environmental effects	Major environmental effects and full assessment
1993/94	261	73	14	13
1994/95	254	54	26	20
1995/96	264	31	52	17
1996/97	273	23	59	18

Source: Ministry of Environment and Energy.

facilitated by Denmark's commitment to leadership in international environmental diplomacy (Chapter 8). *Defence* also has a well established, comprehensive environmental policy and management.

With the publication in 1997 of the report on a *Structural Monitoring Framework* for Denmark, the government initiated an extensive survey of Denmark's international position covering all areas of economic activity and welfare, including the environment. The framework, developed as a joint effort involving seven government departments, should be regularly updated. It examines the relative strengths and weaknesses of Danish performance in relation to both domestic policy objectives and the situation in other OECD countries. The rationale for this exercise is to monitor world developments and ensure that Denmark's policy objectives and achievements are in line with those of its trading partners, as well as with its overall objective of becoming ''a pioneering country at international level''. In regard to environment, performance is based on an assessment of 16 different areas. For almost three-quarters of the environmental indicators selected, Denmark's performance was found to be average or above average (e.g. waste management and recycling, pesticide use and energy intensity). It was below average for indicators that reflect the large size of its agricultural sector (emissions of ammonia) and its reliance on fossil fuels (acid deposition, emissions of CO_2).

Integration within sectoral planning

Transport is an increasingly important economic sector, growing faster than GDP and reflecting Denmark's international role as a transit country and hub for Nordic countries (with new bridge and tunnel connections between Danish islands and between the Swedish and Danish mainland, as well as the extension of Copenhagen's airports). The 1993 Traffic 2005 plan is a national transport policy statement that establishes the management of transport demand and the need to curb traffic growth as a policy objective (Chapter 3). It sets a range of emission targets for the transport sector, in line with domestic and international commitments to reduce atmospheric emissions. It was supplemented in 1996 by the Action Plan for the Reduction of CO_2 Emissions from the Transport Sector. At local level, the Danish Environmental Protection Agency (EPA) has provided direct support to the 73 largest municipalities to establish and implement transport and environment plans which cover issues such as air pollution, visual impact, noise, CO_2 emissions and traffic safety, in line with the targets set in Traffic 2005.

Denmark's *energy sector* is marked by high reliance on fossil fuels and a recent deterioration of the energy intensity of the economy, largely due to electricity exports. The current Energy 21 Action Plan for sustainable development of the

energy sector provides a range of economic and regulatory measures designed to shape energy supply and demand activities that can meet environmental objectives (Chapter 3). Denmark is currently the only OECD country that has a single ministry dealing with both environmental and energy matters.

Denmark's *agriculture* sector is undergoing a major process of reform. The 1991 Action Plan for Sustainable Agriculture laid the ground for the integration of environmental concerns in agricultural policies, bringing together a range of targets concerning nutrient discharges and pesticide use with longer term goals such as removal of sensitive land from agricultural production (Chapter 7). These reforms, which are taking place in the context of EU Common Agricultural Policy, include agri-environmental measures and measures to support organic farming.

Sustainable production and consumption patterns, greening of government operations

The shift from conventional to *sustainable production and consumption patterns* has been initiated in recent years. Industrial production patterns are undergoing a major change with the development of cleaner technologies and environmental management capacities, now extending to product-based approaches (Chapter 4). Public environmental awareness and *consumer* demand for green products, along with the co-operation of households in recycling and reuse, are also contributing to making consumption patterns more sustainable.

The *greening of government operations* was a major focus of the SEA carried out on the 1998 budget, though efforts to improve government performance in this area go back several years. *Green auditing* has been completed for, among others, the Ministry of Environment and Energy, the Ministry of Defence, the Ministry of Foreign Affairs, State-owned forests and the national railways. Out of 400 public institutions, 80 per cent have sent an *action plan* to the Danish EPA. An action plan for sustainable *public procurement* was published in 1991 by the then Ministries of Environment and of Energy: subsequent guidelines (which now cover 25 product types) and policy measures have focused inter alia on office machines, computing equipment, office furniture, cleaning agents and paints, and catering equipment. In 1994, two categories were added: transportation equipment and food. Participating institutions act on their own responsibility, using a procurement manual prepared as a co-operative effort of various departments and involving associations of municipalities and counties. Almost 90 per cent of public institutions have a public procurement policy that takes environmental considerations into account.

Environmental planning

Denmark's first environmental plan dates back to the mid-1970s. The core concept of Danish environmental planning is the setting of *broad policy goals* which are regularly monitored and adjusted, followed up by more detailed plans concerning the aquatic environment (1987), groundwater and drinking water (1994), waste management and recycling (1993-97), and pesticides (1986), though not nature protection (Chapter 5). These plans, along with international commitments, provide a range of *specific targets* for environmental policy.

White papers on the environment are produced every four years, the next one being due in 1999. The 1995 white paper (Denmark's Nature and Environment Policy 1995) introduced the concept of environmental space into Danish environmental policy, with a focus on *environmental equity* applied both geographically and across generations. The Ministry of Environment and Energy has set up a working group that is due to report at the end of 1998 on how the concept of environmental space can be used to define sustainable development, particularly in the following areas:

– land use and food production, with an evaluation of the environmental space devoted to agricultural production;
– forests, with an estimate of the environmental space devoted to forestry and a definition of sustainable forestry;
– non-renewable resources, with testing methods and identifying tools to determine the environmental space for selected resources such as oil, copper and lime.

Economic impact of environmental policies

Environmental expenditure

Public environmental expenditure reached DKr 9 327 million in 1996, or 0.93 per cent of GDP (Table 6.3). It had increased by 30 per cent since 1990. Water protection represented the largest item of expenditure (48.3 per cent of total public environmental expenditure), with waste management accounting for 6 per cent. The national government accounts for 23.8 per cent of total public environmental expenditure, counties 9.4 per cent and municipalities 66.8 per cent (Table 6.4). Public pollution abatement and control expenditure amounted to DKr 7 631 million, or 0.76 per cent of GDP.

There are no aggregate data available on *private environmental expenditure*. It is estimated that an additional 0.2-0.3 per cent of GDP is spent by enterprises

Table 6.3 **Public environmental expenditure,** 1990-96

(million DKr)

	1990	1991	1992	1993	1994	1995	1996	Change 90/96 (%)
Water protection	3 836	4 440	4 717	4 839	4 346	4 351	4 620	*20*
Waste management	502	587	464	890	726	788	604	*20*
Air protection [a]	–	–	–	–	–	–	–	–
Nature and forest management	1 397	1 483	1 541	1 531	1 687	1 831	1 770	*27*
Other (including R&D)	1 448	1 430	1 560	1 537	1 674	1 908	2 333	*61*
Total	7 183	7 940	8 282	8 797	8 433	8 878	9 327	*30*

a) Public expenditure on air protection (especially air quality monitoring) can be roughly estimated at about DKr 100 million annual between 1990 and 1996. Public expenditure on energy conservation amounted to DKr 1.2 billion in 1996.

Source: Statistics Denmark.

Table 6.4 **Environmental expenditure by counties, municipalities and national government,** 1995

(million DKr)

	National government	Counties	Municipalities	Total	Share (%)
Water protection	166	102	4 082	4 350	*48.9*
Waste management	246	206	341	793	*8.9*
Air protection	–	–	–	–	–
Nature and forest management	675	94	1 062	1 831	*20.6*
Other (including R&D)	1 025	437	453	1 915	*21.5*
Total	2 112	839	5 938	8 889	*100*
Share (%)	*23.8*	*9.4*	*66.8*	*100*	

Source: Statistics Denmark.

on investment and operating expenditure for pollution abatement and control (excluding charges paid to public authorities).

Danish public and private expenditure on pollution abatement and control can be estimated at around *1 per cent of GDP*, a level comparable to that of other Nordic countries and below that of countries such as Austria, Germany, the Netherlands and Switzerland.

Macro-economic effects

There is no evidence that environmental measures and expenditure in Denmark have adversely affected its economic growth or *international competitiveness* to date. On the contrary, environmental protection has become an important element of competitiveness in Danish industry, with efforts to protect the environment perceived as a selling point.

Within the Danish *eco-industry*, a small number of companies account for about 80 per cent of the market, with a combined annual turnover of DKr 2 billion, about 50 per cent of which is from exports; these industries employ an estimated 2 000 employees. In addition, the environmental consulting and engineering sector is dominated by three large companies employing a total of about 600 employees.

The *Danish wind turbine industry* is the largest in the world, with a turnover of over DKr 5.7 billion in 1997 and exports worth DKr 3.5 billion (0.35 per cent of GDP). This success is largely the result of years of public support for the development of wind energy, including grants for R&D and demonstration and the creation of a protected domestic market through regulation and price supports (Chapter 3). The benefits of this policy are now apparent not only in terms of energy technology exports, but also in the improved competitive position of wind power on the Danish electricity market, with costs now comparable to those of coal-based generation.

A macro-economic evaluation of the *green tax reform* in the industrial sector shows that effects on employment are marginally positive. This can be attributed to the fact that the overall cost effects of the new energy and CO_2 tax rates are limited by their being revenue neutral, and by the fact that they are being phased in over five years. Their extra tax burden has been estimated to be equivalent to an annual wage cost increase of 0.1 per cent, which is more than cancelled out by the 0.5 per cent wage cost reduction brought about by the reduction in employers' social contributions. Some energy-intensive companies would nevertheless

experience a reduction of up to 1.2 per cent in added value if they chose not to take advantage of the tax reductions linked with energy efficiency agreements.

2. Policy Instruments

Regulatory instruments

Main instruments

The current *licensing system* is defined in the 1991 Environmental Protection Act and its statutory orders. Environmental permits are compulsory for the larger polluters, the so-called ''listed'' facilities, which currently number about 10 000 (Table 6.5). The system takes an integrated pollution prevention and control approach increasingly based on the use of best available technologies, with a recent emphasis on cleaner technologies. County and municipal authorities also refer to various guidelines that define emission and immission limits, such as the Industrial Air Pollution Control Guidelines.

Table 6.5 **Administrative enforcement,** 1995

	Counties	Municipalities	Total
Number of facilities supervised			
Listed facilities	3 502	6 109	9 611
Non-listed facilities	–	29 600	29 600
Livestock farms	–	58 681	58 681
Waste water treatment plants	1 480	–	1 480
Person-years for inspections	125.7	450.3	576.0
Site inspections	9 000	35 000	44 000
Recommendations	1 250	14 000	15 250
Warnings and injunctions	450	4 700	5 150
Police reports	100	200	300
Prohibitions	30	180	210

Source: Danish EPA.

As part of a process of *devolution* initiated in the late 1970s, responsibility for processing and issuing licenses or permits (other than those for chemical substances) has devolved to the counties (for the 4 000 larger polluters and for 1 500 waste water treatment plants) and municipalities (for the remaining 6 000 listed facilities, as well as 59 000 livestock farms and 30 000 non-listed facilities) (Table 6.5). Counties have additional responsibilities for licenses to exploit natural resources.

At national level, Denmark has a well developed regulatory system for the control of new and existing *chemicals*, administered by the Danish EPA (Chapter 4).

Compliance and enforcement

Counties and municipalities are responsible for ensuring that installations and activities comply with the conditions of the licence, and for environmental monitoring. The effectiveness and extent of the *implementation of environmental regulations* by county and municipal authorities have been the subject of some debate over the years. In the mid-1980s, the consensus was that significant progress was needed to reduce the implementation gap. It was therefore agreed that local authorities should have the equivalent of one full-time inspector per 10 000 inhabitants. Between 1984 and 1992, the number of inspectors employed by municipal authorities rose from 189 to 446 (i.e. half the total number of staff assigned to environmental duties) and a similar increase was noted in the number of inspectors employed by counties.

The balance of *inspection activities* has improved substantially as a result (Table 6.5). Municipalities carry out 35 000 inspections a year, representing one inspection at least every three years for the 6 000 listed companies and 59 000 livestock farms they supervise. At county level, 9 000 companies or facilities (including municipal installations) are inspected once every two years. Wastewater treatment plants are inspected twice a year on average. In some areas, smaller municipalities have encountered problems in ensuring an adequate level of expertise and quality control and have merged their environmental inspection activities into 31 Environment and Foodstuff Control Units.

Although overall compliance with environmental and nature protection regulations has improved very significantly, *difficulties* remain: a large number of farmers oppose the creation of buffer zones along rivers; regulations concerning fish farming and pig farming are not systematically implemented; small and medium-sized industries as well as local civil servants find environmental

regulation overly complex; and local development interests can still prevail over environmental protection in some cases.

The Danish EPA has responsibility for processing first *appeals* against local administrative decisions, the second level of appeal being the Environmental Appeals Board, an independent body operating at national level. The Danish EPA also monitors specific cases, provides advice and issues guidelines that are often cited in appeal cases. The Nature Protection Board of Appeal handles cases relating to land use planning and EIAs.

Generally, county and municipal authorities tend to encourage dialogue and are more likely to issue recommendations and warnings for *infringements of environmental regulations* than to impose sanctions. A large majority of polluters comply unopposedly. The tendency to seek negotiated agreements and the role played by the Environmental Appeals Board limit recourse to the police and judicial system (Table 6.5). The Environmental Appeals Board examines about 100 cases per year, whereas the Nature Protection Board of Appeal examines 1 500. Given that the environmental administration has a broad range of *administrative sanctions* at its disposal, the judicial system is considered a last resort, as procedures can be lengthy and it can be difficult categorising infringements and securing adequate legal expertise. However, the 1990s have seen an increase in the number of cases referred to the courts (200-300 cases per year), notably for prosecution of municipalities that fail to control waste water treatment and of livestock and fish farmers who infringe regulations relating to nutrient discharges. The *judicial sanctions* are not generally severe, though they can reach 40-day custodial sentences and a fine of DKr 1.5 million. In 1996, out of 64 cases, four led to custodial sentences and four to fines over DKr 100 000.

As is usually the case in OECD countries, companies operating in Denmark are liable for unlawful pollution acts and for negligence. Rules relating to environmental liability have been gradually strengthened, notably by establishing objective *liability* for environmental damage caused by listed major and hazardous facilities. According to the 1994 Act on Environmental Damage Compensation, liability is not precluded if the conditions of the license are followed.

Economic instruments

The green tax reform

The current system of environmental taxes is largely the result of the green tax reform designed in 1993 and carried out from 1994 (Table 6.6). Its main

Table 6.6 **Economic instruments relating to the environment**

	Rate in 1997 (1998)	Comments	Revenue in 1997 [a]
Vehicle fuels			
Leaded gasoline	DKr 0.65/l extra tax	Since 1986	Nil, due to 1995 phase-out of leaded gasoline
Gasoline and diesel	DKr 0.03/l excise tax reduction for purchases in filling stations that recover VOCs	Since 1995	Funded by DKr 0.01 increase in vehicle fuel excise tax
CO_2 emissions from energy products [b]	Households: average DKr 600/t CO_2 Industry: DKr 5-850/t CO_2	Since 1992 Since 1996	ET) DKr 4 050 million ET)
SO_2 emissions	DKr 10/kg SO_2	Since 1996	ET: DKr 375 million
Water supply (drinking water)	DKr 4/m^3 (DKr 5/m^3 in 1998) DKr 5/m^3 on average	Since 1994 households only; agriculture and industry exempted Municipal charge	ET: DKr 1 279 million EC: DKr 1.4 billion (1996)
Waste water			
Discharges of:			
nitrogen	DKr 10/kg N (20)	Since 1997	ET: DKr 140 million
phosphorous	DKr 55/kg P (110)	The rate doubled in 1998	(DKr 425 million in 1998)
organic matter	DKr 5.5/kg of organic matter (11)		
Treatment	DKr 12/m^3 on average	Municipal charge	EC: DKr 4.6 billion (1996)
Waste			
Landfilled [c]	DKr 335/t	Since 1987	ET)
Incinerated [c]	DKr 260/t	Since 1987	ET)
Incinerated with cogeneration	DKr 210/t	Since 1987	ET) DKr 900 million
Landfilled	DKr 150-200/t	Municipal charge	EC)
Incinerated	DKr 150-350/t	Municipal charge	EC)
Retail packaging			
Beverage containers	DKr 0.15-3.20		ET: DKr 513 million
Carrier bags	DKr 9/kg (paper bags) DKr 20/kg (plastic bags)	Bags under 5 l capacity exempted	ET: DKr 160 million
Deposit refund	DKr 1.25 to 5.00/bottle		Nil

Table 6.6 **Economic instruments relating to the environment** *(cont.)*

	Rate in 1997 (1998)	Comments	Revenue in 1997 [a]
Pesticides		Since 1996	ET: DKr 234 million
Insecticides	54% retail price before VAT		
Fungicides and herbicides	33% retail price before VAT		
Wood preservatives	3% wholesale price before VAT		
Raw materials	DKr 5/m^3 of sand, gravel, etc. extracted	Since 1979	ET: DKr 145 million
Disposable tableware	50% of wholesale value before VAT		ET: DKr 56 million
ODS	DKr 30/kg of product	CFCs, HCFCs, halons	ET: Negligible due to phase-out
Chlorinated organic solvents	DKr 2/kg of product	Since 1996	ET: DKr 3 million
Ni/Cd batteries	DKr 6 per battery cell	Since 1996	EC: DKr 35 million

a) Note: EC = environmental charge; ET = environmental tax.
b) Equivalent CO_2 tax rate, including energy and SO_2 taxes.
c) Rough estimates.
Source: Ministry of Environment and Energy.

objective is a gradual *shift in the balance of the tax system away from income tax towards environmental taxes*. This shift involves a gradual increase in environmental taxes to 1.2 per cent of GDP by 2000. *Existing environmental taxes such as excise taxes and CO_2 taxes*, and taxes on waste, were increased. A number of new environmental taxes were introduced, notably a water tax, a tax on SO_2 emissions and a tax on waste water discharges. The reform also abolished tax loopholes concerning the taxation of commercial vehicles and road fuels that were acting as a disincentive for environmental management (Chapter 3).

One fundamental principle of the green tax reform is that it should be *revenue neutral*, while still providing an incentive for improved environmental protection.

Households bear the largest part of the green tax reform, particularly for taxes on energy and on water, and are the main beneficiaries of the compensation provided by reduced marginal tax rates. The combined marginal rate of personal income tax and social contributions was lowered from 50 to 45 per cent for the lowest incomes, from 52 to 50 per cent for middle incomes and from 69 to 62 per cent for the highest. There have also been reductions in the marginal tax rates applied to capital investment income, as well as increases in child support.

Industry is affected mainly by the waste water, CO_2 and SO_2 taxes. In the longer term, it also benefits from reduced marginal income tax rates as a result of lower pre-tax wage pressure. Revenue from the green taxes affecting industry are *recycled* through investment support grants and a reduction in employers' social contributions. For instance, the revenue from CO_2 and SO_2 taxes applied to industry (DKr 1 955 million in 1998, rising to DKr 2 450 million in 2000) was recycled through a reduction of DKr 945 million in employers' contributions in 1998 (rising to DKr 1 750 million in 2000) and about DKr 500 million of grants for annual investment in energy efficiency improvements. After 2000, the investment grants will be replaced by reductions in employers' contributions.

As a result of the green tax reform and the growing use of environmental charges and taxes in Denmark, total *revenue from environmental charges and taxes* increased from DKr 2 600 million in 1992 to 7 800 million in 1997, or *0.74 per cent of GDP*. Most of the additional revenue was due to the increase in CO_2 taxes (DKr 4 050 million in 1997), the new SO_2 tax (DKr 375 million) and the drinking water tax (DKr 1 279 million).

Over the period 1992-97, *energy (excise) taxes* increased from DKr 14 192 million to DKr 20 720 million and *vehicle registration taxes* from DKr 8 532 million to DKr 15 350 million. *Road tolls*, which did not exist in 1992, now generate an annual revenue of DKr 264 million.

Environmental taxes on energy products

In 1992, a *CO_2 tax* of DKr 100 per tonne of CO_2 on energy products was first applied to oil products, coal and electricity. It was not intended to increase energy prices, as excise taxes were lowered to compensate for it. A minimum 50 per cent reduction of the CO_2 tax was given to industrial energy users and could be higher for energy-intensive industries, provided energy audits were carried out. As a result, the energy, CO_2 and SO_2 taxes paid by industry were equivalent to DKr 35 per tonne of CO_2. In 1994, the green tax reform increased energy taxes on coal and electricity, and to a lesser extent on diesel and gasoline. The average tax applied to energy products consumed by households rose from DKr 450 to

600 per tonne of CO_2. In 1996, a new set of green taxes on energy consumption was introduced for industrial users, along the following lines:

- taxes on energy products are broken down into three components: an energy tax, a CO_2 tax and a SO_2 tax;
- taxation varies according to the energy use: space heating, heavy (energy-intensive) processes and light processes;
- tax rate reductions can be granted to specific energy-intensive industries provided they undertake to improve their energy efficiency;
- taxes are phased in gradually (Table 8.1) and their revenue is returned to industry, partially through the funding of energy efficiency improvement measures.

By 1998, energy use for space heating was taxed at the same rate for industry and for households: an average of DKr 600 per tonne of CO_2, ranging from DKr 550 to 850 per tonne according to the energy form. For energy used in heavy industrial processes, the *tax rate* rises from DKr 5 to 25 per tonne between 1996 and 2000. For companies that enter into an agreement with the Danish Energy Agency to undertake energy efficiency investments, the rate can be lowered to DKr 3 per tonne. Grants of up to 30 per cent of the investment can be provided for projects with a pay-back period of two to seven years. It is estimated that about 600-800 of Denmark's 20 000 industrial companies will opt for such agreements. The rate for light industrial processes rises from DKr 50 to 90 per tonne between 1996 and 2000. Rate reductions are available to a small number of companies using light processes (Table 8.1).

The *SO_2 tax* being phased in between 1996 and 2000 is expected to result in substitution towards low-sulphur coal and natural gas. As a special concession, the 1996 rate will apply to coal used in high energy-consuming boilers and furnaces for a maximum transition period of 20 years, to avoid an excessive burden being placed on processes committed to using coal.

Other environmental taxes, environmental charges and deposit-refund schemes

Municipal *water supply charges* are based on drinking water consumption, which is mostly metered. They average about DKr 4 per cubic metre, with substantial regional variations. The green tax reform introduced a *water tax* of DKr 1 per cubic metre of drinking water supplied in 1994, rising progressively to DKr 5 per cubic metre in 1998; it applies only to households, with industry and agriculture exempted (Chapter 2). At its highest level, the water tax results in a doubling of water prices for household consumers.

Municipal treatment plants are entirely financed by water charges, without subsidies. To this effect, water charges include a *waste water charge* which averages DKr 12 per cubic metre. For industries discharging heavily polluted water to the sewerage system, charges can be increased to reflect pollutant loads. In addition, the green tax reform introduced a *tax on waste water discharges* to the environment which applies to all point sources (i.e. municipal and industrial sources, but not agriculture). The rate of the tax was doubled in 1998 (Table 6.6).

Taxes on pesticides, first introduced in the 1980s, have been regularly increased in line with policy objectives (Table 6.6). A further substantial increase is being introduced in 1998. Heavy polluters can obtain a rebate of up to 97 per cent to protect their international competitivity These taxes are compensated by a reduction in other taxes paid by farmers, notably the abolition of the county tax on agricultural property, as well as support provided to organic farming (Chapter 7). Other taxes designed to limit consumption of *harmful chemicals* include a tax on chlorinated organic solvents and on CFCs (Table 6.6).

Municipalities set *waste management charges* which must cover the costs of waste collection and treatment. A range of taxes are used to support the waste management objectives of banning the landfilling of incinerable waste, increasing recycling and reuse, and reducing waste at source. These taxes include a *waste tax* differentiated according to whether the waste is landfilled or incinerated so as to encourage incineration, preferably associated with cogeneration. Taxes are applied to *retail packaging* such as beverage containers and carrier bags (Chapter 4).

Regulations imposing the use of returnable bottles for beer and soft drinks sold in Denmark were upheld at European level, and steel and aluminium cans are banned. The *deposit-refund* system is highly efficient, bottles being reused 35 times on average. A deposit-refund system for motor vehicles is under discussion. *Product charges* are increasingly used to help fund collection costs in take-back agreements, for instance for nickel-cadmium batteries and tyres.

Polluter pays and user pays principles

Overall, the *polluter pays and user pays principles* are applied in Denmark with respect to *industry and households*; no significant subsidies are provided for pollution abatement and control. Revenue from environmental charges and taxes in the mid-1990s covered public pollution abatement and control expenditure. Innovative projects have been supported under the successive cleaner technologies programmes, most recently for product-oriented activities; subsidies

amounted to DKr 75 million in 1996. Support has also been granted for environmental management in industry (EMS, ISO 14001 and EMAS), notably in SMEs.

User charges covering all relevant costs are applied to the *provision of environmental services*, including the supply and distribution of drinking water and sewage collection and treatment. Cost pricing is also applied to waste collection, transport, treatment and disposal. Most waste collection and treatment is carried out by municipalities, though in many of them waste collection is contracted out to private companies. Industrial and construction waste is often collected and partially recycled by private companies.

In addition, since 1994, most companies pay their local authority an annual charge based on average *administrative costs* for the implementation and enforcement of environmental regulations in their jurisdiction.

Financial assistance and subsidies

So far, *no overall review of subsidies* to sectors such as energy, transport, agriculture, industry or fisheries with detrimental effects on the environment and natural resources is available in Denmark.

Subsidies are extensively used to support *energy conservation and renewable energy*. Some 15 subsidy programmes are currently in place to provide support for energy efficiency investments and audits. In addition to a range of tax exemptions, renewable energy benefits from production price subsidies (Chapter 3).

The *agricultural sector* benefits from several subsidy schemes, including grants for investments in manure storage facilities to reduce nutrient loading (DKr 50 million in 1997) and for afforestation (DKr 18 million in 1997). As part of agri-environmental measures, direct payments are available to farmers to protect wildlife habitats and landscapes and prevent groundwater pollution (Chapter 7). Agri-environmental budgetary expenditure on direct payments and capital grants amounted to DKr 245 million in 1997.

Other instruments for policy integration

Spatial planning

Until 1970, urban development outside large cities was allowed to proceed without any real controls; some 300 000 week-end homes were built between 1950 and 1960. *Uncontrolled urban growth* came to an abrupt halt with

the entry into force of legislation on spatial planning in 1970 and the implementation of a strict urban and rural zoning system. The *Planning Act* was completely overhauled in 1992. Its main provisions include:

- an obligation to take account of different socio-economic interests, with an emphasis on protection of nature and the environment;
- a functional division of the national territory into urban areas and areas where stringent rules apply to the use of land or buildings (e.g. use of week-end homes in winter);
- clear allocation of responsibilities for administration, planning and appeals;
- highly restrictive provisions with regard to urban development in coastal areas;
- rules governing and increasing public participation.

Municipal councils are responsible for preparing *municipal plans* and revising them every four years. The reform of municipal government in 1970 reduced the number of municipalities from 1 200 to 275, so that they can draw up plans on a meaningful scale. Municipal plans define zoning for different activities and set out a municipal strategy for land use and public participation consistent with national and regional planning regulations. Municipalities also prepare local plans where needed; over 30 000 have been completed in the last 20 years.

Counties are responsible for drawing up *regional plans* valid for 12 years (though they are revised every four years). These regional plans lay down requirements with regard to urban development, infrastructure siting, protection of nature and the environment, and natural resource management. Under the terms of the Planning Act, the county is the authority responsible under common law for the administration of rural areas, which account for 20 per cent of Denmark's territory. Changes in land use within rural areas are subject to stringent restrictions and controls in order to protect landscapes.

The Ministry of Environment and Energy has major spatial planning responsibilities. After each election, it must draw up a *national report on spatial planning* for submission to Parliament; this document is designed to ensure that development goals and environmental concerns are compatible at the national level. The Ministry can also publish national planning directives with which the decentralised authorities must comply; it can intervene in the drafting of plans setting out development goals, oppose the approval of plans and negotiate amendments. In the event of opposition to local or regional planning projects, the population concerned as well as some NGOs can lodge appeals through the *Nature Protection Board of Appeal*, an independent body consisting of a chairman, two members of the Supreme Court and a representative of each of the parties. No appeal

against the Board's decisions can be brought before any political or administrative body and appeals are rarely made to the civil courts, which indicates the Board's high standing in the legal system.

The *management of coastal areas* is of major concern to the authorities. Legislation enacted in 1937 prohibits construction within 100 metres of the shoreline as well as any modification of beaches. In 1994, the distance was increased to 300 metres outside urban areas, calculated from the limit of vegetation. This highly protective measure was backed up by a planning directive issued in 1981, and translated into legislation in 1994, which recommended that as far as possible no new urban development should be allowed within 3 kilometres of the coastline.

Environmental impact assessments

Danish regulations on environmental impact assessment (EIA) were adopted in 1989 and 1994, in order to implement the 1985 *EU directive* on EIA. Eighty-two assessments have been conducted, including about 40 in 1997. With regard to the list of facilities or activities subject to a mandatory EIA, Denmark has adopted the provisions of Annexes I and II of the EU directive. Most facilities covered by Annex II are subject to an EIA in five specific instances, including when construction of the projected facility requires local development plans to be modified. As stipulated by the EU directive, projects adopted by law are exempt from a mandatory EIA though subject to an SEA under Circular 31.

From a legislative and administrative standpoint, EIA procedures are incorporated in *spatial planning procedures*, placing the emphasis on siting. Consequently, if a given project is incompatible with the relevant development plan, county authorities must initiate an EIA. A permit can only be issued once the appropriate changes have been made to the development plan. Provision is made for *the public to be notified and consulted* at two stages during the EIA procedure, in which the Ministry of Environment and Energy can intervene directly if necessary.

Environmental information and education

Information to the public on the environment has a high priority in Denmark. In 1997, the Ministry of Environment and Energy devoted 55 person-years and 54 million DKr to providing public environmental information. Information on the state of the environment is presented in regular State of the Environment reports (every four years), the latest version of which was published in March 1998. Publications on environmental indicators are produced annually. A range of other information materials are regularly released by the Ministry of Environment and

Energy, notably through newsletters, a wealth of technical reports and an Internet site.

Since the mid-1980s, a series of nature guides called *Environmental Interpreters* have been produced to inform and educate the public about nature conservation and the management of natural resources. The series, now familiar to most Danes, includes over 260 publications. An Environmental Interpretation Committee has been created with representatives from local authorities, museums, green NGOs, agriculture and forestry. The Environmental Interpreter Service costs about DKr 27 million annually, mostly from public funds. It carries out a range of Environmental Interpreter activities aimed at schools, local residents' associations, trade unions, industry and agricultural groups as well as green organisations. About 300 000 people over 15 participate every year in these activities, while those organised for children and schools involve about 150 000 children annually. In addition, the Ministry of the Environment and Energy and the Ministry of Education operate *Environment Schools* that supplement school work with outdoor classes and field work. There are currently 70 Environmental Schools in Denmark.

The public has statutory rights of *access to information*, including environmental information, at national, county and municipal level. This information can include non-confidential information on non-compliance as well as on sanctions for violating environmental laws. In 1997, a statutory order was introduced making green accounting mandatory for certain industrial activities. The green accounts, which are made publicly available, contain accessible information about industry's environmental performance. They include data on energy, water and raw material use as well as pollutant releases to the environment and waste generation.

Role of NGOs

Major environmental NGOs include the Danish Society for the Conservation of Nature (around 250 000 members), the Danish Ornithological Society (12 000 members), WWF Denmark and Greenpeace Denmark (17 000 members). Denmark has a well established tradition of *formal and informal collaboration between NGOs and authorities*. Article 11 of the Environmental Protection Act requires the Minister to consult NGOs on draft statutory orders. It is common practice for draft policy proposals and bills to be sent out to NGOs and for hearings to be organised. The Danish Society for the Conservation of Nature has a special role in nature management, as it can propose an area for conservation, a process that involves public hearings (Chapter 5). Environmental NGOs also play an important part at local level, where the many local committees gather

detailed knowledge and information and belong to advisory bodies at county (Green Councils) and municipal level.

The *right to lodge a complaint and the formal right of appeal* have been extended since the 1970s, when they were restricted to individuals with a direct and significant interest. They now also apply to Greenpeace, the Trade Unions' Industrial Council, the Danish Society for the Conservation of Nature, the Consumers' Council and organisations representing anglers and fishermen. Appeals against local decisions are handled in the first instance by the Danish EPA. For a development covered by an EIA or a case covered by the Nature Protection Act, the Forest Act or the Planning Act, an appeal can be lodged with the Nature Protection Broad of Appeal, while for cases relating to the Environmental Protection Act (including pollution licenses) the Environmental Appeals Board is the body of second appeal. Out of 200 cases appealed by the Danish Society for the Conservation of Nature, under half were won.

Since 1990, as part of the follow-up to the report of the World Commission on Environment and Development, the government launched a joint programme with NGOs to promote sustainable consumption patterns. The programme is now entirely operated by NGOs. *Green Information* is an information centre founded by five NGOs in 1993. The centre is independent but entirely subsidised by the government. Its main purpose is to assist the public in reducing environmental impacts and to give concrete advice on how individuals can contribute to this goal. An evaluation of Green Information showed that many of the users agreed the information provided had a positive impact on their behaviour. In 1996, the centre received about 8 000 enquiries.

Role of industry and voluntary approaches

Danish industry is involved in a broad range of voluntary agreements relating to environmental protection that aim to restrict or phase out the use of harmful products, control pollutant emissions and discharges, and improve energy efficiency. The Confederation of Danish Industries actively supports the work of the International Chamber of Commerce (ICC) Environment Commission. Approximately 70 larger Danish companies have signed the ICC Business Charter for Sustainable Development. More manufacturing firms have entered into environmental quality assurance schemes and are introducing eco-audits. Some 128 companies have obtained ISO 14001 certification, 38 have BS 7750 and 45 have EMAS.

There are *three types of voluntary agreements* currently in force. The most common is an agreement between the authorities (the Ministry of Environment

and Energy or the Danish EPA) and an industrial branch or group of companies. This is the case, for instance, with agreements concerning the collection and recycling of tyres, demolition waste, electric and electronic products and road vehicles. There are also several such agreements on phasing out organic solvents, NPEOs and surfactants in detergents and softeners, high-sulphur diesel and timber impregnation products. Secondly, some agreements link the actors in an industrial branch without the authorities being a party to the agreement. This is the case with agreements on the collection and recycling of CFCs and HCFCs, the Halon Bank, lead accumulators and transport packaging. Finally, the Ministry of Environment and Energy has signed an agreement with the National Association of Local Authorities on the disposal of combustible waste (Chapter 4).

3. Environmental Performance

Institutional integration and planning

Economic and environmental trends point to a *partial decoupling of economic growth and environmental pressures* in Denmark in the last two decades. Though this achievement is not always apparent at ecosystem level, air quality has improved, a number of contaminated sites have been identified and cleaned up and water pollution from point sources is under control. On the other hand, looking at trends in waste generation and CO_2 emissions and at nitrate loadings, there is little room for complacency and the shift to sustainable development clearly remains a major challenge. As the Danish economy continues to grow at a high rate in the 1990s, environmental *pressures from agriculture, transport and energy* in particular are still strong.

Much progress has been made in recent years in improving *sectoral integration* at the planning, budgeting and project levels. *Sectoral planning* plays a major part in efforts to integrate environmental concerns in sectoral policies in Denmark. Furthermore, one of the strengths of the Danish planning approach is that plans are regularly reviewed and adjusted if necessary. The Energy 21 action plan has managed to reconcile *energy* and environmental objectives in a coherent energy policy approach. However, Denmark's energy sector is undergoing major restructuring, as a result of the implementation of EU policies and directives on market liberalisation and deregulation, at a time when the energy sector above all is concerned by atmospheric emission reduction targets agreed at the national and international level, notably concerning CO_2. The Traffic 2005 plan sets a longer time frame for achieving environmental objectives in the *transport* sector, and there is some uncertainty as to whether current policies are adequate to meet

these objectives. The Action Plan for Sustainable *Agriculture* elaborated in 1991 was a first step towards a comprehensive integration of environmental considerations in agricultural policies. Nevertheless, much progress is still needed, notably with respect to nitrate pollution and to nature management and biodiversity conservation.

Strategic environmental assessments of government bills and proposals, as well as environmental impact evaluation of the national budget, are innovative and in some respects exemplary. Focusing on the marginal effect of budgetary changes, the evaluation of the 1998 *national budget* was favourable with regard to both that budget and budget trends over the past eight years. The evaluation process improved the integration of environmental considerations in economic decision making as well as sectoral integration, as a broad range of ministries were involved. Further environmental evaluations of the budget should be carried out and strengthened, for instance with respect to the use of energy and transport indicators and CO_2 modelling. In addition, it would be useful to consider the whole structure of public funding and expenditure in terms of environmental impact and to carry out, as several OECD countries have, a *comprehensive review of existing fiscal and other subsidies* undermining both economic efficiency and environmental effectiveness.

Spatial planning in Denmark is strongly geared towards environmental protection. From an institutional standpoint, the fact that the administrative department concerned and the relevant powers have been assigned to the Ministry of Environment and Energy is a major factor in the integration of environmental concerns in the planning process; furthermore, it is the Nature Protection Board of Appeal that is competent for appeals against land use planning decisions. Land use regulations, particularly those applicable to rural and coastal areas, are rigorous. By maintaining a clear-cut distinction between urban and rural areas, they have successfully protected rural landscapes from inappropriate development. Significant efforts made at municipal and county level contribute to ensuring that spatial planning is an effective instrument for the protection of nature and landscapes in Denmark.

The strong link between project-related *EIA procedures* and spatial planning can have a significant impact on the consistency of land use planning, calling for a degree of moderation. While the rigour and precision of planning procedures need to be balanced by the possibility of applying for exemptions that will require an EIA, amendments to regional or municipal development plans can undermine planning procedures, particularly in rural areas.

Environmental policy implementation

From an *administrative standpoint*, the allocation of responsibilities between the Ministry of Environment and Energy (which focuses on major policy issues, relations with other ministries and Parliament, and international matters) and the Danish EPA and National Forest and Nature Agency (in charge of implementing national environmental policies) has proved *highly effective*. The Ministry and its implementing agencies have high-quality staff and their budgets have regularly and substantially increased over the last 25 years, in line with expanding responsibilities and policy priorities. Carrying out of those environmental responsibilities devolved to county and municipal authorities has likewise improved, particularly since staffing levels were upgraded in the 1980s, and environmental and economic interests and objectives have been better integrated.

Regulatory approaches

Starting from the solid regulatory foundations laid in the 1970s and 1980s, Denmark has in recent years taken stock of remaining and new environmental challenges and extensively *revised and upgraded its environmental legislation*. The 1990s have so far confirmed its effectiveness in controlling pollution from point sources. The current licensing system has effectively addressed a range of issues relating to waste water discharges, atmospheric emissions, and waste collection and disposal. The challenge is now to make the shift towards cleaner technologies which recent regulatory developments intend to support. To this end, it would be useful to ensure that the licensing process also systematically considers issues such as waste prevention and reduction, as well as efficient use of energy and other material inputs.

For many years, county and municipal authorities have been entrusted with important environmental responsibilities requiring a high level of technical expertise. A major effort has been made since the mid-1980s to improve inspection activities at the local level. This effort has made it possible to close the *implementation gap* in most cases, though there are still variations from one municipality to another that need to be carefully monitored. Even though livestock rearing developments undergo mandatory EIAs, and farms have been subject to licensing and inspection since 1994, there is scope for improving the implementation of environmental regulation of agricultural activities. Another recurring topic of concern is the enforcement of environmental regulations applicable to fish farms.

Recent moves to improve the *conservation of coastal areas*, notably the prohibition of construction and planting within 300 metres of the shoreline, have been fiercely opposed by professional bodies in the tourist sector as well as many

local authorities, on the grounds that they represent excessive interference; as a result, a certain amount of political pressure was brought to bear to secure a less restrictive interpretation of the new rules. The value of the coastal natural heritage is such that Danish regulations regarding the development and protection of coastal areas must be maintained and properly implemented. In particular, implementation of the 300-metre protection zone should be accelerated, notably to improve the conservation of dune and beach areas (Chapter 5).

Economic instruments

Denmark makes extensive *use of economic instruments* for environmental management, notably environmental charges and taxes. It is a high-tax country, with over 50 per cent of GDP paid in taxes and one-half of tax revenue spent directly by the government. When the green tax reform was launched in 1993, it was decided that an evaluation would be carried out in 1998. Such an evaluation will no doubt conclude that overall the green tax reform, and more generally the use of economic instruments for environmental management, has been a success. Nevertheless, some notable opportunities exist to improve and refine environmental taxes applied in Denmark.

The current *energy tax structure* imposes a complex range of carbon tax rates, with the highest values given to residential space heating and the lowest to energy-intensive industrial processes, in order to protect the competitiveness of Danish industry. The effectiveness of such differentiation in providing this protection and meeting environmental goals needs to be carefully examined, and the system should be simplified.

As early as 1992, the principle was established of applying a *CO_2 tax*, albeit small, to industry. The recent revision of industry taxation attempts to enhance the incentive effect of this tax while preserving industrial competitiveness. The opportunity to obtain a tax reduction by entering into an energy efficiency agreement with the Danish Energy Agency is available to only a limited number of companies, due to the considerable administrative costs involved in establishing and monitoring such agreements. Nevertheless, this opportunity has been offered to a few hundred large energy users that would otherwise be faced with a substantial increase in their energy bill, affecting employment levels. Given that most large industrial energy users have already made many of the energy efficiency investments, with a pay-back time under four years, the potential savings from these agreements are limited. In many companies there is little opportunity to recycle the revenue from CO_2 taxation due to lack of projects. It would therefore be useful to review the *effectiveness of the CO_2 taxation rebate* for industry in terms of actual improvements in energy efficiency.

While high *vehicle registration taxes* have contributed to limiting vehicle ownership, relatively low gasoline taxation translates into vehicle use well above that of other countries in OECD Europe: these taxes need to be reviewed to favour more fuel-efficient, cleaner vehicles and curb the environmental impacts of vehicle use. Even though the new *green tax imposed annually on cars* should generate an incentive to purchase more fuel-efficient cars equivalent to an increase in gasoline tax of DKr 5-6 per litre, it is independent from fuel consumed and its incentive effect actually increases with mileage. It is not clear to what extent current fuel price levels and planned tax increases can contribute to meeting the target of stabilising transport CO_2 emissions by 2005, compared with 1988. Influencing emissions and fuel consumption through the adjustment of *variable transport costs* should also be considered in terms of the introduction of road use pricing systems such as tolls.

Concerning other taxes, there are also opportunities to improve their effectiveness. For instance, *pesticide taxes* are based on the price of the product and do not necessarily reflect the toxicity of the chemical used. Products might be taxed according to their toxicity (Chapter 7). The *tax on water* might be applied to all water users, not only households (Chapter 2).

As in other OECD countries, the *balance of environmental taxation among the various economic sectors* remains uneven. Most green taxes are levied on households. Industry is often provided with exemptions or opportunities for rebates, in order to protect international competitiveness. Agricultural activities are little affected by environmental taxation; those taxes that exist (with the exception of the recently increased pesticide taxes) are limited in their application and rates, and any incentive effect is therefore likely to be small.

Environmental democracy

Danish environmental policy making is generally *open and consultative*, with a range of measures in place to ensure public participation and stakeholder involvement. In particular, consultation with and input from environmental NGOs is largely institutionalised, at both national and local level. *Access to environmental information* and *access to appeals and courts* are in many ways *exemplary*. Environmental information is made available through a wide variety of publications and dissemination mechanisms.

While detailed information is available on public *environmental expenditure*, there is no overview of the structure and trends of private expenditure on environmental protection. As a result, little is known about the costs to industry of environmental protection measures. A survey of private environmental

expenditure needs to be undertaken and updated regularly. In addition, it would be useful to gain a better view of Danish *eco-industries* and their development in terms of turnover, employment and exports.

The most recent land use survey dates back to 1982 and covers mainly urban areas. Without a *systematic inventory of land use* and its legal status, the environmental effects of land use planning policies developed since the early 1970s cannot be precisely assessed, notably in coastal areas that have been subject to the strongest development pressure. They can only be established from statistics showing that 80 per cent of the population lives in coastal areas and that a third of the coastline has been developed. Land use data therefore needs to be collected systematically, in order to allow an assessment to be made of land use trends.

7

INTEGRATION OF ENVIRONMENTAL CONCERNS IN AGRICULTURAL POLICY

1. Agriculture and the Environment

Current situation and trends in the agricultural sector

Between 1980 and 1996, the *share of agriculture in GDP* fell by a fifth to 4 per cent, and its share in employment decreased by 40 per cent to 3 per cent. The share of food processing in GDP was 4.4 per cent in 1996, and its share in employment 1.2 per cent. Pig meat accounts for over a third of the total value of agricultural production, and milk for 20 per cent. Two-thirds of agricultural production in value is exported. Agriculture accounts for 22 per cent of total exports (down from 30 per cent in 1980), while agricultural imports account for 10 per cent of total imports (as in 1980).

The *agricultural area in use* (AAU) covers 65 per cent of Denmark's total area (Figure 1.1). Some 86 per cent of AAU is devoted to crops, notably cereals. The rest is permanent pasture, including 7 per cent of land set aside to comply with 1992 EU Common Agricultural Policy (CAP) reform requirements. Between 1970 and 1996, the agricultural area declined by over 10 per cent, the land released being used mainly for urban development and recreational areas. This trend should continue, due to the structural adjustment of agriculture, population growth, the increase in the average area inhabited per person, and the planned doubling of forest area (currently about 10 per cent of the country) (Chapter 5).

The number of *farm holdings* fell from 200 000 in 1950 to 62 000 in 1996. About 60 per cent of farmers are full-time. Average farm size increased from 15 hectares in 1950 to 43 hectares in 1996, and the share of large farms (over 50 hectares) rose to 30 per cent. These trends are expected to continue due to

structural adjustment in the context of CAP reforms and the Agricultural Holdings Act, which was amended in 1994 to double the maximum farm size to 450 hectares.

Since the beginning of the 1980s, the *livestock population* has evolved differently according to species. Following the introduction of milk quotas in 1984, the number of cattle decreased by 30 per cent to 2 million head in 1997, including 700 000 dairy cows. In contrast, the number of pigs increased by over 20 per cent to 11 million in 1997 and the number of broilers by over 50 per cent to 13 million in 1996; the number of hens slightly increased to 5 million in 1996. In the future, the number of feeder pigs should increase with falling intervention prices for maize feedgrains. Since milk yields should continue to rise by 2 per cent annually, the number of dairy cattle should fall due to the maintenance of the quota system and cuts expected in milk support prices.

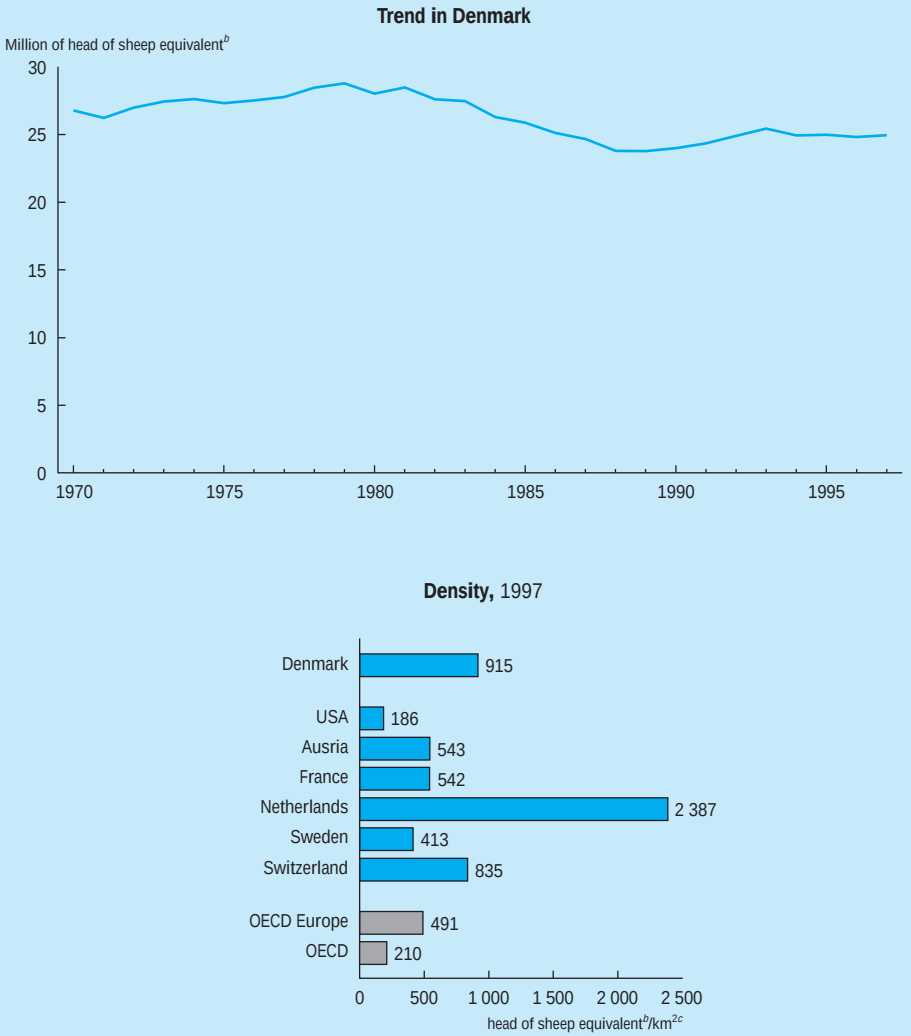
Since 1980, *livestock density* per hectare has remained almost stable. It is among the highest in the EU, after the Netherlands and Belgium (Figure 7.1). The size of herds has substantially increased due to specialisation and concentration of livestock production; over the last 15 years, the number of pigs per holding has more than tripled and the number of dairy cows per holding has increased by 70 per cent. In 1996, specialised livestock holdings had 77 per cent of all cattle and 78 per cent of all pigs. Herds over 100 units account for 15 per cent of the total number of dairy cows. One-third of the pig population is in herds of over 2 000 head; three-quarters of hens are on holdings of over 10 000, and 90 per cent of broilers are produced in flocks of over 25 000.

Environment and agricultural activities interface

Use of fertilisers and pesticides

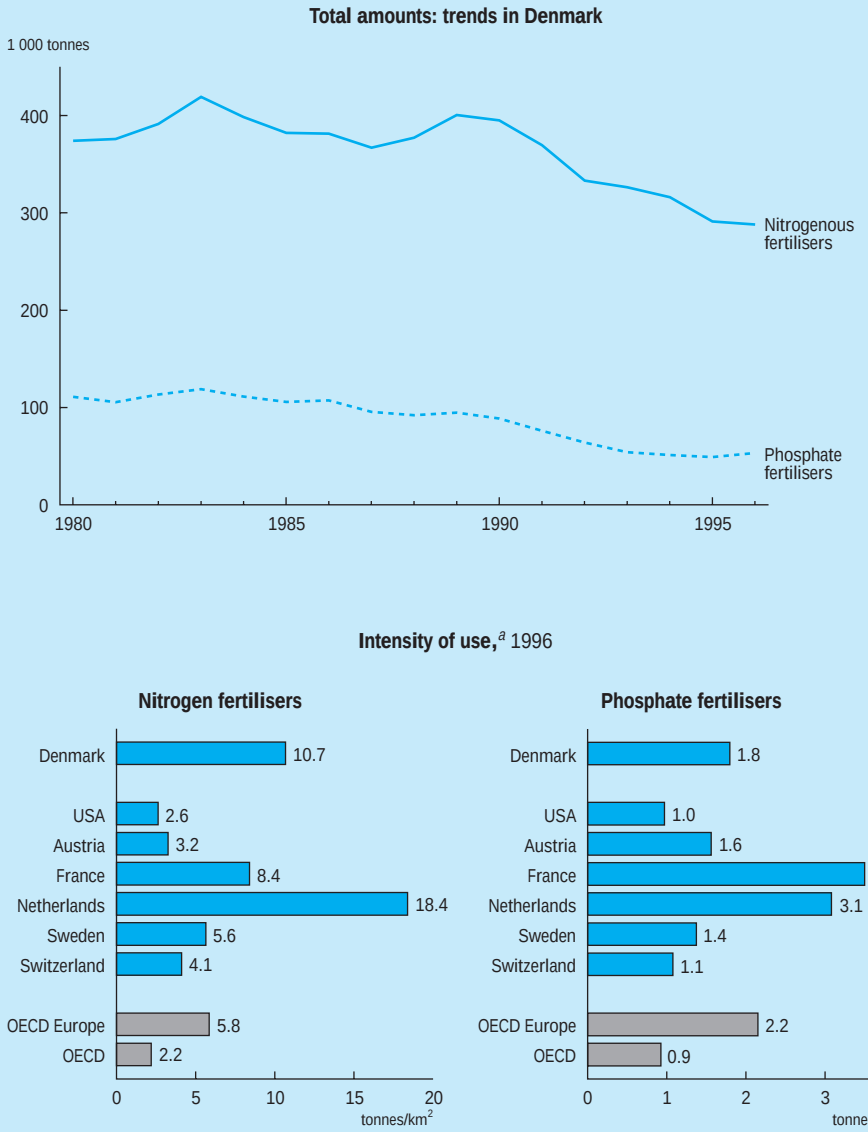
After a seven-fold increase between 1950 and 1984, nitrogen supply from commercial fertiliser use fell by 27 per cent between 1985 and 1996 (Figure 7.2). Nitrogen supply from livestock was stable between 1950 and the mid-1980s, but fell 8 per cent between 1985 and 1996 as a result of the fall in the number of cattle. It now accounts for half the total nitrogen supply. The intensity of use of *nitrogen fertilisers* (commercial and from livestock manure) per hectare of agricultural land is among the highest in the EU, after the Netherlands and Belgium. The OECD estimates the surplus of the nitrogen-soil surface balance for 1985-1996 at 120-150 kg N per hectare (excluding atmospheric losses) between nitrogen inputs (half from fertilisers, 40 per cent from manure, 10 per cent from atmospheric deposition and biological fixation) and outputs (harvested crops and pasture). The

Figure 7.1 **Livestock**[a]



a) Cattle, horses, pigs, hens, sheep and goats.
b) Based on equivalent coefficients in terms of manure:
1 horse = 4.8 sheep; 1 pig = 1 goat = 1 sheep; 1 hen = 0.1 sheep; 1 cow = 6 sheep.
c) Of agricultural land (arable, permanent crop land and permanent grassland).
Source: FAO; OECD.

Figure 7.2 **Commercial fertiliser use**



a) Tonnes/km^2 of agricultural land (arable and permanent cropland and permanent grassland).
Source: FAO ; OECD.

nutrient surplus ranged from 125 to 150 kg N per hectare in the 1985-92 period, though it has since fallen to 100 kg N per hectare. Danish authorities estimated a fall in annual nitrogen loss, through leaching from the root zone, from 85 kg N/ha/year in the early 1990s to about 70 kg N/ha in 1996 (whereas the EU nitrate directive standard is 50 kg N/ha/year or 50 mg of nitrate per litre of soil water).

Consumption of *phosphate fertilisers* fell by 64 per cent between 1980 and 1996, when intensity of use per hectare of agricultural land was among the lowest in Europe (Figure 7.2). However, phosphorus from livestock remained almost stable during this period. It now accounts for three-quarters of the total phosphorus load and intensity of use is among the highest in the EU. An estimate by Danish authorities of the phosphorus soil surface balance at national level shows that excess phosphorus fell from 15 to 8 kg P/ha of agricultural land between 1985 and 1996.

After a five-fold increase between the mid-1950s and 1984, sales of *pesticides* (active ingredients of all types of pesticides) fell by 40 per cent between 1985 and 1996, reflecting a shift from products for which relatively large doses of active ingredients are applied per hectare to low-dose products. Spraying intensity, as measured by treatment frequency, is unchanged. In the mid-1990s, the intensity of pesticide use was about 1.6 kg active ingredients per hectare of agricultural land, below the EU average and close to the OECD average (Figure 7.3).

Impact on water resources

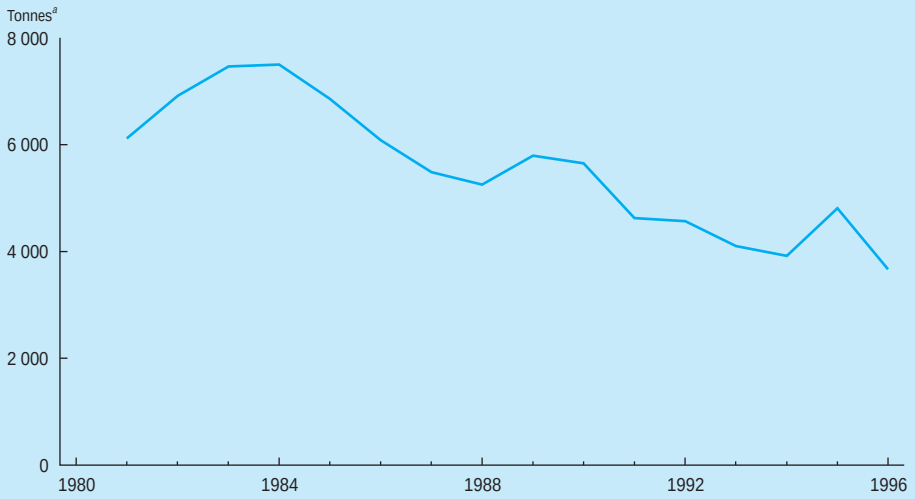
Agriculture accounts for around a third of *freshwater withdrawals*, almost exclusively from aquifers (Chapter 2). Irrigated areas, which increased by nearly a quarter between 1980 and 1995, currently represent 18 per cent of the cultivated area.

Agriculture has a very high impact on the *quality of surface waters*:

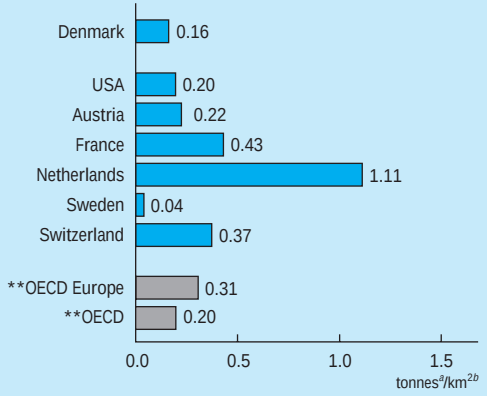
– The concentration of *nitrates* in watercourses is at least five times higher in agricultural areas than in areas dominated by natural habitats. Leaching from agricultural land accounted for about 80 per cent of total nitrogen loading in watercourses in the early 1990s, as it had in the 1980s. Together with run-off from agricultural land, loadings were estimated at 230 000 tonnes of nitrogen a year in the early 1990s. As the use of nitrogen fertilisers has decreased in the last 15 years, contamination can be attributed to marked local over-fertilisation with manure. Recent water quality monitoring shows improved nitrate concentrations in ozone areas.

Figure 7.3 **Pesticide use**

Total amount: trend in Denmark



Intensity of use, mid-1990s



a) In tonnes of active ingredients.
b) Of arable and permanent cropland.
Source: OECD; FAO.

- *Phosphorus* concentration in watercourses draining agricultural catchments (without point sources such as wastewater discharges) is 2.5 times greater than in those draining natural catchments; phosphorus emissions from agriculture are estimated at 4 400 tonnes annually, accounting for about 30 per cent of total phosphorous loadings in watercourses.
- Agriculture's contribution to the *eutrophication of watercourses* and lakes is considered high, but not as high as 80 per cent, though recent studies indicate it may be higher than previously believed.
- Studies on *pesticides* in surface waters have found the actual occurrence of about 30 per cent of the substances analysed.

The nitrogen content of *groundwater* is considerably higher under agricultural land, particularly in sandy soils fertilised with animal manure (i.e. in western Denmark). It exceeds 25 mg N/l in 22 per cent of wells and 50 mg N/l in 13 per cent (Chapter 2). Concentrations are lower in upper layers (below the root zone) in areas with reduced fertilisation. Agricultural phosphorus is not considered a serious groundwater problem because soils have a large fixation capacity. In 1994, one or more of eight pesticides were found in 9 per cent of wells monitored, and in 3 per cent drinking water standards were exceeded. The first results of a new monitoring programme covering 35 pesticides show traces of pesticides in 40-75 per cent of wells in some counties.

The eutrophication of *Danish inner marine waters* is primarily the result of leaching of nitrates from agricultural soils, though deposition of evaporated ammonia is also an important factor.

Soil erosion and soil quality

Most agricultural soils are subject to wind erosion, particularly in western Denmark. Because of the mild climate and geomorphology, only 3 per cent of agricultural soil is highly sensitive to water erosion. Water erosion from wetland drainage has led to ochre pollution of water bodies in parts of Jutland.

Danish soils in general do not contain critical amounts of heavy metals. Agricultural soil contamination by cadmium fell by a quarter between 1990 and 1993, mainly due to lower consumption of phosphate fertilisers and lime. Cadmium, lead and mercury loads on the 4-5 per cent of farmland fertilised with sewage sludge may cause concern over the long term. Risk assessment studies of the effects of sewage sludge on soil micro-organisms and fauna are being conducted by the Danish EPA. Excessive nutrient loads in moors and heathland have caused soil acidification.

Greenhouse gases and ammonia emissions

In 1995, agriculture accounted for 13 per cent of total gross emissions of the main *greenhouse gases* (in CO_2 equivalent), 60 per cent of methane emissions, 80 per cent of those of nitrous oxide and 3 per cent of those of CO_2 (Chapter 8). Together with fuel combustion, *ammonia* volatilisation from liquid manure is a major source of nitrogen emissions, contributing to the eutrophication of ecosystems such as moors and heathland. As a result of improved manure storage, ammonia emissions from agriculture have fallen by 23 per cent over the last 15 years. Over the same period methane emissions have fallen by 20 per cent, due to reduced emissions from enteric fermentation, and nitrous oxide emissions by 5 per cent due to reduced fertiliser use.

Impact on biodiversity and landscape

Over the last 50 years, agriculture has undergone major structural changes resulting in *extensive loss of biodiversity* (Chapter 5). In particular, property amalgamation has eliminated many small biotopes, drainage has reduced the area of wetland habitats, and the widespread use of pesticides has affected a broad range of plant and animal life. As agricultural land covers almost two-thirds of the country, it is a prominent element of the *landscape*. Considerable specialisation and regionalisation of production have reduced landscape variety: there has been a concentration of cattle-keeping in West Jutland, an increase in farms devoted only to crop production, and a 40 per cent reduction in permanent grasslands since 1960 mainly due to reclamation of wet meadows and pastures. Meadows, uncultivated dry grassland and heaths have shrunk by 80 per cent over the last century; remaining areas are threatened with overgrowth, as summer grazing and hay harvesting are no longer practised.

2. Responses

Policy objectives concerning agriculture and the environment

The major policy issues concerning agriculture and the environment are high nutrient discharges to ground and surface waters and the risk of groundwater contamination by pesticides. The first action programme to reduce nitrogen, phosphorus and organic matter discharges, the so-called *NPO Action Plan* in 1985, was replaced in 1987 by the more comprehensive *Action Plan for the Aquatic Environment*, which focused on reducing nitrogen and phosphorus leaching, while the 1986 *Pesticide Action Plan* focused on reducing pesticide application. The

1991 *Action Plan for Sustainable Agriculture* and the 1998 second *Action Plan for the Aquatic Environment* confirmed the following targets:

- *reduction of nitrogen discharges* from agriculture by 50 per cent compared with the 1985 level, which was evaluated at 230 000 tonnes from field leaching and surface run-off and 30 000 tonnes from farmyard manure storage. Target reductions were set at 100 000 tonnes for the field load and 27 000 tonnes for the farmyard load by 1993 and the deadline was later postponed to 2003;
- *reduction of phosphorus discharges* from agriculture, sewage treatment plants and industry by 80 per cent by 1993 compared with the 1985 level. The reduction was initially aimed mainly at waste water discharges, though as sewage treatment has been considerably improved the contribution of agriculture to phosphorus pollution of lakes has become more apparent;
- *reduction of chemical pesticide consumption and treatment frequency* by 25 per cent by 1990 (compared with the 1981-85 average) and by a further 25 per cent by 1997, and banning sales of the most hazardous pesticides.

An Act on Organic Farming Production was passed in 1987 and an *Action Plan on Organic Food Production* was approved in 1995. The Organic Agricultural Council aims to convert 7 per cent of arable land to organic farming by 2000.

There are no specific targets for landscape *biodiversity* enhancement on farmland, although small biotopes are generally protected under the Nature Protection Act.

Policy measures

Measures to reduce nutrient loadings

Since 1985, *limits have been set on livestock density* to balance livestock manure production and the area of adjoining farmland on which to apply it. Limits on manure applied to land are based on livestock units (LU), with 1 LU equivalent to the annual manure production of one dairy cow, 30 pigs or 2 500 broilers. High livestock density farms must provide the municipality with a written agreement by neighbouring farms to receive excess manure. To curb the concentration of livestock production in very large units, since 1994 farms between 250 and 500 LU must own 75 per cent of the land needed to spread the manure and farms over 500 LU must own all of it. According to the 1991 EU nitrate directive, the limit of 2.3 LU/ha/year for cattle, 1.7 LU/ha/year for pigs and 2 LU/ha/year for poultry should be lowered to an average of 2.1 LU/ha/year by 1999 and 1.7 LU/ha/year

by 2003 (from 2000, 1 LU will be equivalent to 100 kilograms of nitrogen; from 2002, this will apply to all livestock).

Since 1985, animal manure must be applied in spring and summer when the crop can take up the nutrients, or before October on areas with subsequent green cover (winter rape and grass). Farmers are therefore required to have the *manure storage capacity* needed to apply it when there is least risk of nitrogen leaching. Farms over 31 LU are required to have six to nine months storage capacity. Between 1987 and 1997, farmers received grants covering 25-35 per cent of storage investment costs up to DKr 150 000 per holding. Continuous progress in reducing the protein content of fodder has lowered the nitrogen content of animal wastes, especially that of slaughtering pigs.

Since 1992, a minimum share of the *nitrogen* applied must be from manure in order to reduce consumption of commercial fertilisers; initially these shares were set at 45 per cent for pigs and 40 per cent for cattle, but since 1997 they are 50 per cent and 45 per cent respectively. In 2002, the minimum shares will be 65 per cent for pigs and 60 per cent for cattle.

Since 1988, farmers have been required to draw up annual *crop rotation plans* including green cover specifications; since 1990, 65 per cent of farmland must be under green cover crops during the autumn and winter to reduce nitrate leaching. These include cash crops, winter grain cereals, and crops with long growing seasons such as beets and potatoes. This regulation has led to considerable land conversion from spring to winter grain cereals.

Since 1988, farms with over ten hectares of arable land must draw up a *fertilisation plan* for nitrogen and phosphorus according to the economically optimal dosages for individual crops and the share of livestock manure and commercial fertilisers. Since 1994, farmers have been required to prepare a farm level *fertilisation account* at the end of the year stating the total crop demand and use of nitrogen, the intensity of use of nutrients from manure, and the share of manure used from the previous year's storage. Every year half of these reports, as well as crop rotation plans, must be submitted to the Ministry of Agriculture on request and spot checks can be undertaken.

The Watercourses Act requires farmers to leave uncultivated a two-metre *buffer zone along watercourses.* Also contributing to reducing nutrient supply and leaching are: protection of *wetlands* (in which bacteria convert nitrate to nitrogen released to the atmosphere), *organic farming* (through more stringent requirements on the maximum level of fertilisation), the maintenance of *extensive grass-*

land (as part of EU agri-environmental measures) and *afforestation* (as part of EU farm forestry measures), and the *ban on straw burning* (the surplus straw must be incorporated into the soil).

Since 1988, farms with an annual production of over 7 500 slaughtering pigs or over 625 000 broilers are listed enterprises and have to be licensed; since 1994, the establishment, extension or change of manure storage facilities in these farms has to undergo an *environmental impact assessment* (EIA) carried out by the county.

Measures to reduce pesticide use and application

Since 1987, regulations controlling chemicals such as pesticides have been considerably tightened (Chapter 4). As a result, a quarter of the products sold in 1993 are now banned. An international assessment carried out at the request of the Danish EPA in 1997 concluded that the *Danish pesticide approval scheme* is one of the most stringent in the EU with respect to groundwater protection. In 1992, a report published at the request of the Parliamentary Committee on Sustainable Agriculture called for all types of toxicity (human health, aquatic life, etc.) to be considered when measuring the impact of pesticides on the environment.

Measures to reduce pesticide use include a tax on pesticides, research and development, information and advice, mandatory training for pesticide users (31 000 farmers have been trained), inspection of spraying equipment and mandatory spraying logbooks. Spraying is prohibited in certain areas and restricted in others in accordance with the Nature Protection Act.

Soil protection measures

Financial support is provided to encourage farmers to plant shelterbelts. Since 1985, wetlands with high ochre pollution cannot be drained. In areas that have already been drained, farmers are eligible for compensation. Environmental regulations from 1996 list waste products which can be applied on farmland and the application limits (250 kg N and 40 kg P/ha/year together with animal manure); they can be used only for fertilisation and in areas that comply with soil quality standards. Denmark has strict rules on the composition of sewage sludge (Chapter 2).

Measures to reduce ammonia emissions and air pollution

Regulations to reduce ammonia volatilisation require that all liquid manure storage containers be covered or closed and that liquid manure and silage effluent applied on bare soil be ploughed within 12 hours. To reduce odour pollution,

at least 50-300 metres (according to the number of animals) is required between new livestock housing and adjacent buildings. Straw burning was banned in 1990 to reduce atmospheric pollution.

Biodiversity and landscape protection measures

The 1987 Strategy on Marginal Land provides a framework for addressing the impact of agriculture on landscapes and nature. It is implemented through regulations on spatial planning, nature protection, forestry and watercourses, as well as provisions relating to the agricultural sector. The Planning Act defines urban and rural zones to protect the countryside against uncontrolled development, reserve it for agricultural purposes and preserve landscapes. The Watercourses Act prohibits the channelling of natural watercourses. Compensation is provided to farmers whose land is affected by watercourse restoration projects. Since 1994, incentives have been provided to farmers for tree planting as part of the implementation of EU farm forestry measures. The emphasis has been on five-row shelterbelts, for which farmers are reimbursed 50 per cent of establishment costs (70 per cent for collective establishment). The Nature Protection Act prohibits farming in nature protection zones along watercourses, coastlines and lakes as well as on heaths, salt marshes, grasslands and uncultivated dry meadows (Chapter 5). In areas protected through Conservation Orders, farmers are compensated for loss of income.

Agri-environmental measures

Since 1994, direct payments have been made available to farmers implementing (through voluntary five-year agreements) EU agri-environmental measures, which are grouped into *four main programmes*: Environmentally Beneficial Farming, Organic Farming, the County Programme and the Training and Demonstration Programme. The main thrust is to reward farmers who go a step further than the regulatory environmental constraints imposed on farming practices. Since 1997, payments are restricted to activities that protect habitats and landscapes and prevent water pollution in *2 500 sensitive farming areas* (SFAs) defined by guidelines from the Ministry of Agriculture (Table 7.1). SFAs cover 365 000 hectares (or 13 per cent of AAU in each county) in semi-wetlands (52 per cent), groundwater protection areas (28 per cent), coastal areas (11 per cent) and drylands with high conservation priority (9 per cent), with an emphasis on soils of poor agricultural value, organic and sandy soils, valuable and sensitive landscape types, marshland, tunnel/river valleys (meadows and wet pastures) and reclaimed land.

Under the *Environmentally Beneficial Farming Programme*, payments are granted for:

– overall nitrogen inputs under 60 per cent of the needs defined by national standards, excluding areas set aside or cultivated with leguminous non-food crops;
– rye grass ground cover over at least five hectares;
– the maintenance of extensive grasslands, with limits on fertilisation, grazing density and pesticide application and mowing periods that allow for the protection of ground-nesting birds;
– pesticide spray-free margins of 12 metres on arable land along watercourses, lakes and some hedgerows;
– 20-year set-aside, with arable land permanently covered by vegetation and no irrigation used, though fertilisers and pesticides are allowed and non-commercial extensive grazing to avoid shrub and tree overgrowth is permitted.

Under the *County Programme*, payments are granted for establishing 12-metre cultivation-free margins along fields with grain or seed crops in rotation. Payments are also offered to farmers who accept a raised water level due to reduced drainage. Permanent grassland management, including the clearance of shrubs and trees, and recreational or public access are also subject to payments.

Table 7.1 **Sensitive farming areas: guidelines for their designation**

Groundwater areas where the nitrate level is above 25 mg/l or above 10 mg/l and increasing
Water catchment areas under pressure from nutrients
Denitrification areas, including freshwater wetlands and salt marshes
Buffer zones along lakes and watercourses
Existing and former salt marshes in coastal areas
Dry agricultural areas of high natural value, including heaths and upland pasture
Recreation areas suitable for public access
Ecological corridors (20 metres wide)
Cultural landscapes, including traditional hedges, old trees, walls, dikes, mounds, etc.

Source: Ministry of Agriculture.

Measures to support *organic farming* include a labelling system in which production and marketing are controlled and certified by the Ministries of Agriculture and of Health. According to rules set by the Ministry of Agriculture, organic farmers must not use chemical fertilisers and requirements for the maximum level of fertilisation at farm level are more stringent (1.4 LU/ha/year), with an additional limit on field fertilisation (2.8 LU/ha/year). The implementation of EU agri-environmental measures since 1994 has increased area payments to organic farmers, who must convert at least one hectare per year (excluding permanent grassland). After four years all the land must be organically farmed. A three-year regressive conversion payment allows for income losses.

Agricultural research and advisory services

Research and development has played an important part in promoting environmentally friendly agricultural practices. Efforts have been made to ensure that research results are effectively transferred to farmers by advisory services. Farmers are kept informed about codes of good agricultural practices through detailed guidelines issued by the *advisory services*, which also help individual farmers prepare crop rotation and fertiliser plans and calculate storage capacity. From the mid-1980s, several *agricultural research* programmes have focused on environmental protection. The 1994 National Strategy for Public Sector Agricultural Research and Development increased the priority given to the quality and safety of agricultural products, landscapes, and animal health and welfare. In 1998, the Agricultural Council of Denmark completed a two-year Environmental Management in the Agriculture and Agri-Food Sector demonstration project, bringing together farmers and the food industry. It is intended to develop environmental farm management plans in order to strengthen enforcement of regulations and standards.

Agri-environmental expenditure

Agri-environmental budgetary expenditure on direct payments and capital grants amounted to DKr 250 million in 1997. First, *organic conversion grants* rose from DKr 57 million in 1996 to DKr 100 million in 1997 (as per hectare payments doubled to DKr 2 000 for the first two years, falling to DKr 800 the third year). Secondly, direct payments to encourage *environmentally friendly farming* increased from DKr 20 million in 1996 to DKr 80 million in 1997; they are provided during five years (20 years for set-aside of arable land) and range from DKr 375 to DKr 2 125 per hectare depending on the activity. Thirdly, capital grants for *manure storage* amounted to DKr 50 million in 1997, totalling DKr 500 million over the last ten years. Finally, payments for *shelterbelt establishment* amounted to DKr 20 million in 1997.

Public expenditure on environmental *research* in agriculture has amounted to about DKr 50 million annually since the mid-1980s, with priority given to organic farming (DKr 98 million in 1988-92, DKr 40 million in 1992-95 and DKr 98 million in 1995 to establish an organic research station). In 1997, advisory services for organic farmers were estimated at DKr 8 million. Government expenditure on research relating to pesticides is financed by the taxes on pesticides.

3. Environmental Performance

Towards sustainable agriculture

Considerable efforts have been made to begin moving Danish agriculture along an environmentally sustainable path: reduction of commercial fertiliser and pesticide application, removal of sensitive land from agricultural production, a start in using direct payments to support agri-environmental measures in designated sensitive farming areas, the take-off of organic farming. However, there is still a long way to go before policy *objectives of reducing agricultural pressures on the environment* are achieved. The biological death of the Mariager estuary in eastern Jutland in 1997 sparked off a public controversy over agricultural pollution, due to the high level of nitrates found in the estuary. There is increasing public concern about the growth in broiler and pig farming, low standards of animal welfare, the use of growth promoters and antibiotic feed additives, and the growing volumes of manure with limited land available to apply it.

Nitrogen discharges: still too high

All the *measures to reduce nitrogen discharges* contained in the codes of good agricultural practice of the 1991 EU nitrate directive were already part of Danish legislation. Concerning limits on livestock density, however, Denmark has applied for a derogation with respect to cattle holdings (dairy farming) to allow the application of animal manure of up to 230 kg N per hectare on farms where over 70 per cent of the land is cultivated with high nitrogen demand fodder crops; other farms would be limited to 140 kg N per hectare. Achievements can be noted in the following areas:

- capacity and quality of *manure storage facilities* have considerably improved, as the share of farms with nine months storage capacity increased from 40 per cent in 1989 to 80 per cent in 1996;
- the share of *manure applied* in spring and summer increased from 56 per cent in 1990 to 85 per cent in 1996;

- *fertilisation and crop rotation* plans have been introduced on 80 per cent of farms. Most (87 per cent) of the fertiliser accounts submitted in 1996 were approved, less than 1 per cent revealing an excess dosage above 20 kg of nitrogen per hectare;
- at the field level, *fertilisers applied* still exceed the economically optimal level in 20-30 per cent of the cropped area (especially on farms with over 2.3 LU/hectare);
- a growing share of the agricultural area (87 per cent in 1995/96) is kept winter-green to prevent *nitrogen leaching*, but some 30-50 per cent of farmers do not comply with the two-metre border zones along watercourses;
- the *share of nutrients from livestock manure* increased from 34 per cent in 1990 to 44 per cent in 1996, reducing the application of commercial fertilisers.

Nevertheless, the implementation of these measures has not been sufficient to meet the 50 per cent *nitrogen discharge reduction target*. Though nitrogen fertiliser use has fallen by 25 per cent in the last ten years, the quantity of manure has not fallen significantly and increasingly exceeds the capacity of field application on individual farms, especially pig farms. Nearly half the pig farms have over 1.7 LU per hectare and need to find outlets for their surplus manure to comply with regulations on maximum use of manure per hectare.

A 1998 status report emphasised that *further measures were necessary to achieve the target* for nitrogen loads from agricultural fields. If the target of reducing 27 000 tonnes of nitrogen discharges from the farmyard load has been achieved, mainly through major efforts in developing and improving manure storage facilities, data and modelling show that between 1989/90 and 1995/96 only around a third of the reduction target of 100 000 tonnes of nitrogen discharges from the field load was achieved, largely due to improved manure management and lower consumption of commercial fertiliser. Existing measures should reduce nitrogen discharges by another third by 2003. The 1998 Action Plan for the Aquatic Environment should reduce discharges by the remaining third, taking account of additional leaching due to the reduction of set-aside schemes under Common Agricultural Policy. These measures include better use of livestock manure (manure currently accounts for a quarter of total nitrogen uptake by crops), reduced fertilisation standards (to ensure a more accurate calculation of the nitrogen requirement of crops and accounting of nitrogen in livestock manure) and the establishment of wet meadows (Table 7.2).

The *introduction of economic instruments* to control fertilisation has been the subject of much debate. Two measures became effective in August 1998: administrative fines of DKr 10 per kilogram of excess fertilisation up to 30 kg/ha and DKr 20 per kilogram beyond; and a fertiliser tax of DKr 5 per kilogram on all purchases of fertilisers other than by farmers who prepare fertilisation accounts (Chapter 2).

Other discharges and emissions: good progress

The overall *phosphorus discharge* reduction target of 80 per cent has been met, mainly due to the considerable progress made in municipal and industrial wastewater treatment. Phosphate fertiliser use over the last 15 years has also been reduced by almost two-thirds, though fields fertilised by animal manure may still receive excessive amounts. However, phosphorus leaching from agricultural

Table 7.2 **Additional measures to reduce nitrogen discharges from agriculture by 2003**[a]

Measures	Predicted reduction in		Land affected (hectares)
	N leaching (tonnes)	N commercial fertiliser consumption (tonnes)	
Wetlands	5 600	1 100	16 000
Sensitive farming areas (SFAs)	1 900	10 000	88 000
Afforestation	1 100	2 440	20 000
Improved feed	2 400	–13 600	
Livestock density	300	600	
Use of nitrogen in manure[b]	10 600	26 000	
Organic farming	1 700	17 600	170 000
Green cover[c]	3 000	3 000	120 000
Fertiliser consumption standards[d]	10 500	40 000	
Total	37 100	87 140	414 000

a) Under the 1998 second Action Plan for the Aquatic Environment.
b) A 15 per cent increase over existing rules.
c) A further 6 per cent of farmland to be sown by grass cash crops.
d) A 10 per cent reduction of nitrogen commercial fertiliser applications to crops.
Source: National Environmental Research Institute; Danish Institute for Agricultural Science.

land has become a leading source of water pollution due to build-up in soil and reductions in loads from wastewater treatment and industrial discharges.

Agriculture accounts for 90 per cent of *pesticides* consumed. The use of pesticides in agriculture (sales of active ingredients) has decreased by 40 per cent over the last ten years (due to the introduction of new types of pesticides), in line with the reduction target. The establishment of plant protection groups consisting of eight to ten farmers and an agricultural adviser has had a major effect on the choice and dosing of pesticides. However, frequency of treatment has remained unchanged. Less than 16 per cent of farmers have altered their crop rotation schedules, though the use of varieties resistant to fungal diseases is far more widespread. Most farmers keep spraying logbooks, but large pesticide users such as horticultural producers are less inclined to keep records and spraying equipment is often well below standard. It is too early to evaluate the effects of the pesticide tax. An independent expert assessment of the consequences of a further reduction or complete phase -out of pesticide consumption in agriculture, and of opportunities for alternative pest control methods, is due at the end of 1998. Preliminary findings suggest that there is substantial scope for reducing pesticide use at low cost to farmers.

Although *ammonia emissions* have fallen over the last 20 years as a result of improved storage, their level is still high and an Action Plan to Reduce Ammonia Volatilisation will be submitted to Parliament in the 1998/99 session.

Nature and landscape: a low priority

Implementation of the Nature Protection Act (protection zones) in agriculture has proven difficult. *Nature conservation* is given a low priority in agri-environmental measures focusing on nitrate leaching and pesticides, though the maintenance of extensive grasslands has contributed to the enhancement of landscapes and of biodiversity. Varieties, land races, wild types and breeding lines are preserved together with other plant genetic resources in the Nordic Gene Bank, though few conservation programmes have been carried out in Denmark to safeguard endangered species *in situ*.

Landscape management is not perceived as a key agri-environmental issue, and the most valuable protected areas have been excluded from core SFAs with the argument that fertilisation is already prohibited. However, incentives to preserve cultural landscapes were recently introduced in the County Programme.

Agri-environmental measures: only a start

By the end of 1996, only a quarter of total sensitive farming areas, or 58 000 hectares, was covered by agreements and only 23 per cent of the funds available for *agri-environmental measures* under the Environmentally Beneficial Farming Programme had been used, largely reflecting unattractive compensatory payments and land competition from manure disposal. This was notably the case for 50 000 hectares designated in three counties to protect groundwater against nitrate contamination; agreement was not reached with any of the farmers, despite the offer of payments for 20-year set-aside of the land and additional support for its afforestation. Although no target had been defined for the programme, over 80 per cent of the area covered by agreements was for protection of semi-natural grasslands against agricultural intensification or abandonment, as these grasslands are found in marginal agricultural production areas. The uptake of measures under the County Programme concerns only small areas.

Organic farming has taken off

Around 2 200 certified *organic farms cover 93 000 hectares* (3.5 per cent of the total agricultural area), of which 40 per cent has been converted and the rest is under conversion. These farms are mostly large (an average of 55 hectares). The ten-fold growth in the number of organic farms over the last decade can be explained by a strong grassroots producer organisation, budgetary support to organic farmers, state inspection of the organic label, support from the processing industry (the largest Danish dairy company gives premiums to farmers converting to organic milk production), high consumer demand, and an awareness campaign by the Ministry of Agriculture. Although the number of farmers applying for organic conversion grants fell drastically in 1992 due to uncertainty about grants and marketing outlets, improved prospects and higher payments since 1994 have brought an expansion beyond expectations, as shown by the 12 per cent overuse of funds under EU agri-environmental measures.

Provided such payments are maintained, the objective of the Organic Agricultural Council to double the area of organic farms by 2000 can be met, though probably with a delay of a few years. The 1995 Action Plan on Organic Food Production aims to meet consumer demand, with retailers estimating that organic food will supply 15-20 per cent of the domestic market by 2000. An independent expert committee is undertaking a cost-benefit analysis of the conversion of all Danish agriculture to organic production.

Implementation and cost-effectiveness

Growing awareness of the environmental impacts of agriculture has been demonstrated by the creation of an environmental unit in the Ministry of Agriculture and an agricultural unit in the Ministry of Environment and Energy, and by the 1991 Action Plan for Sustainable Agriculture and the Action Plans for the Aquatic Environment. However, there is a need to go further, as cost-effectiveness requires agriculture to contribute more to nutrient discharge reduction, given the large efforts already made for industrial and municipal effluent treatment, and to establish a *comprehensive agri-environmental strategy* dealing with all the technical and policy aspects of the interface between agriculture and the environment and creating a better balance between concerns about manure, fertilisers and pesticides and those relating to nature, biodiversity, landscape protection and greenhouse gas emissions. The various action plans relevant to agriculture could then be brought together within such a strategy.

The shift in the CAP from market price support to direct payments, some of which are subject to environmental cross-compliance criteria, and the increasing attention given to agri-environmental measures in the CAP reform process, should *increase the efficiency of natural resource use* by reducing distortions in the supply of agricultural commodities. To increase farmers' take-up of *agri-environmental measures*, *incentive levels* should take account of their economic and environmental costs and benefits and apply the polluter pays principle. Payments should be linked to environmental outcomes or farming practices which determine those outcomes, rather than to the volume or type of production or production factors. Training of farmers on implementation of agri-environmental measures should be stepped up.

Other OECD countries' experience with the changes in relative prices of agricultural inputs resulting from general taxation has shown that this was not a very efficient way to reduce pollution. Targeted *economic instruments* such as the recently adopted fine on nitrogen surpluses should increase the incentive to use nitrogen from animal manure more efficiently than a general tax on nitrogen fertilisers, and they are consistent with the polluter pays principle. In addition, *fertilisation accounts* (which should be encouraged by the fertiliser tax) can make it possible to monitor farmers' efforts aimed at sustainable management, though their usefulness depends on regular checking and enforcement. The *tax on pesticides* should be fixed according to products' toxicity (with all types of toxicity being considered) and a fixed amount levied per kilogram of active ingredient, in preference to the current ad valorem tax which makes the cheapest and often less efficient products (those for which more treatments are needed) even more attractive. The cost-effectiveness of economic instruments in agri-environmental policy

greatly depends on the *transaction costs* (implementation, enforcement and monitoring): thus there is a need to balance the targeting of measures taken because of environmental concerns with the public resources required to implement and enforce these measures.

The creation of SFAs is a good way to address the *site specificity* of many environmental issues associated with farming. However, counties have followed their own objectives in designating SFAs, which in some cases do not correspond to national goals. SFAs should be designated as part of an overall environmental protection strategy and not consist mainly in selecting marginal agricultural land. They should not correspond to a fixed percentage of farmland in each county, regardless of differences in agricultural and environmental conditions. A complementary way of implementing agri-environmental measures is the *farm level approach*. Farmers are required to report annually on their fertilisation plans, but there is no systematic assessment of their farms' overall environmental performance. The Danish EPA and Danish Agricultural Advisory Centre are testing an Environmental Management System on 300 farms where agri-environmental measures are made available to farmers using *certified farm management systems*.

Agri-environmental objectives and measures should be monitored and evaluated in a more systematic and comprehensive manner. *Overall performance assessments* for each environmental target should show the level of implementation of specific measures (in terms of farmer participation, area covered, etc.) and environmental effects. Environmental regulations in agriculture are mainly enforced by the Ministry of Agriculture (fertilisation accounts) and municipalities (timeliness of manure spreading, distance to neighbours). Counties are responsible for land use planning, including the designation of SFAs, and for EIAs relating to large animal farms. Their enforcement role should be increased to improve implementation of agri-environmental measures and strengthen control over compliance with environmental standards on individual farms, notably concerning fertilisation accounts.

Part III

CO-OPERATION WITH THE INTERNATIONAL COMMUNITY

8

INTERNATIONAL CO-OPERATION

International co-operation plays a major role in Danish environmental policy, and environmental matters are high on the agenda of Danish foreign policy. This situation stems from the awareness among the Danish public and policy makers alike that with its small territory and open economy, Denmark's environmental conditions are very much influenced by the international environmental and economic context: *regional environmental interdependencies* in northern Europe and as a riparian State of both the North Sea and the Baltic Sea; and *regional economic interdependencies*, notably within the EU and with other Nordic States. Denmark also promotes international environmental co-operation and environmentally sustainable development for reasons of *solidarity*.

1. Climate Change and Global Co-operation

Climate change

Targets

Denmark is committed to taking measures to return greenhouse gas emissions to 1990 levels by 2000 under the UN *Framework Convention on Climate Change* and has also undertaken to work towards the EU target of stabilising greenhouse gas emissions at 1990 levels by 2000. The *Kyoto Protocol* adopted in December 1997 commits the EU region to reduce emissions of six greenhouse gases by 8 per cent between 2008 and 2012: CO_2, nitrous oxide, methane (emission base year 1990) and three halocarbon gases that are used as substitutes for CFCs (emission base year 1995). Denmark's contribution to meeting these targets has been set at a 21 per cent reduction of emissions of the six gases, based on emissions adjusted for climatic variations and electricity trade,

though this commitment is conditional on the EU taking action collectively on measures such as carbon taxation. In addition, a recent resolution by Parliament instructs the government to work towards a *50 per cent reduction in the 1990 level of CO_2 emissions* in all industrialised countries by 2030.

At *domestic level*, the 1990 *Energy Action Plan* set the target of a 20 per cent reduction in energy-related CO_2 emissions by 2005 compared with 1988. This target was broken down in the 1996 *Energy 21 plan* into a target reduction of at least 28 per cent for stationary sources and a stabilisation of transport emissions, which currently account for about 25 per cent of total emissions. A further target of reducing transport emissions by 25 per cent in 2030 compared to 1988 was also set.

Reduction of CO_2 emissions

Denmark's current strategy for reducing CO_2 emissions is contained in the 1996 *Energy 21* plan. The plan considers that the continuation of existing trends in energy efficiency improvements (e.g. higher appliance and equipment efficiencies, expanded use of cogeneration) should bring a 12 per cent reduction in CO_2 emissions by 2005 relative to 1988 (Chapter 3). The additional 8 per cent reduction needed to reach a 20 per cent reduction should be achieved through a combination of more vigorous *energy efficiency* improvement measures, substitution of coal by biomass, and other renewable energy and transport measures, as follows:

- electricity conservation programmes: 0.7 per cent;
- labelling and efficiency standards for appliances: 0.6 per cent;
- house energy labelling regulations: 0.9 per cent;
- public sector conservation: 0.4 per cent;
- substitution away from coal in electricity generation: 2.3 per cent;
- measures in the transport sector: 3.1 per cent.

Denmark strongly supports the development of *minimum EU-wide energy efficiency standards* for a range of energy-using equipment. Progress on this issue within the EU has been slow and Denmark is studying opportunities to implement specific product-oriented measures through bilateral and multilateral co-operation.

Denmark introduced a CO_2 tax on energy in 1992 (Chapter 6). The tax has since been increased and extended to industrial energy users (Table 8.1). In view of the introduction of *carbon taxes* in several EU countries and Norway, Denmark has expressed an interest in co-ordinated positions among groups of countries on

this matter. The possibility of a Nordic approach to a carbon tax has been discussed, and it has been noted that the broader the international agreement on harmonised fuel taxes, the higher and the more effective such taxes can be. Emission trading has also been discussed by Nordic countries.

Denmark's national *CO_2 emission data* differ from those measured internationally, for instance by the IEA, as Denmark adjusts its emission data for temperature variations and, unlike other countries, for trade in electricity. Electricity trading between Denmark and other Scandinavian countries fluctuates considerably from year to year, depending on the availability of hydropower in Norway, where it accounts for nearly 100 per cent of electricity generation, and in Sweden, where it accounts for 42 per cent. Net Danish electricity exports in 1996 were 1.3 million tonnes of oil equivalent, over 40 per cent of domestic consumption, whereas in wet years such as 1990 net imports have represented almost a quarter of domestic consumption. Because Danish electricity exports are based on coal-fired generation, they have a considerable impact on the country's CO_2

Table 8.1 **Energy CO_2 tax rates,**[a] 1996-2000

(DKr per tonne of CO_2)

	1996	1997	1998	1999	2000
Sectors with standard rate					
(households, central and local government, some non-profit activities, financial and housing services)	600	600	600	600	600
Sectors with differentiated rates					
(other service industries, manufacturing industries, agriculture, other primary industries)					
Space heating	200	400	600	600	600
Light processes:					
– without voluntary agreement	50	60	70	80	90
– with voluntary agreement	50	50	50	58	68
Energy-intensive processes					
– without voluntary agreement	5	10	15	20	25
– with voluntary agreement	3	3	3	3	3

a) Equivalent CO_2 tax resulting from energy, CO_2 and SO_2 tax rates.
Source: IEA-OECD.

emissions: in 1996, energy-related CO_2 emissions were 22 per cent higher than in 1995.

Denmark plans to double its forested area (presently 4 200 km^2 or 10 per cent of the country) over the next 80-100 years (Chapter 5). The current annual afforestation rate is only about 25 km^2 per year. This afforestation should contribute to increasing *sinks for CO_2*, particularly after 2020.

Reduction of other GHG emissions

Existing policies concerning agriculture (biogas-based cogeneration) and waste management (increased incineration, and reuse and recycling of waste) are reducing emissions of *methane* and are likely to lead to further significant reductions in the future (Chapters 4 and 7). In addition, decreased fertiliser sales as well as improved utilisation of nutrients in livestock manure have limited emissions of *nitrous oxides*, which are expected to fall further as a result of the implementation of the second Action Plan for the Aquatic Environment (Chapter 2). The consumption of *HFCs*, used to replace CFCs in some applications, rose from zero in 1990 to 750 tonnes in 1995; they should be phased out for refrigerant uses by 2006. The Danish EPA is supporting activities to develop products and production processes that would allow HFCs to be replaced by natural cooling agents.

Protection of the ozone layer

Denmark has agreed to phase out or reduce the production and use of ozone-depleting substances such as CFCs and halons (Vienna Convention, Montreal Protocol, London and Copenhagen amendments). An *Action Plan for the Reduction of the Consumption of Ozone-Depleting Substances* was adopted in 1988. As a result, the use of these substances has dropped dramatically, from 7 000 tonnes in 1986 to under 2 000 tonnes in 1993 and 110 tonnes in 1996. The deadlines adopted by Denmark for phasing out ozone-depleting substances are ahead of the schedule of the Montreal Protocol and its amendments: for halon and tetrachloromethane, 1 February 1992; for CFCs and 1,1,1-trichloroethane, 1 January 1995; and for methyl bromide, 1 January 1998. The use of HCFCs in new refrigeration equipment will be prohibited from 1 January 2000, and a total ban for all purposes will be introduced from 1 January 2002.

Concerning *existing ozone-depleting substances*, the Ministry of Environment and Energy initiated a voluntary collection and recycling system now independently run by KMO, the association of refrigeration installers, importers and

wholesalers (grouping about 1 000 companies) with the support of economic incentives. The collection, recovery or destruction of CFCs, HFCs and HCFCs from scrapped refrigeration equipment, as well as re-servicing and retrofitting, are financed by a tax of DKr 30 per kg on new CFCs and HCFCs. KMO is paid DKr 5-10 per kilogram collected. Since 1993, about 150 tonnes has been collected this way, of which 70 per cent has been recovered and 30 per cent destroyed. For halon used in fire protection equipment, the Halon Bank (set up by the Ministry of Environment and Energy and run voluntarily by fire prevention contractors) collects, recycles or destroys the stock of halon. Its activities are funded by the revenue from a tax of DKr 30 per kg of new halon. Since 1993, about 15 tonnes of halon-1301 and 2 tonnes of halon-1211 have been collected and most has been reused.

For 1997, 1998 and 1999 Denmark is contributing US$44 million to the Vienna/Montreal Trust Funds and the interim *Multilateral Ozone Fund*. In addition, the Danish Government recognises the need to *help phase out ODS in central and eastern European countries* and has provided US$1.75 million in bilateral assistance to this effect.

Marine pollution and marine traffic

MARPOL

The MARPOL 1973/78 Convention covers all technical aspects of the *prevention of pollution from ships* (except waste dumping, covered by the London Convention). The Baltic Sea is a special area under Annex I of MARPOL, requiring special protection against oil spills. Denmark applies lower port and pilot fees to double hull tankers, as well as segregated ballast tankers and oil tankers of alternative design.

Despite the aerial surveillance system for marine pollution in place over Danish waters, and the prosecution of the captains responsible, *illegal spills* in the Baltic and North Sea remain numerous. A study carried out in 1996 by the Danish EPA indicated that the high frequency of illegal discharges on the north-western coast of Jutland and in the Skagerrak pointed to such discharges becoming normal practice for ships as soon as they leave the MARPOL zero-discharge area at the mouth of the Kattegat. The number of birds killed by oil slicks has fallen in recent years in the Baltic, though not in the North Sea.

The Danish EPA and the Ministry of Defence are responsible for *combating oil and chemical pollution* at sea. Equipment is available to cope with oil pollution

emergencies up to 10 000 tonnes and for the clean-up of most chemical spills. There is no specific fund for oil pollution clean-up and compensation.

To reduce *air pollution from ships* (SO_x, NO_x), the Baltic Sea area has also been designated as a special area under the MARPOL annex on this subject. Since 1990, many passenger ferries have voluntarily used fuel with a sulphur content below 0.5 per cent. Denmark has proposed that the sulphur content of fuel used by ships in EU waters be limited to 1.5 per cent.

Port state control

Denmark participates in the Memorandum of Understanding on Port State Control and meets its requirements concerning reporting procedures and information exchange. In particular, about 20 per cent of ships calling at Danish ports are inspected. No special fee is levied for access to Danish port reception facilities, so as not to discourage their use.

Other marine pollution aspects

Denmark recently signed and ratified the 1990 *London Convention* (Oil Pollution Preparedness, Response and Co-operation). The delivery of oily waste from ships is mandatory in Danish ports, and Denmark is pushing for this measure to be made mandatory at EU level and in all Baltic Sea ports.

Denmark advocates the world-wide control of *persistent organic chemicals*. It contributed to the establishment in July 1998 of a negotiating committee in charge of preparing a global, legally binding agreement on at least 12 persistent organic pollutants before 2000, within the framework of the UNEP Global Programme of Action for the Protection of the Marine Environment from Land Based Activities.

Trade and the environment

Concerning trade and the environment, Denmark makes considerable use of the European Union as a forum to make its views known. It advocates *improved integration of environmental concerns in multilateral trade* and has proposed wider recognition of eco-labelling for a range of internationally traded products such as timber.

Denmark has banned the *export of hazardous waste to non-OECD countries* for final disposal and recovery (OECD amber and red lists) since 1998 (Chapter 4). It is seeking to have certain provisions of the Basel Convention tightened, notably through a ban on the export of some types of toxic chemicals.

Denmark participates in *international co-operation on chemicals* within the EU, the UN, the OECD and the Nordic Council. It has signed the Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. It strongly supports international negotiations to create an instrument to control the spread of persistent organic chemicals in the global environment. More generally, Denmark would like to see the establishment of a framework convention on chemicals that would integrate and strengthen activities under a range of existing international agreements and arrangements such as the Vienna Convention, the PIC regime, the Geneva Convention and the Global Action Plan on the Seas.

Follow-up to UNCED

Denmark has ratified the *Convention on Biodiversity* and supports the adoption of a complementary global convention on the protection and sustainable use of forests. It was one of the first countries to ratify the *Convention to Combat Desertification* in 1995 and has set aside funding for the Convention Secretariat, as well as DKr 10 million for projects in six countries in Southern Africa. The Danish local *Agenda 21* campaign was launched in 1994 as a joint project between the Ministry of Environment and Energy, the National Association of Local Authorities and the Danish Association of County Councils.

In November 1997, the Danish Parliament held a debate on the initiatives that the government should take to *follow up on the outcome of the United Nations General Assembly Special Session (UNGASS)* on sustainable development (New York, June 1997). It called upon the government to take national follow-up measures by developing further environmental planning (including improved environmental assessments of bills and the national budget) and considering a way to ensure a continuous assessment of subsidies, indirect taxes and quotas, with a view to evaluating their effect on sustainable development. Parliament also recommended that at international level the government maintain its action to increase financial transfers from rich to poor countries and for sustainable development, continue efforts to make progress on specific problems relating to biodiversity and forests, and strengthen the UN Commission on Sustainable Development as a permanent forum for global environmental decisions.

Denmark endorses a substantial strengthening of *international environmental law*. It has ratified all but a few international conventions (Annex III). In particular, it has not yet ratified the 1982 Montego Bay Convention on the Law of the Sea.

2. Aid

Overall development aid

Current Danish development aid policy is laid out in the *Strategy for Development Aid Towards 2000*, endorsed by Parliament in 1994 and implemented by the Danish International Development Agency (DANIDA). The strategy identifies several major cross-cutting themes:

- poverty alleviation (an overriding objective);
- a stronger role for women in development;
- environmentally sustainable development;
- the promotion of democratisation.

Danish official development assistance (ODA) reached 1 per cent of GNP in 1992 and has since not declined, contrary to many other OECD-DAC countries. At *1.04 per cent of GNP in 1996 (US$1.77 billion)*, Denmark has *the highest level of ODA* among OECD-DAC countries (Figure 8.1). The government intends to maintain ODA at this level in the foreseeable future and to increase it along with higher budget appropriations. As shown by recent opinion polls, this high level of development assistance enjoys wide support by the Danish population.

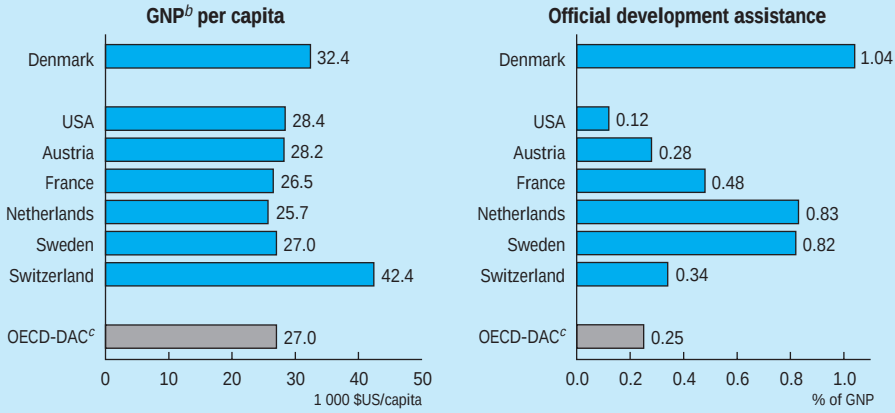
Assistance to central and eastern European countries is over and above ODA. It amounted to DKr 936 million in 1996 (DKr 1.214 billion in 1997), leading to *expenditure on development aid and assistance above 1.13 per cent of GNP*.

Environmental aid

Major *environmental objectives* are identified in about 20 per cent of Danish bilateral ODA. Other environmental assistance includes activities related to the global environment, as well as environmental assistance provided to central and eastern European countries (Table 8.2).

Denmark's *multilateral aid* has a strong sustainable development component. It emphasises the integration of environmental considerations into programmes managed by international development organisations, by working in favour of increased international co-operation and co-ordination on the environment and by furthering sustainable management of natural ecosystems. Denmark has recently redirected its multilateral co-operation towards selectively supporting international institutions whose activities are of high quality and correspond to priority areas as defined by the strategy, notably environmental protection and sustainable development.

Figure 8.1 **Development assistance,**[a] 1996



a) Data refer to official development assistance only.
b) GNP in US$ at current exchange rates.
c) Member countries of the OECD Development Assistance Committee.
Source: OECD-DAC.

Table 8.2 **Environmental assistance,** 1996

(million DKr)

Environmental component of ODA	2 282
– Environmental component of DANIDA funds	*1 893*
– Environmental component of ODA under EDRF	*389*
Environmental component of overseas assistance under EDRF	495
– Assistance to central and eastern Europe	*295*
– Integrated environmental sector programmes	*100*
– Other environmental assistance	*100*
Total environmental assistance	2 777

Source: DANIDA; DANCED; OECD-DAC.

Danish *bilateral aid* is concentrated on a limited number of countries (essentially the least developed and other low-income countries). It focuses on improving aid quality by establishing long-term co-operation programmes, strengthening presence in the field and developing dialogue with development partners, and it supports reforms in receiving countries by emphasising the development and promotion of the private sector. Aid is primarily targeted at 20 partner countries, where activities focus on selected sectors. In parallel, DANIDA is phasing out its activities in the almost 40 remaining former receipient countries. About 20 per cent of bilateral ODA has an environmental component. All development assistance projects are subject to an environmental assessment on the basis of guidelines provided by DANIDA which were updated in 1994.

Environmental funds

In 1993, as a follow-up to UNCED, Denmark established the *Environmental and Disaster Relief Facility (EDRF)*. The government intends to bring the funding of the facility up to 0.5 per cent of GNP annually in 2005; it reached 0.25 per cent in 1998 (DKr 2.76 billion), with half going for environmental activities. Of this amount (DKr 1.38 billion), one-half is for central and eastern Europe and the other half for developing countries. EDRF assistance to developing countries is part of ODA, whereas assistance to central and eastern Europe is over and above ODA. Activities for central and eastern Europe are mainly administered by the Ministry of Environment and Energy; developing country activities are administered jointly by DANIDA, in the Ministry of Foreign Affairs, and the Danish Co-operation for Environment and Development (DANCED) in the Ministry of Environment and Energy.

Denmark's contribution to the *Global Environment Facility* (GEF) between 1994 and 1997 amounted to about DKr 225 million. It is one of the GEF's largest contributors in relative terms and has also contributed through co-financing projects.

As part of the *Danish Environmental Research Programme*, DANIDA is funding a sub-programme on the sustainable use of natural resources in developing countries. A total of US$8.3 million has been allocated to three cross-disciplinary research projects between 1994 and 1998.

3. Bilateral and Regional Co-operation

Marine environment: Baltic Sea, North Sea, Wadden Sea

Denmark's marine waters are two and half times larger than its land area. They include fjords, bays, belts and the open sea. Denmark has the longest coastline relative to its size of any European OECD country. About 25 per cent of its land mass drains into the North Sea, 72 per cent into inner marine waters (the Kattegat and the Belt Seas) and 3 per cent into the Baltic.

Baltic Sea and Baltic region co-operation

During the 1980s, *oxygen depletion in the Danish waters of the Baltic* became more frequent, severe and long-lasting. Winter concentrations of nutrients, especially nitrogen, greatly increased while primary production of plankton was found to have doubled since the 1960s. Heavy algal blooms became common, especially in the spring, and mass production of plankton algae, some toxic, became an annual occurrence in many inlets and bays. Increased coverage by rapidly growing algae was observed along the coast.

The 1974 Helsinki *Convention on the Protection of the Marine Environment of the Baltic Sea Area*, strengthened in 1992, was the first to take into account all sources of marine pollution and to include strong participation from eastern European countries. In 1988, Baltic countries undertook to halve discharges of harmful substances from point sources by 1995. Denmark has met the objectives of the convention relating to phosphorus discharges (50 per cent reduction between 1987 and 1995) and loading of heavy metals (50 per cent reduction between 1985 and 1995). It reduced mercury, cadmium and lead discharges by 70 per cent between 1985 and 1995. However, the target of a 50 per cent reduction of nitrogen discharges between 1987 and 1995 was not met and is not likely to be met until the middle of the next decade, subject to implementation of the second Action Plan for the Aquatic Environment adopted in February 1998 (Chapter 2).

In 1992, the Baltic Sea Joint Comprehensive Environmental Programme was adopted by the Environment Ministers of Baltic countries. It aims to clean up 132 *hot spots* by 2012 at a cost of about ECU 18 billion. Four of these hot spots were in Denmark: pollution caused by municipal waste water discharges from the Copenhagen area has been cleaned up with the recent upgrading of the waste water treatment plant; the three others concern areas with high nitrogen loading from agriculture and are expected to be cleaned up through the implementation of the second Action Plan for the Aquatic Environment (Chapter 2). Denmark is also contributing to progress in some 30 hot spots around the Baltic, notably by

providing support to upgrade Polish and Lithuanian waste water treatment facilities.

In 1998, an Agenda 21 for the Baltic Sea Region was adopted by the region's Council of Ministers of Foreign Affairs. The emphasis is on regional co-operation, and on the environment and its bearing on economic and social aspects of sustainable development. Work focuses on seven sectors of crucial regional economic and environmental importance: agriculture, energy, fisheries, forestry, industry, tourism and transport. For each sector, goals and scenarios for sustainable development have been elaborated as well as a sector action programme including time frames, actors and financing. An overall action plan and overall goals have been elaborated. The process of implementing Baltic 21 has started.

North Sea

In the framework of the *North Sea Ministerial Conferences*, Denmark has made the following North Sea Declaration commitments for 1995 relative to 1985:

- 50 per cent reduction of phosphorous and nitrogen discharges;
- 50 per cent reduction of heavy metal loading;
- 70 per cent reduction of mercury, cadmium and lead discharges.

As in the case of discharges to the Baltic Sea, Denmark has met these objectives with respect to phosphorous, heavy metals and mercury, cadmium and lead, but has fallen short of meeting its commitments concerning nitrogen discharges.

In accordance with the 1992 *OSPAR Convention* for the Protection of the Marine Environment of the North-East Atlantic, Denmark does not dump or incinerate waste into or at sea. Only non-hazardous dredged spoil is dumped in coastal waters. Denmark has been a strong advocate of a ban on dumping decommissioned oil drilling platforms at sea adopted under the Convention in July 1998.

Wadden Sea

The Wadden Sea area, which extends along the south-western coast of Denmark, includes coastal areas of Germany and the Netherlands. It is considered one of the most important wetlands in the world and is protected under a *series of trilateral declarations (1982, 1991, 1994 and 1997) and agreements*. Trilateral co-operation has developed successfully and a common secretariat was established in 1987, with government conferences held every three years. A joint

monitoring programme has been established. Denmark is contributing to the preparation of a common trilateral framework for the administration of the Wadden Sea, so that the area can apply to be placed on the UNESCO World Heritage List.

The *Danish Wadden Sea*, which covers about 1 125 km^2, was declared a wildlife reserve in 1979, protected as a nature reserve in 1982-83 and designated a Ramsar site and an EU bird protection area. As a result, ecological conditions have improved. The number of common seals has increased since 1988, when the population was affected by an epidemic. Since 1989, sightings of harbour porpoises have been increasing. Breeding birds have recovered from the massive losses caused by pollution in the 1960s; bird populations are now stable or growing. As the quality of the wetlands system still needs to be improved significantly, economic and other activities are strictly regulated. Cockles can be fished on a limited scale and mussel fishing is forbidden in half the tidal area, with a minimum marketable size. The use of lead shot is forbidden, though hunting is still allowed in some foreshore areas. The exploration and exploitation of oil and gas are prohibited in the Danish Wadden Sea Nature Reserve.

The Arctic environment

Denmark and seven other circumpolar countries adopted the *Arctic Environmental Protection Strategy* in Rovaniemi in 1991. The objective of this strategy is to protect Arctic ecosystems, including humans, by protecting and restoring a sound environment and furthering sustainable exploitation of natural resources (including indigenous peoples' utilisation of the Arctic resources); by taking into account the traditional needs, values and lifestyles of indigenous people on their own conditions; by monitoring the conditions of the Arctic environment; and by identifying, reducing and ultimately eliminating pollution in the Arctic.

Denmark established and operates the Greenland-based part of the *Arctic Monitoring and Assessment Programme* (AMAP) and supports the participation of indigenous people in work relating to the Arctic Environmental Protection Strategy. Furthermore, support can be given to global environmental protection projects, particularly as they relate to Greenland's fulfilment of international conventions. Environmental activities costing DKr 33 million in 1998 are managed by the Ministry of Environment and Energy, in close co-operation with the Ministry of Foreign Affairs and the Greenland Home Rule Authority.

Transfrontier air pollution

Denmark *has met or is well on the way to meeting its international commitments* concerning the Geneva Convention on Long Range Transboundary Air Pollution (Chapter 3). It has more than met the targets of reducing total sulphur emissions by 30 per cent by 1993 and by 50 per cent by 1995 compared with 1980 levels (Helsinki Protocol) and is expected to meet the 80 per cent reduction target by 2000 (Oslo Protocol). It has also met the target of stabilising total NO_x emissions at 1987 levels by 1994 (Sofia Protocol) and seems likely to meet the target of reducing NO_x emissions by 30 per cent by 1998 (Sofia Declaration). Between 1988 and 1995, Denmark reduced VOCs emissions by 27 per cent and is well on its way to meeting the target of 30 per cent by 1999 (Geneva Protocol).

Acid deposition decreased by about 40 per cent between 1980 and 1995, deposition of sulphur fell by 60 per cent, and deposition of oxidised and reduced nitrogen fell by 27 per cent and 22 per cent respectively. Despite these achievements, improvements have yet to be felt at ecosystem level. Acid deposition is still much higher in Denmark than in other Nordic countries. It exceeds critical loads almost everywhere in the country, largely due to transboundary imports. With a modest ranking in SO_x and NO_x emissions per capita and per unit of GDP in Europe, Denmark remains a net exporter of acidifying substances (Table 8.3).

Co-operation within the EU

Environmental issues have played a major part in the positions Denmark has taken on a range of EU matters. In particular, it supports the free movement of goods within the EU but wishes to retain the right to introduce *stricter standards if justified on environmental grounds*. Concerning the Maastrich Treaty, Denmark considers that opportunities given by the treaty for a qualified majority to adopt environmental rules within the EU should be used as fully as possible to ensure an increasingly higher level of environmental protection. The Danish Government considers that the Amsterdam Treaty strengthens rules on environmental protection.

The European Commission does not report any particular problems regarding Denmark's *transcription of EU directives* in its legislation. Concern has been expressed by NGOs in the past that projects included in Danish legislation, and therefore submitted for Parliamentary approval, are not subject to environmental impact assessments even though they should be according to the 1985 EU directive on EIAs (Chapter 6). A few directives raise difficulties of implementation (for instance, those concerning nitrates, habitats, water).

Denmark has a particularly *active role in shaping EU environmental legislation policies and positions* for global international negotiations. NGOs are formally consulted in the national process of preparing for environmental negotiations at EU level.

Nordic co-operation

Nordic environmental co-operation began in the 1960s, in the framework of the *Nordic Council of Ministers*. It has led to a series of agreements to enhance co-operation on issues such as marine oil pollution, non-discrimination, emergency preparedness and mutual assistance, and nuclear power plants. Nordic Ministers of the Environment have adopted a *Nordic strategy for 1996-2000*, which provides the general basis for Nordic co-operation in the field of the environment and focuses on four key areas: protection of nature and the environment in the Nordic countries, protection of the fragile Arctic environment, co-operation to improve the environment in areas close to the Nordic countries (including

Table 8.3 **Acid deposition,** 1996

(100 tonnes of SO_x or NO_x)

Country of origin or receiving country	Into Denmark		From Denmark	
	SO_x	NO_x	SO_x	NO_x
Denmark	52	23	52	23
Germany	108	53	34	31
Finland	1	1	9	17
Netherlands	4	13	3	2
Norway	1	3	15	22
Poland	43	12	20	27
Sweden	4	7	59	52
United Kingdom	34	33	6	8
Czech Republic	22	5	2	4
Russian Federation	4	1	17	32
Others (including marine sources)	120	75	331	333
Total	393	226	548	551

Source: UN-ECE.

capacity building and assistance in EU approximation), and international co-operation to promote common Nordic points of view on environmental protection. Integration of environmental concerns in other sectors is also a key element of the strategy. A Nordic environment and fishing strategy, and a Nordic strategy for environment, agriculture and forestry for 1996-2000, have been adopted.

Nordic ministers have increased the 1996-2001 base capital of NEFCO (the Nordic Environment Finance Corporation) from ECU 40 million to ECU 80 million for *venture financing*, in order to contribute to active investments by Nordic environmental companies in eastern Europe in the form of joint ventures or *environmental loans*. The Ministers of the Environment have also decided to contribute to joint Nordic loan-softening facilities by providing funds from the Nordic countries.

The *Nordic Convention on Environmental Protection* has been invoked by Finland concerning the Great Belt bridge, which was not high enough to allow Finnish maritime platforms to pass; Denmark compensated Finland accordingly. Sweden is also invoking the convention concerning Danish and Norwegian offshore operations in the Kattegat. Denmark has referred to the provisions of the convention for matters relating to the Swedish nuclear power plant of Barsebäck.

Pan-European co-operation

Denmark has been very active in the Environment for Europe process, both within the Environmental Action Programme for Central and Eastern Europe, and the Environmental Programme for Europe. It hosted the fourth *Pan-European Conference of Environment Ministers in Aarhus* in June 1998. Denmark has supported the development of the Convention on Public Participation signed at the ministerial conference to increase public participation, environmental information and access to environmental information. Protocols on persistent organic pollutants (POPs) and on heavy metal emissions were also signed in Aarhus, and a strategy was adopted for phasing out leaded gasoline in Europe.

Co-operation with Central and Eastern Europe

Denmark's current *Strategy for Environmental Activities in Eastern Europe* gives high priority to reducing air and water pollution, solving waste problems and strengthening nature protection as well as institutions. Geographically, activities are mainly targeted at Poland, the Baltic States and the Russian regions close to Denmark. In addition, activities primarily aimed at limiting air pollution are carried

out in the Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Belarus and Ukraine.

In 1991, Parliament adopted the Act on Subsidies for Environmental Activities in Central and Eastern Europe and the Danish Environmental Support Fund for Eastern Europe (DESF) was created, with its management allocated to the Danish EPA. Between 1991 and 1996, the DESF provided DKr 1.2 billion worth of support for over 500 projects; since 1994, it constitutes the main point of the central and eastern European part of the Environmental and Disaster Relief Facility (EDRF). *Danish environmental assistance to central and eastern European countries* totalled DKr 741 million between 1994 and 1996.

A special environment fund has been created under the Investment Fund for Central and Eastern Europe. This *Green Investment Facility* was allocated DKr 70 million for 1998 (following up on DKr 259 million for 1995-97). In addition, a new environmental soft loan scheme has been created under the *Export Credit Facility*, with DKr 45 million available to soften DKr 145 million in loans.

The Strategy for Environmental Activities in Eastern Europe also provides for the establishment of new *environment-related sector programmes* initiated and carried out by the relevant ministries. Such programmes have been carried out in the areas of industry, energy, nuclear safety, agriculture and transport. In 1996, DKr 100 million was allocated to integrated environmental sector programmes, mainly in the energy sector; notably, DKr 62 million was granted by the Danish Energy Agency within the Ministry of Environment and Energy for energy conservation projects.

In May 1997, the government updated its strategy on assistance to eastern Europe with an emphasis on the principles of the market economy and on environmental sustainability in the Baltic region. The focus of the new *Baltic Initiative* is not only on bringing environmental standards up to EU level and ensuring that Baltic States comply with international agreements, but also on environmental integration in sectoral activities (energy, industry, agriculture, fisheries, forestry and transport). The Baltic Initiative was allocated DKr 204 million for environmental assistance and DKr 141 million for sectoral integration in 1998.

Issues with neighbouring countries

The Øresund bridge between Denmark and Sweden was developed as a bilateral project and approved by the Danish Parliament. Though infrastructure projects that have been legislated are exempt from *environmental impact*

assessments (EIAs) under Danish law, an EIA was eventually completed for the bridge. Local and regional authorities on either side of the Øresund and the Kattegat in Denmark and Sweden have developed joint activities on marine environment issues for many years and are further developing a range of regional development activities. The ''zero option'' was not considered, since the decision to build the bridge had already been taken.

The Danish county of South Jutland and the German Land of Schleswig-Holstein have established a regional co-operation agreement concerning notification and exchange of information on *projects subject to EIA* on either side of the border. Denmark recently ratified the 1991 Espoo Convention on environmental impact assessment in a transboundary context, and is proceeding to ratify the 1992 Helsinki Convention relating to transboundary effects of industrial accidents.

Joint *emergency measures* have been planned with Sweden in the case of an accident involving the Barsebäck nuclear reactor in that country. Close regional co-operation to respond to oil spills in the Baltic and North Sea has existed since the 1970s. Co-operative agreements with Sweden and Germany cover both surveillance and measures to combat oil spills. Denmark has contributed to the development of Baltic Sea oil spill emergency plans in eastern European countries.

4. Environmental Performance

Danish policy makers and the vast majority of the public share a sense of responsibility for the local, regional and global environment. A high level of commitment to protecting the environment through international co-operation has been a constant of Danish policy over the years. Denmark's proactive stance has contributed to bringing a range of environmental issues into international fora to be debated and addressed (e.g. Copenhagen amendment to the Montreal Protocol, Pan-European Aarhus conference, POPs). This proactive stance applies particularly within the EU, with the aims of both furthering European environmental legislation and influencing the European environmental position in global negotiations.

Global issues

Climate change

Denmark has taken a vigorous international stance on *climate change* and has endeavoured to adopt domestic objectives and policies consistent with such

an approach. Nevertheless, it has *not succeeded so far in limiting total actual CO_2 emissions*, which were well above 1990 levels in 1995 and 1996 and may be difficult to stabilise at 1990 levels by 2000. Much of the increase in emissions in the first half of the 1990s was due to gas combustion (75 per cent increase) rather than coal (9 per cent growth) or oil (8 per cent growth). The carbon intensity of the Danish economy has not changed significantly since the mid-1980s. Danish CO_2 emissions per unit of GDP and per capita are higher than in many other European countries.

Meeting CO_2 emission reduction targets is *closely linked to policies adopted in the energy and transport sectors*. Because Denmark relies mainly on fossil fuel for electricity generation, this sector accounts for a larger share of CO_2 emissions (48 per cent) than in many other OECD countries, while the transport sector accounts for a smaller share (25 per cent). Electricity generation currently offers greater possibilities for cost-effective fuel substitution than the transport sector. The 20 per cent reduction target has been split, so that the goal is to stabilise emissions from transport while those from stationary sources are reduced by at least 28 per cent. The behavioural and technological changes needed to meet these targets will require that energy and transport pricing and taxation move further towards internalisation for all end-users. Denmark is one of only a few OECD countries that have introduced a carbon tax on energy products; the continuation of the green tax reform should contribute to the country's performance in meeting its climate change commitments. The 1996 transport action plan details the measures needed to stabilise transport emissions, assuming fuel prices in 2005 will be 30 per cent above 1988 prices; should such a trend not occur (in mid-1998, oil prices were at their lowest in two decades), the measures set out in the plan will be insufficient. It would therefore be prudent to envisage supplementary measures, particularly in the absence of an international consensus on carbon taxation.

There are considerable differences between IEA data on CO_2 emissions and data adjusted by Denmark for climatic variations and electricity trade. In 1996, on the basis of the former, CO_2 emissions were 37 per cent above 1990, whereas based on the latter they were 3-4 per cent below. The use of *adjusted CO_2 emissions* can be useful to assess the performance of measures designed to influence domestic energy consumption. Adjusting for variations in electricity trading appears reasonable where year-to-year fluctuations disguise an underlying trend in average emissions. Despite the volatility of such trading, it is a regular feature of the Danish market. Since 1990, electricity imports and exports have been roughly in balance and the outcome in adjusted figures can be justified as a simple averaging. Nevertheless, such a balance may not necessarily be kept in

the future; the adjustment methodology will be in doubt if there is a strong trend towards either imports or exports. Moreover, the Danish situation is not unique: energy-intensive exports (e.g. aluminium, steel) are also a form of energy trade, which entail an increase (and fluctuations) in the producing country's CO_2 emissions. In order to assess overall emission performance, for instance in relation to international commitments, an *accepted and widely applicable methodology* is clearly needed.

Other global issues

Denmark has taken vigorous action to *reduce and phase out the use of ODS* and has met its international commitments in this area in advance of the relevant deadlines. It has devoted much effort to collecting, recycling or destroying existing ODS, using a range of voluntary systems and market-based economic incentives; it has also made a significant contribution to helping countries in central and eastern Europe phase out ODS through bilateral assistance activities.

Denmark is one of the strongest advocates of the *control of persistent organic pollutants* and is taking the lead internationally in this area. It is making a significant contribution to promoting international co-operation through taking a global, multimedia approach as well as a more regional approach to achieve best results. These efforts are beginning to bring returns, as progress is made in reaching global agreements on some pollutants.

The country has played a significant part in the establishment of the Convention on Biological Diversity and actively contributes to a range of *international co-operation agreements relating to nature conservation* (Chapter 5).

Denmark has been slow to *ratify some international agreements*, though in some cases this delay has been largely due to technical reasons. It has not ratified the 1982 Montego Bay Convention on the Law of the Sea and should do so as soon as feasible, particularly in view of the fact that missing the November 1998 deadline for ratification would restrict its contribution to the treaty's policy making bodies.

Aid

Denmark has the *highest level of ODA* related to GNP among OECD-DAC countries, over 1 per cent of GNP in 1996, and other financial efforts concerning development assistance add significantly to this amount (e.g. aid to central and eastern European countries, special funds). Efforts made to maximise the

effectiveness and coherence of Danish development co-operation inspire confidence and optimism in the public mind, and the high level of ODA enjoys wide support as a result. Denmark plans to continue to play an *exemplary role in development aid* by maintaining high levels of overseas development assistance. Danish ODA has a large environmental component and includes an environmental assessment of all development projects. This environmental component, which currently accounts for about 20 per cent of bilateral ODA, is set to increase with the higher budget appropriations planned for the EDRF in the coming years. The objective of increasing EDRF funding to 0.5 per cent of GNP by 2005 and maintaining it at that level indicates the extent of Denmark's commitment to addressing global environmental problems.

Bilateral and regional co-operation

Denmark has met or is well on the way to meeting its international commitments concerning discharges of phosphorous and heavy metals in the Baltic and North Sea as well as emissions of SO_2, NO_x and VOCs. It has been very active in international fora concerned with the protection of the Arctic environment, Nordic co-operation and Pan-European co-operation. In recent years Denmark has granted considerable funds for environmental action in *central and eastern Europe* compared to other OECD donor countries. Its support has shifted from pollution control to addressing environmental problems in sectors such as energy and transport, thereby contributing to these countries moving towards sustainable development.

The Danish public remains divided on *EU membership and European economic integration*, as shown by referendums held on the Maastrich and Amsterdam treaties as required by the Constitution. EU membership, initially considered a threat to high environmental standards, is now increasingly seen as an effective way to drive European policies towards sustainable development. Overall, Denmark has one of the best records of implementing EU environmental directives. An assessment of the environmental impact of European directives carried out by an independent commission came to the conclusion that Denmark's influence on European legislation had on the whole been positive. A number of directives had a positive effect on environmental legislation and protection in Denmark and several were difficult for Denmark to implement (e.g. nitrates, birds, habitats, water).

Denmark has fallen short of meeting its international commitments relating to nutrient discharges to *marine waters* in both the Baltic and North Sea, despite major and effective investments in the abatement of nutrient discharges by waste

water treatment plants. This reflects the difficulties encountered in addressing nutrient discharges from the agricultural sector, particularly those relating to the nitrogen loadings due to animal manure. Parliament recently adopted a new Action Plan for the Aquatic Environment (Chapters 2 and 7). The new measures it contains should make it possible for Denmark to meet its international commitments in this area, even if with some delay, providing policy efforts are sustained over the next years.

ANNEXES

I. Selected environmental data

II. Selected economic data and trends

III.A Selected multilateral agreements (worldwide)

III.B Selected multilateral agreements (regional)

IV. Chronology of selected environmental events (1990-98)

Annex I: Selected environmental data[1]

	DNK	CAN	MEX	USA	JPN	KOR	AUS	NZL	AUT	BEL	CZE	FIN
LAND												
Total area (1 000 km²)	**43**	9 971	1 958	9 364	378	99	7 713	270	84	31	79	338
Major protected areas (% of total area)[2]	**31.8**	9.5	8.2	18.9	6.8	6.9	7.7	23.4	28.2	2.6	15.5	8.3
Nitrogenous fertiliser use (t/sq. km of arable land)	**12.7**	4.0	3.8	6.0	11.6	22.2	1.5	34.4	7.4	18.3	7.8	7.5
FOREST												
Forest area (% of land area)	**10.5**	45.3	29.8	32.6	66.8	65.4	19.4	28.2	46.9	20.1	34.0	76.1
Use of forest resources (harvest/growth)	**0.6**	0.8	0.2	0.6	0.3	..	..	0.6	0.6	1.0	0.7	0.8
Tropical wood imports (US$/cap.)[3]	**3.6**	1.1	0.2	1.5	21.5	14.5	6.0	3.1	4.8	12.1	0.5	3.2
THREATENED SPECIES												
Mammals (% of species known)	**24.0**	24.4	33.5	10.5	7.7	12.1	14.9	..	37.5	31.6	33.3	11.9
Birds (% of species known)	**12.9**	8.8	16.9	7.2	8.3	7.4	5.9	29.5	28.1	27.5	55.9	6.8
Fish (% of species known)	**18.2**	21.7	5.7	2.4	11.1	7.5	0.4	37.0	42.5	54.3	29.2	11.7
WATER												
Water withdrawal (% of gross annual availability)	**16.0**	1.6	14.5	18.9	20.8	28.5	4.3	0.6	2.7	42.5	15.6	2.2
Fish catches (% of world catches)	**2.2**	0.9	1.4	5.7	6.5	2.5	0.2	0.6	–	–	–	0.2
Public waste water treatment (% of population served)	**87**	78	22	71	50	45	..	..	75	27	59	77
AIR												
Emissions of sulphur oxides (kg/cap.)	**33.6**	91.2	23.2	63.1	7.3	34.0	119.1	11.5	8.0	23.6	91.7	18.8
" (kg/1 000 US$ GDP)[4]	**1.7**	4.7	3.9	2.5	0.4	3.0	6.6	0.8	0.4	1.3	9.1	1.2
Emissions of nitrogen oxides (kg/cap.)	**54.7**	68.2	16.4	75.1	11.7	25.5	120.4	57.5	21.7	32.9	41.9	50.5
" (kg/1 000 US$ GDP)[4]	**2.7**	3.5	2.8	3.0	0.6	2.2	6.6	3.9	1.2	1.8	4.2	3.2
Emissions of carbon dioxide (t./cap.)[5]	**13.7**	15.7	3.5	20.1	9.4	9.0	16.6	8.9	7.8	12.3	11.6	12.5
" (t./1 000 US$ GDP)[4]	**0.68**	0.80	0.63	0.79	0.46	0.74	0.89	0.60	0.42	0.67	1.15	0.76
WASTE GENERATED												
Industrial waste (kg/1 000 US$ GDP)[4, 6]	**25**	..	60	..	61	52	124	..	75	74	371	140
Municipal waste (kg/cap.)	**540**	630	330	720	400	390	690	..	480	470	310	410
Nuclear waste (t./Mtoe of TPES)[7]	**–**	7.2	0.3	1.1	1.7	1.5	–	–	–	2.2	1.1	2.2
NOISE												
Population exposed to leq > 65dB(A) (million inh.)[8]	**0.5**	..	..	17.2	38.0	..	..	..	1.2	1.2	1.5	0.2

.. Not available.
– Nil or negligible.
* Figures in italics include: for Germany: western Germany only;
for United Kingdom: threatened species and public waste water treatment: Great Britain only.
Water withdrawal: England and Wales only.

a) Data for Luxembourg are included under Belgium.

1. Data refer to the latest available year. They include provisional figures and Secretariat estimates. Partial totals are underlined. Varying definitions can limit comparability across countries.
2. Data refer to IUCN categories I to VI; AUS: national data.

Source: OECD Environmental Data, Compendium 1997.

Annex I: Selected environmental data[1]

FRA	DEU*	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	ESP	SWE	CHE	TUR	UKD*	OECD*
552	357	132	93	104	70	301	3	42	324	313	92	506	450	41	779	245	34 730
11.6	26.4	2.5	6.8	9.4	0.8	7.1	13.9	11.5	24.2	9.3	6.5	8.3	4.7	17.3	1.6	19.8	11.8
13.0	14.8	10.0	6.4	8.5	42.7	8.0	*a*	37.7	12.0	6.5	5.2	5.7	6.7	13.9	4.3	22.5	6.4
27.4	29.9	20.3	19.1	1.5	8.3	23.1	34.4	9.2	39.2	29.4	35.3	32.3	67.8	31.7	26.9	10.4	33.5
0.6	..	0.5	0.5	..	..	0.3	0.5	0.4	0.5	0.6	1.1	0.5	0.7	0.5	0.4	0.5	0.6
8.6	2.5	4.2	–	3.6	10.0	9.5	*a*	17.7	6.8	0.2	23.7	6.9	3.8	1.2	0.6	4.0	6.1
20.2	39.8	37.1	69.9	–	16.1	32.2	54.1	15.6	8.0	11.9	17.2	19.5	18.2	33.8	8.6	*22.2*	..
14.7	39.6	11.8	27.1	13.3	24.7	24.7	20.0	27.1	10.4	15.9	34.9	13.0	8.6	44.2	13.9	*22.6*	..
6.3	68.2	36.9	19.5	–	..	..	38.2	82.1	–	25.0	18.6	26.5	4.7	44.7	2.3	*11.1*	..
21.3	25.3	..	5.2	0.1	2.3	32.2	3.4	8.6	..	19.2	11.9	28.7	1.5	4.9	15.2	*13.7*	*11.3*
0.6	0.3	0.2	–	1.7	0.4	0.4	–	0.5	2.7	0.5	0.3	1.3	0.4	–	0.7	1.0	31.1
77	89	11	32	4	..	61	88	96	67	42	21	48	95	94	12	*86*	*59*
17.4	26.1	50.6	69.8	30.3	46.1	25.0	19.5	9.6	8.0	60.6	26.1	52.8	10.6	4.7	29.2	40.3	39.5
0.9	1.5	5.2	11.4	1.7	3.1	1.5	0.7	0.5	0.4	12.1	2.5	4.2	0.6	0.2	6.4	2.4	2.4
25.8	23.7	33.5	18.0	106.4	32.2	37.2	48.8	34.9	50.9	29.0	25.9	31.3	41.0	18.6	13.3	39.1	40.0
1.4	1.3	3.5	3.0	6.0	2.2	2.2	1.7	2.0	2.4	5.8	2.5	2.5	2.4	0.9	2.3	2.3	2.4
6.6	11.0	7.4	5.9	9.3	10.1	7.3	21.9	12.0	7.2	9.5	4.9	6.0	6.7	6.0	2.7	9.9	11.1
0.35	0.62	0.73	0.95	0.50	0.63	0.41	0.76	0.67	0.33	1.78	0.45	0.44	0.39	0.29	0.49	0.58	0.65
101	48	5	104	1	71	22	162	30	39	117	..	28	100	9	94	58	89
560	400	310	420	560	430	470	530	580	620	290	350	370	440	610	590	490	500
5.0	1.3	–	2.2	–	–	–	–	0.2	–	..	–	1.6	4.5	2.5	–	3.3	1.7
9.4	*9.5*	2.0	..	..	..	..	..	0.6	0.5	..	3.0	8.9	0.3	0.8	..	5.7	*124.0*

3. Total imports of cork and wood from non OECD tropical countries.
4. GDP at 1991 prices and purchasing power parities.
5. CO_2 from energy use only; international marine bunkers are excluded.
6. Waste from manufacturing industries (ISIC 3).
7. Waste from spent fuel arising in nuclear power plants, in tonnes of heavy metal, per million tonnes of oil equivalent of total primary energy supply.
8. Road traffic noise.

Annex II: Selected economic data and trends[1]

	DNK	CAN	MEX	USA	JPN	KOR	AUS	NZL	AUT	BEL	CZE	FIN
TOTAL AREA (1 000 km²)	**43**	9 971	1 958	9 364	378	99	7 713	270	84	31	79	338
POPULATION												
Total population, 1997 (100 000 inh.)	**53**	302	982	2 677	1 262	460	185	37	81	102	103	51
% change (1980-1997)	**2.9**	22.9	41.0	17.6	8.0	20.5	25.8	17.0	7.5	3.4	–0.2	7.5
Population density, 1997 (inh./km²)	**122.4**	3.0	50.2	28.6	333.9	462.9	2.4	13.6	96.8	333.6	130.6	15.2
GROSS DOMESTIC PRODUCT[2]												
GDP, 1997 (billion US$)	**110**	611	583	6 996	2 576	587	349	56	152	191	105	90
% change (1980-1997)	**44.5**	49.4	39.5	55.8	66.7	285.7	67.9	50.9	43.8	33.2	..	45.5
per capita, 1997 (1 000 US$/cap.)	**20.8**	20.2	5.9	26.1	20.4	12.8	18.9	15.2	18.7	18.8	10.2	17.4
INDUSTRY[3]												
Value added in industry (% of GDP)	**24**	26	26	28	38	43	26	26	30	27	38	30
Industrial production												
% change (1980-1996)	**53**	39	38	45	50	397	41	..	44	21	–8	60
AGRICULTURE												
Value added in agriculture (% of GDP)[4]	**4**	2	6	2	2	6	3	7	1	1	4	4
ENERGY SUPPLY												
Total supply, 1996 (Mtoe)	**23**	236	141	2 135	510	163	101	16	27	56	40	31
% change (1980-1996)	**15.9**	22.4	43.0	17.8	47.3	272.2	43.0	76.1	15.9	22.3	–13.9	23.9
Energy intensity, 1996 (Toe/1 000 US$)	**0.22**	0.40	0.26	0.32	0.20	0.29	0.30	0.30	0.18	0.30	0.39	0.37
% change (1980-1996)	**–17.1**	–14.9	9.6	–21.5	–10.8	1.8	–12.5	20.0	–17.6	–5.6	..	–9.8
Structure of energy supply, 1996 (%)[5]												
Solid fuels	**42.8**	14.5	10.1	26.5	18.0	19.4	45.3	12.0	21.1	16.5	52.2	40.5
Oil	**41.6**	33.2	62.3	39.0	53.6	62.0	36.9	37.2	43.0	42.2	20.3	30.4
Gas	**15.2**	29.4	20.8	23.6	11.0	6.7	16.5	26.8	25.0	21.1	18.7	9.5
Nuclear	**–**	10.1	1.5	8.7	15.4	11.8	–	–	–	20.2	8.3	16.3
Hydro, etc.	**0.5**	12.8	5.4	2.1	2.0	0.1	1.4	24.0	10.9	–	0.5	3.3
ROAD TRANSPORT[6]												
Road traffic volumes, 1996												
billion veh.-km	**42**	267	54	3 570	690	57	172	27	56	95	30	43
% change (1980-1996)	**57.8**	29.9	27.0	47.6	77.3	554.5	49.9	65.8	58.5	106.7	42.3	60.0
per capita (1 000 veh.-km/cap.)	**7.9**	8.9	0.6	13.4	5.5	1.3	9.4	7.5	7.0	9.3	2.9	8.4
Road vehicle stock, 1996												
10 000 vehicles	**204**	1 768	1 291	20 637	6 720	955	1 075	206	401	478	361	221
% change (1980-1996)	**23.7**	33.8	108.9	32.5	81.3	1 710.2	48.0	31.5	63.9	37.5	86.6	59.7
per capita (veh./100 inh.)	**39**	59	13	78	53	21	59	57	50	47	35	43

.. Not available.
– Nil or negligible.
* Figures in italics include western Germany only.
1. Data may include provisional figures and Secretariat estimates. Partial totals are underlined.
2. GDP at 1991 prices and purchasing power parities.

Source: OECD Environmental Data, Compendium 1997.

Annex II: Selected economic data and trends[1]

FRA	DEU*	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	ESP	SWE	CHE	TUR	UKD	OECD*
552	357	132	93	104	70	301	3	42	324	313	92	506	450	41	779	245	34 730
586	822	105	102	3	37	575	4	156	47	387	99	397	88	72	637	588	10 998
8.7	4.9	9.0	–5.0	18.4	7.6	1.8	15.3	10.3	14.3	8.6	1.2	6.2	6.5	12.1	43.3	4.5	14.3
106.2	230.2	79.6	109.4	2.6	52.1	190.8	162.8	375.9	14.4	123.5	108.0	78.4	19.7	173.4	81.7	240.3	31.7
1 134	1 491	111	65	5	64	1043	12	288	100	220	112	550	155	151	365	1 041	19 313
38.6	*41.1*	32.7	..	50.0	119.1	34.7	115.2	46.9	65.0	..	52.4	51.9	28.7	22.9	121.7	46.5	*54.8*
19.4	18.1	10.5	6.4	19.4	17.4	18.1	29.4	18.4	21.5	5.7	11.3	13.9	17.6	21.1	5.7	17.7	17.6
26	*36*	20	32	22	39	31	24	27	32	39	32	32	28	34	31	28	*30*
12	*20*	9	..	..	215	20	44	28	111	..	56	23	41	26	179	31	*38*
2	*1*	12	7	9	5	3	1	3	2	8	4	4	2	3	17	2	*3*
254	350	24	25	2	12	161	3	76	23	108	19	101	53	26	66	235	5 020
33.7	–3.0	52.8	–11.9	54.5	41.0	16.2	–5.4	16.6	23.0	–13.1	86.1	47.9	28.3	22.8	109.2	16.6	23.5
0.23	0.24	0.23	0.41	0.45	0.21	0.16	0.29	0.27	0.24	0.53	0.18	0.19	0.34	0.17	0.19	0.23	0.27
–1.2	..	19.3	..	8.1	–28.9	–12.4	–54.4	–18.0	–22.9	..	26.3	0.6	1.4	0.6	0.3	–17.8	..
10.4	26.8	35.1	17.8	2.9	27.1	8.0	17.2	13.3	9.9	74.5	23.8	19.5	20.7	6.2	36.5	20.0	23.8
35.0	39.7	62.7	27.1	35.3	50.2	59.0	62.4	35.2	36.9	16.6	69.2	54.0	32.4	49.4	47.3	36.7	41.9
12.6	21.0	0.2	40.4	–	22.1	29.2	20.2	50.0	13.4	8.8	–	8.5	1.4	9.2	10.4	32.5	20.6
39.8	11.9	–	14.6	–	–	–	–	1.4	–	–	–	14.5	36.9	25.6	–	10.6	10.9
2.2	0.6	2.0	0.1	61.8	0.5	3.8	0.2	0.1	39.8	0.2	7.0	3.4	8.6	9.6	5.7	0.1	2.9
468	563	52	29	2	28	453	5	108	28	119	49	147	69	51	41	436	7 750
58.0	52.1	156.2	52.7	97.9	53.5	100.0	104.8	53.8	46.5	165.8	129.2	108.4	54.8	40.4	177.7	80.6	59.2
8.0	6.9	5.0	2.9	6.6	7.8	7.9	10.9	7.0	6.4	3.1	5.0	3.7	7.8	7.1	0.7	7.4	7.1
3 076	4 356	328	279	14	122	3 352	25	635	205	960	368	1 786	398	355	433	2 849	53 856
41.7	58.4	159.3	137.1	48.0	51.9	75.3	78.1	39.9	46.9	213.1	205.5	99.8	29.4	46.1	269.8	64.1	55.0
53	53	31	28	53	34	58	61	41	47	25	37	45	45	50	7	48	49

3. Value added: includes mining and quarrying (ISIC 2), manufacturing (ISIC 3), gas, electricity and water (ISIC 4), and construction (ISIC 5); HUN, POL: as % of total of branches at basic prices; production: ISIC 2 to 4.
4. Agriculture, forestry, hunting, fishery, etc; HUN, POL: as % of total of branches at basic prices.
5. Breakdown excludes electricity trade.
6. Refers to motor vehicles with four or more wheels, except for Japan and Italy, which include three-wheeled goods vehicles.

Annex III.A: Selected multilateral agreements (worldwide)

Y = in force S = signed R = ratified D = denounced

			CAN	MEX	USA	JPN	KOR	AUS
1946	Washington	Conv. – Regulation of whaling	Y	D	R	R	R	R	R
1956	Washington	Protocol	Y	R	R	R	R	R	R
1949	Geneva	Conv. – Road traffic	Y	R		R	R	R	R
1958	Geneva	Conv. – Fishing and conservation of the living resources of the high seas	Y	S	R	R			R
1963	Vienna	Conv. – Civil liability for nuclear damage	Y		R				
1988	Vienna	Joint protocol relating to the application of the Vienna Convention and the Paris Convention	Y						
1969	Brussels	Conv. – Intervention on the high seas in cases of oil pollution casualties (INTERVENTION)	Y		R	R	R	S	R
1973	London	Protocol (pollution by substances other than oil)	Y		R	R			R
1969	Brussels	Conv. – Civil liability for oil pollution damage (CLC)	Y	R	R	S	R	R	R
1976	London	Protocol	Y	R	R		R	R	R
1992	London	Protocol	Y		R		R	R	R
1970	Bern	Conv. – Transport of goods by rail (CIM)	Y						
1971	Brussels	Conv. – International fund for compensation for oil pollution damage (FUND)	Y	R	D	S	D	D	D
1976	London	Protocol	Y	R	R		R		R
1992	London	Protocol	Y		R		R	R	R
1971	Brussels	Conv. – Civil liability in maritime carriage of nuclear material	Y						
1971	Ramsar	Conv. – Wetlands of international importance especially as waterfowl habitat	Y	R	R	R	R		R
1982	Paris	Protocol	Y	R	R	R	R		R
1971	Geneva	Conv. – Protection against hazards of poisoning arising from benzene (ILO 136)	Y						
1972	London, Mexico, Moscow, Washington	Conv. – Prevention of marine pollution by dumping of wastes and other matter (LC)	Y	R	R	R	R	R	R
1978		Amendments to Annexes (incineration at sea)	Y	R	R	R	R	R	R
1978		Amendments to convention (settlement of disputes)		R		R	R		
1980		Amendments to Annexes (list of substances)	Y	R	R	R		R	R
1972	Geneva	Conv. – Safe container (CSC)	Y	R	R	R	R	R	R
1972	London, Moscow, Washington	Conv. – International liability for damage caused by space objects	Y	R	R	R	R	R	R
1972	Paris	Conv. – Protection of the world cultural and natural heritage	Y	R	R	R	R	R	R
1978	London	Protocol – Prevention of pollution from ships (MARPOL PROT)	Y	R	R	R	R	R	R
1978	London	Annex III	Y			R	R	R	R
1978	London	Annex IV					R		
1978	London	Annex V	Y			R	R	R	R
1973	Washington	Conv. – International trade in endangered species of wild fauna and flora (CITES)	Y	R	R	R	R	R	R
1974	Geneva	Conv. – Prev. and control of occup. hazards caused by carcinog. subst. and agents (ILO 139)	Y				R		

Annex III.A: Selected multilateral agreements (worldwide)

Y = in force S = signed R = ratified D = denounced

NZL	AUT	BEL	CZE	**DNK**	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	ESP	SWE	CHE	TUR	UKD	EC
R	R			**R**	R	R	R			D	R	R		R	R			R	R	R		R	
R				**R**		R	R			R	R			R	R			R	R	R		R	
R	R	R	R	**R**	R	R		R	R	R	R	R	R	R	R	R	R	R	R	S	R	R	
S		R		**R**	R	R				S	S			R			R	R		R		R	
			R						R							R		S				S	
		S	R	**R**	R	S	S	S	R			R		R	R	R	S	S	R	S	S	S	
R		R		**R**	R	R	R	S		R	R	R		R	R	R	R	R	R	R		R	
S		R		**R**	R	R	R				R	R		R	R	R	R	R	R	R		R	
R		R		**R**	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R		R	
		R		**R**	R	R	R	R		R	D	R	R	R	R	R	R	R	R	R		D	
		S		**R**	R	R	R	R			R			R	R	S		R	R	R		R	
	R	R	R	**R**	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R	R	
R		R		**D**	D	D	D	D		R	D	R		D	D	R	R	D	D	D		D	
		R		**R**	R	R	R	R		R	D	R		R	R	R	R	R	R			D	
		S		**R**	R	R	R	R			R			R	R	S		R	R			R	
		R		**R**	R	R	R					R		R	R		S	R	R			S	
R	R	R	R	**R**	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	
R	R	S	R	**R**	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	
			R		R	R	R	R	R			R						R		R			
R		R		**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	
		R		**R**	R	R		R	R	R	R	R	R	R	R	R	R	R	R	R		R	
		R		**R**	R	R	R			R		R		R	R		R	R	R	R		R	
R		R		**R**	R	R		R	R	R	R	R	R	R	R	R	R	R	R	R		R	
R	R	R	R	**R**	S	R	R	R	R	R		R	R	R	R	R	R	R	R	S	S	R	
R	R	R		**R**	R	R	R	R	R	S	R	R	R	R	S	R		R	R	R		R	
R	R	R	R	**R**	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R	R	
	R	R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
	R	R	R	**R**	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R		R	
	R	R	R	**R**	R	R	R	R	R			R	R			R	R	R	R			R	
	R	R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
R	R	R	R	**R**	R	R	R	R	R		S	R	R	R	R	R	R	R	R	R		R	
		R	R	**R**	R	R	R		R	R	R	R			R				R	R			

Annex III.A: Selected multilateral agreements (worldwide) (cont.)

Y = in force S = signed R = ratified D = denounced

			CAN	MEX	USA	JPN	KOR	AUS
1976	London	Conv. – Limitation of liability for maritime claims (LLMC)	Y		R		R		R
1977	Geneva	Conv. – Protec. of workers against occup. hazards in the working env. due to air poll., noise and vibrat. (ILO 148)	Y						
1979	Bonn	Conv. – Conservation of migratory species of wild animals	Y						R
1992	New York	Agreem. – Conservation of small cetaceans of the Baltic and the North Seas (ASCOBANS)	Y						
1982	Montego Bay	Conv. – Law of the sea	Y	S	R		R	R	R
1994	New York	Agreem. – relating to the implementation of part XI of the convention	Y	R		R	R	R	R
1983	Geneva	Agreem. – Tropical timber	Y	R		R	R	R	R
1994	New York	Revised agreem. – Tropical timber	Y	R		R	R	R	
1985	Vienna	Conv. – Protection of the ozone layer	Y	R	R	R	R	R	R
1987	Montreal	Protocol (substances that deplete the ozone layer)	Y	R	R	R	R	R	R
1990	London	Amendment to protocol	Y	R	R	R	R	R	R
1992	Copenhagen	Amendment to protocol	Y	R	R	R	R	R	R
1986	Vienna	Conv. – Early notification of a nuclear accident	Y	R	R	R	R	R	R
1986	Vienna	Conv. – Assistance in the case of a nuclear accident or radiological emergency	Y	S	R	R	R	R	R
1989	Basel	Conv. – Control of transboundary movements of hazardous wastes and their disposal	Y	R	R	S	R	R	R
1995		Amendment							
1989	London	Conv. – Salvage	Y	R	R	R			R
1990	London	Conv. – Oil pollution preparedness, response and co-operation (OPRC)	Y	R	R	R	R		R
1992	Rio de Janeiro	Conv. – Biological diversity	Y	R	R	S	R	R	R
1992	New York	Conv. – Framework convention on climate change	Y	R	R	R	R	R	R
1993	Geneva	Conv. – Prevention of major industrial accidents (ILO 174)							
1994	Vienna	Conv. – Nuclear safety		S	S	S	S	S	S
1994	Paris	Conv. – Combat desertification in those countries experiencing serious drought and/or desertification, particularly in Africa	Y	R	R	R	R	R	R

Source: IUCN; OECD.

Annex III.A: Selected multilateral agreements (worldwide) *(cont.)*

Y = in force S = signed R = ratified D = denounced

NZL	AUT	BEL	CZE	**DNK**	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	ESP	SWE	CHE	TUR	UKD	EC
R		R		**R**	R	R	R	R						R	R	R		R	R	R		R	
		R	R	**R**	R	R	R		R			R			R		R	R	R			R	
		R	R	**R**	R	R	R	S	R		R	R	R	R	R	R	R	R	R	R		R	R
		S		**R**		S	R							R					R			R	S
R	R	S	R	**S**	R	R	R	R	S	R	S	R	S	R	R	S	S	S	R	S			S
R	R	R	R	**S**	R	R	R	R	R	R	S	R	R	R	R	R	S	S	R	R		R	R
R	R	R		**R**	R	R	R	R			R	R	R	R	R		R	R	R	R		R	R
R	R	R		**R**	R	R	R	R			R	R	R		R		R	R	R	R		R	R
R	R	R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	**R**	R	R	R	R	R	R	R	R	R	R	R		R	R	R	R	R	R	R
R	R	R	R	**R**	R	R	R	R	R	R	R	R	R	R	R			R	R	R	R	R	R
R	R	S	R	**R**	R	R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	
R	R	S	R	**S**	R	R	R	R	R	S	R	R		R	R	R	S	R	R	R	R	R	
R	R	R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
		S		**R**	R								R		R			R	R			R	R
				R	S		S	R			R	R		R	R	S		S	R	R		R	
		S		**R**	R	R	R	R		R		S		R	R	S		R	R	R		R	
R	R	R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R
R	R	R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
		S												R					R				
	S	R	S	**S**	R	S	S	S	S		S	S	S	S	R	S	S	S	S		S	S	
	R	R		**R**	R	R	R	R			R	R	R	R	R		R	R	R	R	R	R	R

Annex III.B: Selected multilateral agreements (regional)

Y = in force S = signed R = ratified D = denounced

				CAN	MEX	USA	JPN	KOR	AUS
1933	London	Conv. – Preservation of fauna and flora in their natural state	Y						
1940	Washington	Conv. – Nature protection and wild life preservation in the Western Hemisphere	Y		R	R			
1946	London	Conv. – Regulation of the meshes of fishing nets and the size limits of fish	Y						
1950	Paris	Conv. – Protection of birds	Y						
1957	Geneva	Agreem. – International carriage of dangerous goods by road (ADR)	Y						
1975	New York	Protocol	Y						
1958	Geneva	Agreem. – Adoption of unif. cond. of approv. and recipr. recogn. of approv. for motor veh. equip. and parts	Y						
1959	Washington	Treaty – Antarctic	Y	R		R	R	R	R
1991	Madrid	Protocol to the Antarctic treaty (environmental protection)		S		S	S	S	R
1960	Paris	Conv. – Third party liability in the field of nuclear energy	Y						
1963	Brussels	Supplementary convention	Y						
1982	Brussels	Protocol amending the convention	Y						
1982	Brussels	Protocol amending the supplementary convention	Y						
1988	Vienna	Joint protocol relating to the application of the Vienna Convention and the Paris Convention	Y						
1962	Stockholm	Agreem. – Protection of the salmon in the Baltic Sea	Y						
1972	Stockholm	Protocol	Y						
1991	Brussels	Protocol	Y						
1964	London	Conv. – Fisheries	Y						
1967	London	Conv. – Conduct of fishing operations in the North Atlantic	Y	S		S			
1968	Strasbourg	Agreem. – Restriction of the use of certain detergents in washing and cleaning products	Y						
1983	Strasbourg	Protocol	Y						
1968	Paris	Conv. – Protection of animals during international transport	Y						
1979	Strasbourg	Protocol	Y						
1969	London	Conv. – Protection of the archaeological heritage	Y						
1971	Copenhagen	Agreem. – Co-operation in taking measures against pollution of the sea by oil	Y						
1972	Oslo	Conv. – Prevention of marine pollution by dumping from ships and aircraft	Y						
1983		Protocol	Y						
1973	Gdansk	Conv. – Fishing and conservation of the living resources in the Baltic Sea and the Belts	Y						
1982	Warsaw	Amendments	Y						
1974	Stockholm	Conv. – Nordic environmental protection	Y						
1974	Paris	Conv. – Prevention of marine pollution from land-based sources	Y						

Annex III.B: Selected multilateral agreements (regional)

Y = in force S = signed R = ratified D = denounced

NZL	AUT	BEL	CZE	**DNK**	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	ESP	SWE	CHE	TUR	UKD	EC
		R				S						R					S	R				R	
		R		**R**		R	R			R	R			R	R		R	R	R			R	
	S	R				S		S		R		R	R	R			S	R	R	R	R		
	R	R	R	**R**	R	R	R	R	R			R	R	R	R	R	R	R	R	R		R	
	R	R		**R**	R	R	R		R			R	R	R	R	R	R	R	R	R		R	
	R	R	R	**R**	R	R	R		R			R	R	R	R	R	R	R	R	R		R	
R	R	R	R	**R**	R	R	R	R	R			R		R	R	R		R	R	R	R	R	
R	S	S	S	**S**	R	R	S	S	S			S		S	S	S		R	R	S		S	
	S	R		**R**	R	R	R	R				R	S	R	R		R	R	R	S	R	R	
	S	R		**R**	R	R	R					R	S	R	R			R	R	S		R	
	S	R		**R**	R	R	R	R				R	S	R	R		R	R	R	S	R	R	
	S	R		**R**	R	R	R					R	S	R	R			R	R	S		R	
		S	R	**R**	R	S	S	S	R			R		R	R	R	S	S	R	S	S	S	
				R			R									R			R				
				R			R									R			R				
						R	R						R	R						R			
		R		**R**		R	R				R	R	S	R		R	R	R	R			R	
		R		**R**		R	R			R	S	R		R	R	S	R	R	R			R	
		R		**R**		R	R					R	R	R				R		R		R	
				R			S						R	R				R		S		R	
	R	R		**R**	R	R	R	R		R	R	R	R	R	R		R	R	R	R	R	R	
	R	R		**R**	R	R	R	R		R	R	R	R	R	R		R	R	R	R		R	
	R	R		**R**		R	R	R		R		R	R				R	R	R	R		R	
				R	R										R				R				
		R		**R**	R	R	R			R	R			R	R		R	R	R			R	
		R		**R**	R	R	R			R	R			R	R		R	R	R			R	
				D	R		D									R			R				R
				D	R		D									R			R				R
				R	R										R				R				
		R		**R**		R	R			R	R		S	R	R		R	R	R			R	R

Annex III.B: Selected multilateral agreements (regional) (cont.)

Y = in force S = signed R = ratified D = denounced

			CAN	MEX	USA	JPN	KOR	AUS
1986	Paris	Protocol	Y					
1992	Paris	Conv. – Protection of North-East Atlantic marine env. (ex Oslo-1972 and Paris-1974)						
1974	Helsinki	Conv. – Protection of the marine environment of the Baltic Sea area	Y					
1992	Helsinki	Conv. – Protection of the marine environment of the Baltic Sea area (amendment)						
1979	Bern	Conv. – Conservation of European wildlife and natural habitats	Y					
1979	Geneva	Conv. – Long-range transboundary air pollution	Y	R	R			
1984	Geneva	Protocol (financing of EMEP)	Y	R	R			
1985	Helsinki	Protocol (reduction of sulphur emissions or their transboundary fluxes by at least 30%)	Y	R				
1988	Sofia	Protocol (control of emissions of nitrogen oxides or their transboundary fluxes)	Y	R	R			
1991	Geneva	Protocol (control of emissions of volatile organic compounds or their transboundary fluxes)	Y	S	S			
1994	Oslo	Protocol (sulphur emission ceilings and percentage emission reduction)	Y	S				
1998	Aarhus	Protocol (heavy metals)		S	S			
1998	Aarhus	Protocol (persistent organic pollutants)		S	S			
1980	Madrid	Conv. – Transfrontier co-operation between territorial communities or authorities	Y					
1980	Canberra	Conv. – Conservation of Antarctic marine living resources	Y	R	R	R	R	R
1980	London	Conv. – Multilateral co-operation in North-East Atlantic fisheries	Y					
1982	Paris	Memorandum of understanding on port state control	Y					
1982	Reykjavik	Conv. – Conservation of salmon in the North Atlantic Ocean	Y	R	R			
1983	Bonn	Agreem. – Co-operation in dealing with pollution of the North Sea by oil and other harmful subst.	Y					
1989	Bonn	Amendment	Y					
1989	Geneva	Conv. – Civil liab. for damage caused during carriage of dang. goods by road, rail, and inland navig. (CRTD)						
1991	Espoo	Conv. – Environmental impact assessment in a transboundary context	Y	R	S			
1992	Helsinki	Conv. – Transboundary effects of industrial accidents		S	S			
1992	Helsinki	Conv. – Protection and use of transboundary water courses and international lakes	Y					
1993	Lugano	Conv. – Civil liability for damage resulting from activities dangerous to the environment						
1998	Aarhus	Conv. – Access to environmental information and public participation in environmental decision-making						

Source: IUCN; OECD.

Annex III.B: Selected multilateral agreements (regional) *(cont.)*

Y = in force S = signed R = ratified D = denounced

NZL	AUT	BEL	CZE	**DNK**	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	ESP	SWE	CHE	TUR	UKD	EC
		R		**R**		R	R			R	R			R	R		R	R	R			R	R
		R		**R**	R	S	R			S	S		S	R	R		S	R	R	R		S	S
				R	R		R									R			R				R
				R	R		R									S			R				R
	R	R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	R	R	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	R	R	R	**R**	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R	R	R
	R	R	R	**R**	R	R	R		R			R	R	R	R				R	R			
	R	S	R	**R**	R	R	R	R	R		R	R	R	R	R	S		R	R	R		R	R
	R	S	R	**R**	R	R	R	S	R			R	R	R	R		S	R	R	R		R	S
	S	S	R	**R**	S	R	R	R	S		S	S	R	R	R	S		R	R	R		R	R
	S	S	S	**S**	S	S	S	S		S	S	S	S	S	S	S	S		S	S		S	S
	S	S	S	**S**	S	S	S	S		S	S	S	S	S	S	S	S		S	S		S	S
	R	R		**R**	R	R	R		R		R	R	R	R	R	R	R	R	R	R	R		
R		R			R	R	R	R				R		R	R	R		R	R			R	R
				R						R					R	R	R	R	R				R
		R		**R**	R	R	R	R			R	R		R	R		R	R	R			R	
				R	R					R					R				R				R
		R		**R**		R	R							R	R				R			R	R
		R		**R**		R	R							R	R				R			R	R
							S																
	R	S	S	**R**	R	S	S	R	R	S	S	R	R	R	R	R	S	R	R	R		R	R
	S	S		**S**	S	S	S	R	R			S	R	S	R	S	S	R	S	S		S	R
	R	S		**R**	R	R	R	R	R			R	R	R	R	S	R	S	R	R		S	R
					S			S		S		S	S	S									
	S	S	S	**S**	S	S		S		S	S	S	S	S	S	S	S	S	S	S		S	S

Annex IV

CHRONOLOGY OF SELECTED ENVIRONMENTAL EVENTS (1990-98)

1990

- The Minister of the Environment presents two white papers: ''Objectives and Means in Environmental Policy'' and ''Objectives and Means in International Environmental Collaboration – A Selective Danish Strategy Plan''. They describe the second phase of the follow-up to the Brundtland Report and provide sectoral objectives and measures.
- The government adopts the action plan for energy and transport on greenhouse gas emissions, ''Energy 2000''. The purpose of the plan is to fulfil the targets of the Toronto Conference by reducing CO_2 emissions by 20 per cent in relation to 1988 by 2005, as well as Denmark's obligations under the Climate Change Convention and related EU agreements.
- The Ministry of the Environment publishes the green paper ''The Environment and Economy'', in preparation for the introduction of new green taxes in 1995.
- Parliament adopts the Action Plan on Cleaner Technology.
- The first comprehensive environmental statistics report, ''Figures on Nature and the Environment'', is published.

1991

- Parliament adopts the new Planning Act, which aims at securing sustainable development and protecting nature.
- Parliament adopts the new Environmental Protection Act and the Act on the Exploitation of Natural Resources.
- The government presents ''Denmark: National Report to UNCED – 1992''. As part of the UNCED process, the government supports a series of meetings in Copenhagen including a seminar on sustainable energy development, a UNIDO conference on ecologically sustainable industrial development and an international meeting of experts on freshwater.
- The Minister of the Environment signs MoUs with his colleagues from the Baltic countries, Poland, Czechoslovakia and Hungary indicating the scope, financial framework and time period (usually one year) for Danish environmental aid. In subsequent years, similar

MoUs are signed with ministers from these and other countries of central and eastern Europe.

- Parliament adopts a government proposal to double forest area within one tree generation. Implementation of the decision involves minor revisions of agricultural legislation and the Nature Protection Act, so as to provide financial support for private forest planting.
- The first regular Danish State of the Environment Report is published in Danish.
- The first issue of the annual publication ''Environmental Indicators'' is published. Only the 1992 issue is translated into English.
- Parliament adopts the government's Action Plan for Sustainable Agriculture.

1992

- Parliament adopts the Nature Protection Act, which includes various extensive land use types under general nature protection and expands public access to nature.
- The Nature Protection Board of Appeal is established. This board is the body of final appeal for land use planning and nature protection.
- As a follow-up to the Rio Conference, Parliament's Foreign Affairs Committee issues a report containing a proposal for an additional assistance mechanism targeted at global environmental assistance and disaster relief.
- The Minister of the Environment presents a green paper on ''The Greenhouse Effect and Climate Change – Implications for Denmark'' (with an English summary). The aim is to provide a scientific basis for the political debate on Danish climate change strategy.
- The government releases a white paper on ''Environmental Achievements in the Nineties''.
- The Minister of the Environment hosts and chairs the fourth meeting of the partners of the Montreal Protocol on protection of the ozone layer in Copenhagen.
- The government releases a national planning report, ''Denmark towards the Year 2018''.
- The Minister of the Environment presents a green paper on ''Strategy for Natural Forests and other Forest Types of High Conservation Value in Denmark'' (English version published in 1994).
- The Minister of the Environment releases a government circular regulating exploitation of the coastal zone.
- The government launches an interdisciplinary and co-ordinated environmental research programme covering the main environmental areas.
- Parliament adopts the Action Plan on Waste and Recycling, 1993-97.
- The Danish Oil Association signs an agreement with environmental authorities concerning a clean-up programme for contaminated soil at petrol stations. Site remediation

carried out under this agreement is financed by a DKr 0.04 per litre tax on gasoline collected by oil companies.

- Parliament adopts a tax reform introducing CO_2 taxes and subsidies for energy savings in industry, grants for cogeneration and for power generation based on renewables and natural gas CHP.
- Parliament adopts the Planning Act, which integrates five existing planning laws into a framework law.

1993

- The Spatial Planning Agency is abolished and its tasks integrated into the Ministry of the Environment.
- The government launches a green paper on Danish commitment to international collaboration. Following up on the conclusions in this report, a fund for environmental aid to developing and Arctic countries is established.
- The government launches the green tax reform, which – among other things – introduces and raises a number of green taxes on consumption. At the same time the marginal income tax rate is lowered.
- The first step in implementing strategic environmental planning is taken by issuing an SOE report, which couples development in central environmental areas with developments in sectors of society that have the greatest environmental impact. (Published in English in 1994 under the title ''Environment and Society'').
- The government issues an administrative order stating that bills and other government proposals are to include an assessment of their environmental effects if they are considered likely to have a significant environmental impact.
- Parliament adopts the Hunting and Game ManagementAct. The Act is based on a consensus of NGOs representing various groups of nature users.
- As a result of data showing that nitrate concentrations exceed guideline values in 22 per cent of drinking water samples and that small concentrations of different pesticides are found in 5-7 per cent of samples, the Minister of the Environment presents a green paper on ''Strategy for the Protection of Groundwater''.
- The Minister of the Environment publishes a report, ''The North Sea – Environmental Indicators'', based on the work of the North Sea Task Force. It illustrates the state of the North Sea environment using simple developmental trends and a range of environmental indicators.
- The Minister of Energy launches the follow-up to Energy 2000, which includes new initiatives on standards for appliances, demand-side management and conversion of electrically heated dwellings.

1994

- The Ministry of the Environment and Ministry of Energy are merged.
- In order to further integrate private and public forest management with nature and landscape management, administration of forest legislation is transferred to the Ministry of Environment and Energy from the Ministry of Agriculture and Fisheries, together with the Forest and Landscape Research Institute.
- The Minister of Environment and Energy launches a campaign targeting local authorities as part of the follow-up to Agenda 21. The objective is to promote local action that incorporates global sustainability considerations.
- Parliament adopts a governmental proposal to establish a Green Fund (DKr 17 million in 1995, DKr 50 million in 1996-98, DKr 25 million in 1999-2000) to support initiatives by groups of citizens or local communities to develop urban ecology, reduce resource use and promote environmentally friendly behaviour at grassroots level.
- The Minister of Environment and Energy opens the European Environment Agency in Copenhagen.
- Parliament adopts amendments to the Planning Act and Nature Protection Act concerning coastal areas.
- The Minister of Environment and Energy issues a ministerial order requiring EIAs, in accordance with the Planning Act.
- The Minister of Environment and Energy presents ''The Danish Environmental Strategy'', which gives an overview of the Danish approach to strategic planning concerning environment and development. The strategy involves action plans with targets and implementation measures.
- The Minister of Environment and Energy presents a green paper on forestry, ''Strategy for Sustainable Forestry''.
- To facilitate the environmental assessment of bills and other governmental proposals, a review of examples and experience is published (published in English 1995).
- The second environmental statistics report is published.
- The government launches a national strategy for public research on primary agriculture which gives high priority to the effects of agriculture on landscape and the environment, and the development of administrative tools to protect the environment and biodiversity in agricultural practices.

1995

- The Minister of Environment and Energy presents a white paper on ''Denmark's Nature and Environment Policy, 1995'' which introduces the concept of environmental space. As the policy follow-up to the 1993 SOE report, it is part of strategic environmental planning.
- The EU unanimously agrees on a proposal, originally put forward by the Nordic countries, to ban the export of hazardous waste from OECD countries to non-OECD countries.

- At the meeting of partners of the Montreal Protocol, Denmark takes an active role in negotiations concerning international efforts to restore the ozone layer.
- At the initiative of Nordic countries, the UN launches a Global Protection Plan for the Marine Environment which includes a decision, strongly promoted by Denmark, to develop a global, juridical binding instrument for the reduction/elimination of emissions of persistent organic pollutants.
- Denmark hosts the fourth International North Sea Conference in Esbjerg.
- Parliament adopts a number of green taxes to reduce Danish emissions of CO_2 and SO_2. The revenue from some of the taxes is refunded to industry in the form of energy efficiency or waste collection grants.
- The Minister of Environment and Energy publishes ''Biological Diversity in Denmark, Status and Strategy'' (English version published 1996), as a step towards implementing the Biodiversity Convention in Denmark.
- Parliament revises the Watercourses Act to ensure minimum flow in watercourses during the summer. The Act will be fully enforced in 2005, when existing agreements on the use of river water by fish farms run out.
- Parliament revises the Environmental Protection Act,introducing green account-ing in companies likely to have significant impacts on the environment. The revision ensures public access to information on the environmental impact of individual companies.
- Parliament adopts legislation on subsidies for energy-intensive industries.
- The annual monitoring report reveals that pesticides are found in various concentrations in 10-15 per cent of groundwater samples. In 3 per cent of the samples the maximum admissible limit for drinking water is exceeded.
- The Minister of Environment and Energy launches a strategy on protection of groundwater.
- Parliament adopts a revision of the Act on Chemical Substances and Products to phase out the most harmful pesticides.
- The Minister of Environment and Energy launches a strategy for research, monitoring and development supported either through basic funding of its research institutes or through research programmes.

1996

- The Ministry of Environment and Energy and the Ministry of Foreign Affairs release a ''Strategy for Danish Environmental Assistance'' based on the Rio Declaration on environment and development.
- Parliament revises the Environmental Protection Act. Among other things, it introduces a procedure ensuring that Danish environmental information on used industrial equipment for export is communicated to the environmental authorities in the recipient country.

- Parliament adopts a revision of the Forest Act which introduces subsidies to develop forests' immaterial and ecological values.
- Parliament adopts a revision of the Act on Natural Resources that bans exploitation of minerals on the sea bed in protected areas (such as EU bird protection areas, Ramsar sites, EU habitats, etc.) and elsewhere makes it subject to EIA procedures.
- The government launches Energy 21, an updated action plan for sustainable energy development.
- Parliament adopts a fund of DKr 90 million per year for research and consultancy concerning water supply, drinking water quality and pesticides for small waterworks.
- The Minister of Environment and Energy presents a series of initiatives which would eventually phase out compounds with hormonal effects.
- The preliminary results of a laboratory experiment indicate that in clay soils, which are usually not considered vulnerable to pesticide leaching, pesticides may rapidly penetrate to groundwater through cracks.

1997

- Parliament approves the national planning report ''Denmark and European Spatial Planning Policy'' and adopts national planning measures for urban areas, the transport system and the cultural and natural heritage. The report lists the overall objectives of national planning policy, both internationally and in relation to counties and municipalities.
- The government presents the 1998 budget, which for the first time assesses relations between the State budget and central environmental trends using economic and environmental indicators.
- Parliament adopts, as a follow-up to UNGASS, an amendment to the Planning Act requiring counties and municipalities to elaborate local Agenda 21 reports as part of regional plans.
- The Minister of Environment and Energy opens the Centre of Know-how on Urban Ecology in Aarhus, which contributes to implementing local Agenda 21 by gathering and disseminating information on urban ecological and green issues.
- The government presents a green paper on ''Denmark's Position in an International Context'' which summarises the conclusions of the publication, ''Structural Monitoring System''. Based on indicator comparisons between Denmark and seven countries of similar prosperity, the publications assess Denmark's relative performance. Besides indicators on health, education, public service, infrastructure, international trade, industrial development, economy and taxation, the benchmark system includes 16 environmental indicators. The intention is to publish the benchmark report on a regular basis.
- The Minister of Environment and Energy presents the report of an international expert panel evaluating the Danish approval system for pesticides, with special regard to groundwater protection. The panel concludes that even though the system follows one of

the most stringent approaches in northern Europe and the EU, and legislation is implemented strictly, the geology of Danish soils may pose greater groundwater pollution risk from pesticides. The panel's recommendations are being incorporated in the approval system.

- The government launches a National Strategy for Environmental and Energy Research, part of a comprehensive national research strategy. On a multidisciplinary basis, the strategy aims at co-ordinating applied environmental research with sectoral applied research and with basic research.
- The government publishes a report on ''International Evaluation of Public Danish Fisheries Research''. In 1998, it expects to launch a national strategy for public fisheries research based on the findings of this report. The strategy will improve co-ordination with public environmental research and basic aquatic research.
- The Minister of Environment and Energy announces a plan for five groups of offshore wind turbines with a total capacity of 750 MW.
- A combination of eutrophication and warm weather causes massive death of fish in Jutland's Mariager fjord.
- The Minister of Environment and Energy presents a report to Parliament on future initiatives in the field of chemicals.
- A committee of national and international experts is established to evaluate the consequences of pesticide use in agriculture. The committee will report in 1999.

1998

- As part of the Environment for Europe process, Denmark hosts the fourth Pan-European Conference of Environment Ministers in Aarhus in June. A UN-ECE Convention on Public Participation in Decision-making and two new protocols to the Convention on Long-range Transboundary Air Pollution are signed.
- As a follow-up to the 1997 chemical strategy, the Danish Environmental Protection Agency (EPA) presents a list of some 100 undesirable substances.
- The Ministry of Environment and Energy publishes its second SOE report, ''State of the Environment in Denmark, 1997''.
- The government approves the second action plan for the aquatic environment. To reduce nitrogen loadings, it reduces nitrogen fertiliser input to agricultural land by 10 per cent and introduces a system of fines in case of violation of fertiliser standard. As a result of the action plan, two laws are being prepared to adjust the limit for livestock units per hectare, manage private afforestation and (re-)establish wetlands.
- The Minister of Environment and Energy creates a Nature Council to advise the Minister on matters of nature conservation and preservation of biodiversity.
- A support programme to promote positive environmental qualities in products and goods alongside other parameters (e.g. price, quality and function) is adopted.

- The 18-kilometre bridge and tunnel linking Fyn and Slelland over the Store Belt is opened.
- Danish EPA publishes an action plan on MTBE in gasoline.
- The Act on Water Supply is revised to improve protection of drinking water resources by introducing zoning and other administrative measures.
- The government releases a new action plan on waste (Waste 21).
- The National Monitoring and Assessment Programme for the Aquatic Environment is expanded and launched.

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