OECD Environmental Performance Reviews

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FOREWORD

The principal aim of the OECD's Environmental Performance Reviews programme is to help *member countries improve their individual and collective performances in environmental management* with the following primary goals:

– to help *individual governments* assess progress;

– to promote a continuous policy *dialogue among member countries*, through a peer review process; and

– to stimulate *greater accountability* from member countries' governments towards their public opinion, within developed countries and beyond.

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 and independent reviews have been conducted for all member countries as part of the first cycle of reviews. The OECD is now engaged in the second cycle of reviews directed at *promoting sustainable development,* with emphasis on implementation of domestic and international environmental policy, as well as on the integration of economic, social and environmental decision-making.

The present report reviews environmental performance of Denmark. The OECD extends its most sincere thanks to all those who helped in the course of this review, to the representatives of member countries to the Working Party on Environmental Performance, and especially to the examining countries (Belgium, Korea and Norway) 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. The present review benefited from grant support from Austria and Australia.

The OECD Working Party on Environmental Performance conducted the review of Denmark at its meeting on 26 June 2007 and approved its conclusions and recommendations.

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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 (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey and United Kingdom).

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

Country aggregates may include Secretariat estimates.

The sign * indicates that not all countries are included.

Currency

Monetary unit: krone (DKK).
In 2006 DKK 7.459 = EUR 1.

Cut-off Date

This report is based on information and data available up to June 2007.

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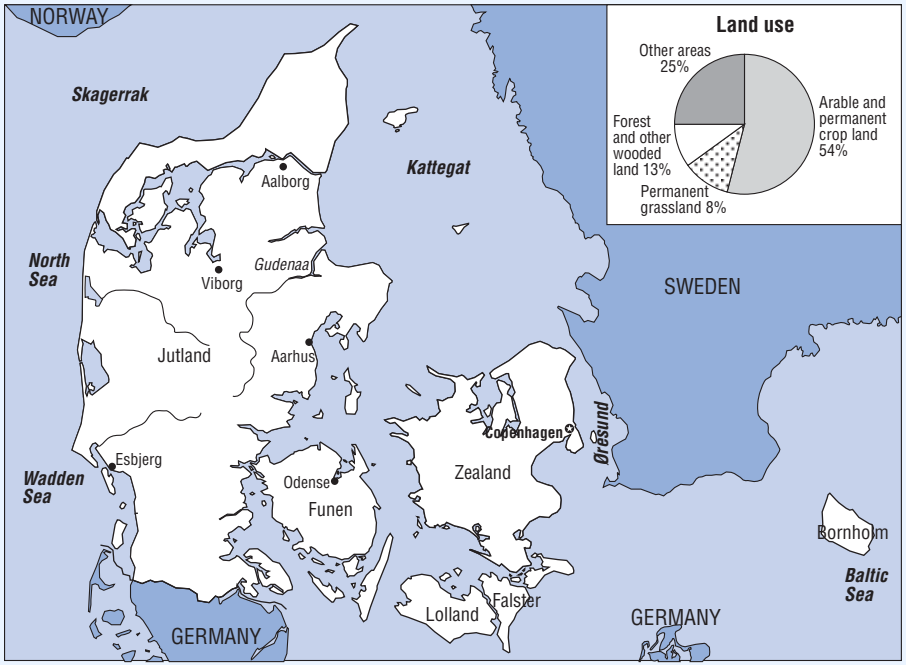
Map of Denmark



Source: OECD.

1

CONCLUSIONS AND RECOMMENDATIONS*

This report examines Denmark's progress since the previous OECD Environmental Performance Review in 1999, and the extent to which the country has met its *domestic objectives and honoured its international commitments*. The report also reviews Denmark's progress in the context of the OECD *Environmental Strategy for the First Decade of the 21st Century*.** Some 37 recommendations are made that could contribute to further environmental progress in Denmark.

Denmark's *economic progress* provides the country with high average income per capita and extensive welfare benefits. Its open economy thrives on trade in the EU and globally. It is largely driven by intensive *agriculture* and *fisheries*, which support a large agro-food industry and have a large environmental impact. Other severe environmental pressures stem from its *transport* sector and from its *energy* supply structure, which continues to rely mainly on fossil fuels. Environmental issues in Denmark also have a strong international dimension due to regional economic and environmental interdependencies (e.g. EU co-operation, North Sea and Baltic Sea pollution, transfrontier air pollution). Denmark is strongly involved in European and global environmental issues and environmental aid.

Over the review period, economic growth and implementation of European Union legislation provided the context for economic and environmental decision-making in Denmark, together with a tax freeze and a major territorial government reform. The implementation of environmental policies is being

* Conclusions and Recommendations reviewed and approved by the Working Party on Environmental Performance at its meeting on 26 June 2007.

** The objectives of the Strategy are covered in the following sections of these Conclusions and Recommendations: maintaining the integrity of ecosystems is covered in Section 1; decoupling of environmental pressures from economic growth, in Sections 2.1 and 2.2; and global environmental interdependence, in Section 3.

further devolved to municipal authorities. *Environmental policies* currently focus on: air pollution, the aquatic environment (nutrient discharges and groundwater contamination), biodiversity, chemical substances, environmental health, and global issues such as climate change. Measures to address these issues rely on a range of diverse, well-established and in some cases innovative policy instruments.

1. Environmental Management

Building on solid environmental legislation largely harmonised with and derived from EU environmental directives, and benefiting from experienced environmental administrations at national and territorial level, environmental management in Denmark is going through a *reform period*, marked by further devolution of environmental responsibilities to municipalities as well as the creation of regional environmental centres within the Ministry of Environment. This is taking place in the context of an overall *territorial government reform*, which included the elimination of counties and aggregation of the 271 municipalities into 98, on 1st January 2007.

Strengthening the implementation of environmental policies

Environmental regulations continue to play a major role in Danish environmental policies. Land-use regulations, particularly those applicable to rural and coastal areas, are rigorous, and spatial planning contributes effectively to protection of the environment, nature, landscapes and coastal areas. Stringent waste incineration regulation has been a driving force for the development of cogeneration and district heating. The concept of producer responsibility was embodied in Danish waste legislation (further to EU directives on end-of-life vehicles and on waste electrical and electronic equipment). More generally, Denmark performs very well in transposing and implementing *EU environmental legislation*. Policy making continues to be *open and consultative*. Denmark uses *economic instruments* (environmental charges, environmental taxes, other economic instruments) extensively. The *full cost-recovery principle* has been tacitly applied in water management for some time and was included in the 2001 Environmental Protection Law. *Green taxes* apply to air, water and waste management policies. The tax on sulphur emissions (1996) contributed to drastic decreases in SO_2 emissions. The waste water tax (1997) led to a significant reduction of nitrogen, phosphorus and organic matter in waste water. Since the 1999 review, Denmark has introduced several new environmental taxes (e.g. CO_2

tax on gasoline, tax on ozone-depleting greenhouse gases, taxes on PVC and phthalates, tax on mineral phosphorous added to feed). Increasing emphasis is placed on the use of *cost-effectiveness analysis* in ex-ante evaluations of environmental actions to optimise the mix of instruments applied. Overall, public environmental expenditures are covered by environmental charges or taxes, and the *polluter pays principle applies to households and, to a lesser extent, industry*.

Despite these excellent environmental policies and many positive trends, Denmark's environmental performance is not always high by OECD standards except for a few indicators (i.e. SO_x emission intensity, public waste water treatment, energy intensity). The actual results are in the middle range for some indicators (e.g. pesticide use, NO_x emission intensity), and below OECD standards for others (municipal waste per capita, nitrogenous fertiliser use). Some health indicators are also of concern. This suggests that Denmark's environmental policies have not always been strong enough to counter the pressures exerted on the environment from transport, agriculture, fisheries and other economic activities, as well as from consumption patterns. The *effectiveness of economic instruments* has been hindered by a series of factors. First, tax concessions should be eliminated (e.g. the very low energy tax paid by industry on electricity consumption, the industry exemption from the water supply tax). Second, their incentive effect should be increased: for example, since 2001, most tax rates have not been adjusted for inflation. Third, their scope

Recommendations:

- further develop the *environmental strategic and planning framework* with specific environmental quality objectives as well as targets and deadlines, in the context of the sustainable development strategy; pursue efforts to use cost-benefit and cost-effectiveness analyses in policy setting and implementation;
- set up capacity building mechanisms to *help municipalities carry out new environmental management tasks* resulting from the territorial government reform; foster exchange of expertise among municipalities;
- adjust the *rates of green taxes* to internalise externalities; reduce tax concessions and the associated administrative cost of their implementation;
- adopt a *national action plan for promoting environmental technology* based on appropriate economic analysis, and implement it;
- prioritise *monitoring* of national environmental action plans.

could be further extended, although this has become difficult following the *tax freeze* introduced in 2001. Further, there is uncertainty about the extent to which the full cost-recovery principle (enshrined in the 2001 Environmental Protection Act) is applied to municipal waste collection. It is not clear whether the territorial government reform will allow improvement in enforcement of environmental legislation. The *number of environmental inspections* has decreased drastically to focus on IPPC facilities. Finally, Denmark's sustainable development strategy has not always been used as a platform to develop environmental strategies, though individual environmental action plans do exist (e.g. National Action Plan for the Aquatic Environment, National Action Plan on Chemicals).

Air

Denmark has continued to register progress in managing air pollution and meeting its national and international objectives. *Emissions* of SO_x, NO_x and VOCs were strongly decoupled from economic growth during the review period. SO_2 emission intensity (emissions per unit of GDP) is the lowest in the OECD area, partly due to the tax on SO_2 emission introduced in 1996. CO_2 emissions also were strongly decoupled from economic growth, and CO_2 emission intensity is below the OECD-Europe average. Ammonia emissions from the agricultural sector have also decreased. As a result, Denmark successfully reduced emissions of acid substances in recent years. On the whole, *ambient concentrations* of criteria air pollutants decreased during the review period. New NO_2 ambient standards were adopted in 1999. Other ambient air quality standards were reviewed and new limit values set (applying in 2005 or 2010 depending on the substance). Denmark adopted *a strategy and action plan to protect public health* against, inter alia, air pollution in 2003. Monitoring of PM_{10} (in cities and urban background) began in 2001. The government is aiming to reduce particulate emissions from traffic in towns by 50% by 2010, notably by introducing low emission zones in city centres. The *energy intensity* of the Danish economy was improved over the review period and is one of the lowest among OECD countries. Renewable energy represents 25% of total electricity generation. A long-term energy strategy, Energy Strategy 2025, was launched in 2005. Registration tax reductions were introduced for very energy-efficient cars (1999) and for diesel cars equipped with particulate filters (2006).

However, several challenges remain, mainly concerning *NO_x and PM* emissions and concentrations. One fifth of the Danish population is exposed to unacceptable air quality. In Copenhagen, PM_{10} concentrations exceed the limit value. Emissions of PAHs (polycyclic aromatic hydrocarbons) increased during

the review period as a result of increased wood combustion for residential heating. Higher priority should be given to monitoring of *hazardous air pollutants*. There is a need to know more about the health effects of fine particulates ($PM_{2.5}$). Although private car ownership is low by OECD standards (35 vehicles per 100 persons), the number of diesel-powered cars increased over the review period. Despite investment in public transport infrastructure projects (e.g. the Copenhagen metro, the Copenhagen Circle Line Project), *public transport* is still losing out to private cars. Background ozone levels are on the rise, and more should be done to reduce NO_x and VOC domestic emissions and their transboundary transport. Although Copenhagen has the highest rate of cycling of any major European city, Denmark did not have a national policy to develop cycling as a mode of transportation until recently.

Recommendations:

- continue to reduce emissions of *NO_x and VOCs from mobile sources*, including through the use of economic instruments in the most cost-effective way;
- strengthen the *management of particulate matter*, including the monitoring of PM_{10} and $PM_{2.5}$ concentrations and emissions; develop emission standards for residential *wood burning stoves*; implement and enforce *low emission zones* in cities;
- continue to encourage the provision of economically and environmentally attractive *public transport systems* in urban areas; strengthen transport demand management to limit passenger car use in congested areas (e.g. road pricing, parking fees, spatial planning, intelligent transport systems); implement the Bicycle Strategy 2007; address air pollutant emissions from ships;
- integrate *transport and environmental policies*; set quantitative targets, further use demand-side management, and facilitate co-operation among state and territorial authorities and concerned parties;
- continue to *improve energy efficiency* (e.g. transport and building sectors, public sector, distribution companies); review *energy taxation* to establish appropriate price signals.

Water

Use of farm inputs (nitrogen and phosphorus) was decoupled from agricultural production during the review period, following implementation of an

instrument mix (economic incentives, voluntary and regulatory measures) under the second Action Plan for the Aquatic Environment 1998-2004 (VMP II). The target of reducing *nitrogen leaching* by half from 1985 levels was met (in 2003 rather than 1993, the initial deadline). Denmark now complies with requirements of the EU Nitrates Directive. *Pesticide use* was also decoupled from agricultural production, due to the switch to low-dose agents and to the pesticide tax introduced in the mid-1990s (whose rate has since been increased). *Water pricing* covers the cost of providing services (user charges) plus some environmental costs (taxes) for both public water supply and waste water treatment. The increase in water prices brought a significant reduction in household water consumption over the review period, but not in industry or agriculture where tax exemptions still apply. *Municipal waste water treatment* is widely available (89% of the Danish population is connected) and most treatment is advanced (tertiary). Available evidence suggests that *drinking water quality* was kept high, although monitoring should be further improved, particularly for small waterworks. The pressure on water resources from industry has been reduced, mostly due to delocalisation of industrial production.

However, Denmark *still has water quality problems*, particularly in lakes and coastal areas (fjords), but also in rivers and groundwater. The new Action Plan for the Aquatic Environment 2005-15 (VMP III) aims to further reduce nitrogen leaching by 13% and to address phosphorus pollution (through a tax on phosphorus added to animal feed). Reduction targets have been set countrywide, but without looking at *cost-effectiveness* in meeting site-specific water quality objectives; indeed the whole of Denmark's land area is classified as vulnerable under the EU Nitrates Directive, and all Danish waters are sensitive under the EU Urban Waste Water Treatment Directive. There is a need for a holistic (river-basin) approach when addressing water quality and quantity issues, and efforts are needed to compare the cost-effectiveness of measures among households, industry and agriculture sectors. This is the source of major inefficiency in addressing nitrogen pollution. The setting of *water quality objectives* has been put on hold, pending implementation of the EU Water Framework Directive in 2009. Little has been done to renew sewerage networks and allow separate collection of stormwater, due to the low efficiency in providing water services resulting from the present water pricing regime. Efficiency gains are expected from a *water sector reform* under preparation, through benchmarking of water utilities and price regulation. There is considerable scope for further efforts on restoration of Danish watercourses, only 2% of which follow a naturally meandering course. Contaminants other than nitrogen, phosphorus and pesticides have been given too little attention (e.g. heavy metals, toxic chemicals, endocrine disrupters).

Recommendations:

- carry out a comprehensive assessment of the *economic efficiency and environmental effectiveness* of water pollution abatement measures in different sectors (municipal, industrial, agricultural), in the context of implementation of the EU Water Framework Directive;
- consider the further use of *economic instruments to address diffuse pollution*; target fiscal incentives to environmental outcomes and improve cost-effectiveness;
- speed up identification of *areas at high risk of nutrient and pesticide contamination* and take measures to protect them, including establishing groundwater protection zones, 10-metre buffer zones along rivers, and buffer zones around lakes;
- reinforce the *interface between water management and nature protection*, in the wake of local government reform and pursuant to VMP III objectives; in particular, speed up creation of new wetlands and define ecological quality objectives for rivers;
- move toward *river basin management* according to the new water districts; in particular, prepare water plans as required by the EU Water Framework Directive;
- increase the *efficiency of public water supply and waste water management*, in particular by exploiting economies of scale in the wake of local government reform and pursuant to the proposed water reform objectives.

Nature and biodiversity

After the OECD Environmental Performance Review in 1999, Denmark took several steps to emphasise the conservation of biodiversity. It adopted the National Strategy on Biological Diversity (2004) and the *Action Plan for Biodiversity and Nature Conservation* (2004-09). It prevented housing construction in a widened *coastal and dune protection zone* (from 100 to 300 metres). In the context of *Natura 2000*, Denmark has designated 254 special conservation areas and 113 special protection areas, including 27 Ramsar sites, covering 8.4% of its terrestrial areas (i.e. 3 600 km^2) and 12.3% of its marine areas (i.e. 13 050 km^2). Environmental monitoring was extended to nature conservation through the creation of the National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environments (NOVANA). A number of *species*, like the white-tailed eagle, peregrine falcon, common crane, Eurasian spoonbill and corncrake, are starting to return to Denmark. Roe deer and red deer

are increasing, as are grey seal populations in the seas. Denmark has initiated seven pilot projects in support of the creation of national parks, although none has been created yet.

However, agriculture (including aquaculture and intensive livestock farming), urbanisation and increased infrastructure development continue to exert negative impacts on nature and biodiversity. The Danish fish catch represents a major part of the total catch from the North Sea. Depleted fish stocks (due to overfishing), recurring fish kills in the Baltic (due to water pollution), and finding of deformed fish and snails changing sex, of fish unfit for human consumption, and of invasive species (some as a result of climate change) all point towards an *impoverished and degraded aquatic environment*. Further efforts are needed to follow up on several of the 1999 OECD recommendations. The national Action Plan for Nature and Biodiversity Conservation lacks clear time-bound objectives. It has yet to integrate comprehensive biodiversity

Recommendations:

- establish *national parks* in priority conservation areas and clarify their role in relation to other protected areas; complete *management plans for all protected areas* including the Natura 2000 areas, incorporating biodiversity objectives and ecological integrity indicators, and establish a network of corridors linking them; develop and adopt *ecosystem quality objectives* for terrestrial and aquatic habitats, including as part of implementation of the EU Habitats and Water Framework Directives;
- develop time-bound objectives for the *national nature and biodiversity conservation action plan*, including with regard to integration of biodiversity considerations in *agriculture*, *fisheries* and other sectoral policies; develop and implement a *comprehensive planning system*, with a sea use planning component and with cumulative impact assessment and climate change impact scenarios;
- adjust the *levels of economic incentives* and revise the land use legal framework, so as to enhance biodiversity conservation, production of ecological services (e.g. reduction of nitrogen and phosphorus leaching) and groundwater protection (e.g. in priority contaminated areas) on private land;
- expand *restoration projects for major ecosystems*, including major rivers and future national parks, to re-establish their capacity to produce ecological services and to support biodiversity;
- accelerate the rate of *environmental certification* of fish farms.

conservation targets in *fisheries and agricultural policies*. The management plans for protected areas are incomplete and the goal of increasing the forest cover is behind schedule. Despite NOVANA, Denmark has not fully developed indicators and a monitoring system to evaluate progress toward the 2001 Gothenburg EU Summit objective of halting the decline of biodiversity by 2010. Denmark's next challenge will be to move towards ecosystem-specific quality objectives. This will require cross-sectoral co-ordination, particularly among landscape and seascape planning, agriculture and fisheries, and urbanisation and infrastructure development. It will also require improved institutional integration, enhanced use of economic instruments and the application of a risk management approach, particularly with regard to climate change impacts. In 2006, the European Commission launched infringement procedures against Denmark over violations of both the Birds and the Habitats Directives.

2. Towards Sustainable Development

Integration of environmental concerns into economic decisions

Denmark gives importance to *sustainable development* nationally and internationally. In 2002 it adopted a national sustainable development strategy which is to be presented to Parliament every four years and followed up through sectoral plans and a set of indicators published in principle every year. Implementation also takes place at the local level through Local Agenda 21. Over the review period, Denmark successfully *decoupled* environmental pressures from economic growth in several areas, including SO_x emissions, NO_x emissions, water abstraction, nitrogen fertiliser use and pesticide use. Energy intensity also decreased during the review period. *Institutional integration* of environmental concerns into sectoral policies progressed *in agriculture* (e.g. agri-environmental measures, increase in organic production) and *energy policies* (e.g. emphasis on climate change, energy efficiency, renewable energy). Three quarters of government bills underwent *strategic environmental assessment*. At project level, regulations on environmental impact assessment were updated to include an EIA-permit and extended public information. *Market-based integration* relies on a wide range of economic instruments (i.e. charges, taxes, other instruments), although significant subsidies remain (in agriculture, fisheries, tax concessions to industry).

However, Denmark is faced with numerous environmental challenges resulting from unsustainable consumption patterns (e.g. in waste generation, transport, land use). The generation of household waste is growing nearly twice as fast as the economy, and has reached one of the highest generation rates in the

OECD. Greenhouse gas emissions have not been decoupled from private car use. High mobility associated with longer commuting distances generates pressure on peri-urban areas otherwise needed for agricultural or recreational purposes. With the adoption of the national sustainable development strategy, Denmark no longer has a white paper on environment, and environmental efforts are scattered throughout a large number of programmes, policies and ministries. The *environmental strategic and planning framework* and associated objectives should be linked to the sustainable development strategy. *Little progress* has been made in integrating environmental concerns into *transport policy* at the strategic level. Although the transport sector accounts for a third of final energy consumption in Denmark and is showing the fastest energy growth, it is explicitly excluded from the (June 2005) political agreement on greater energy efficiency. Transport policy mainly aims at increasing or upgrading road infrastructure supply; insufficient effort is made to modernise and increase the efficiency of the Danish railway. Little consideration is given to transport demand management.

Recommendations:

- continue to rely on and, where relevant, expand the use of *environmental taxes* to *internalise externalities*; adjust tax rates for inflation;
- continue to examine the existing support schemes from the point of view of their *environmental effectiveness and economic efficiency*;
- develop a *sustainable transport plan*, as a follow-up to the forthcoming national sustainable development strategy;
- review existing *transport taxes* with a view to restructuring them in a more environmentally friendly way (e.g. taxing both car use and ownership; removing the tax break for commuting); consider the introduction of *road pricing* as a means to halt congestion;
- step up efforts to promote *more sustainable consumption patterns* (e.g. concerning waste, transportation, land use) by adopting appropriate regulatory and economic instruments, and by focusing on demand management.

Integration of environmental and social decisions

Environmental health has received increased attention through the 2003 strategy and action plan on environment and health, as well as through targeted

research (e.g. on allergenic substances, endocrine disrupters, impact of traffic on human health). To accelerate their replacement by less dangerous substances, all professional uses of hazardous substances must be registered in the national product register. Cost-benefit analysis and economic valuation methods have been used in several health-related studies and strategies (e.g. on noise, cycling, health effects of air pollution). Concerning *environmental democracy*, Denmark ratified the *Aarhus Convention* in 2000. Pursuant to the related EU directives on environmental information, it has harmonised its practices concerning provision of information, public access to information, public participation and access to courts. A wide range of environmental information (data, indicators, state of the environment reports, targeted information brochures) is publicly available and frequently updated. Most Danish municipalities have adopted a *Local Agenda 21*, and amendments to the Planning Act in 2000 require them to report on implementation every four years. A nationwide Local Agenda 21 network has been created, involving some 200 contact persons. *Environmental awareness* is enhanced through local and national campaigns, as well as through environmental education at all levels of the education system. In 2006, *environmental employment* accounted for some 2.2% of total civilian employment in Denmark.

Despite the high level of wealth and living standards in Denmark, several *health* indicators are of concern: for example, life expectancy is relatively low, the country has some of the OECD's highest rates of mortality from certain forms of cancer, and allergy and respiratory diseases affect about 20% of the population. Some of these problems might relate to environmental factors. Denmark has no explicit targets for fine particles ($PM_{2.5}$), which are known to be dangerous for human health. Little attention has been given to *disparities in pollution exposure*, and further attention should be given to promoting *access to nature* and outdoor recreation and the related health benefits. In 2003 the ambitious targets (set up in 1993) for reducing the number of people exposed to noise were postponed from 2010 to 2020 (as part of the 2003 Road Noise Strategy) due to benefits and costs distribution considerations. Despite the goal of issuing an updated set of sustainable development indicators every year, these indicators were not updated during the last two years. The 1999 OECD recommendation to collect data on *private pollution abatement and control expenditure* has not been followed up.

Recommendations:

- set up additional *targets* concerning environmental factors related to health with related indicators; continue to understand better through research and studies the potential links between environmental pollution and chronic illness or child health issues; take action where there is knowledge (e.g. particulate pollution);
- continue to make use of *cost-benefit analysis* and economic valuation in environmental health policy making; and derive relevant priorities for action;
- include the public health benefits of *access to nature* and outdoor recreation as an integral part of national environment and health action plans;
- continue to promote *environmental democracy* through access to environmental information, public participation, and access to courts for citizens and associations (e.g. environmental NGOs);
- assess and reduce *disparities* in exposure to pollution.

3. International Co-operation

Denmark's proactive stance on protecting the environment through international co-operation has played an influential role in a number of international negotiations, particularly in the EU context. Denmark has met or is well on the way to meeting many of its *international commitments* (e.g. reduced discharges of phosphorous and heavy metals into the Baltic and the North Seas, reduced atmospheric emissions of SO_2 and VOCs). Denmark has phased out or reduced its emissions of ozone-depleting substances ahead of internationally agreed deadlines. Denmark continues to provide a relatively high level of *official development assistance* (0.81% of GNI in 2005). Environmental management is mainstreamed into a substantial part of bilateral and multilateral regional assistance programmes. Danish export credits are well managed and the environmental risk assessment follows the rules agreed within the OECD. Concerning *marine issues*, Denmark (recently) ratified the 1978 UN Convention on the Law of the Sea and shows progress in implementing conventions such as MARPOL, London and OSPAR. Illegal oil spills in the Baltic and the North Seas were reduced by half during the review period. Finally, the Greenland Dialogue on climate is welcome.

However, there is room for progress. Concerning *climate change*, in 2004, Denmark's greenhouse gas emissions had decreased by only 2% compared to 1990 (the base year). This is far from its challenging CO_2 emission reduction target (–21% for 2008-12) under the EU burden sharing agreement. The CO_2

reduction target of the 1990 Energy Plan was not met. Although good progress has been made in reducing greenhouse gas emissions from agriculture, households and the waste sector, much remains to be done and is in progress in the energy, transport and industrial sectors. This is despite the low energy intensity of the Danish economy. Review and revision of energy and transport prices and taxation should be considered. Denmark is one of the few OECD countries that have a carbon tax on energy products, but the CO_2 tax rate was reduced in 2005 to ensure a neutral overall energy tax burden. Further cost-effective domestic efforts will be necessary, given the anticipated allowances under the EU Emission Trading Scheme for the period 2008-12 and the limited scope for expanding the use of the Kyoto Protocol's *flexible mechanisms*. Afforestation projects are behind schedule with respect to the objective of doubling the forest area by 2040. Concerning *marine issues*, although Denmark has been active in many international and regional marine protection fora, fish kills (due mainly to oxygen depletion associated with nutrient discharges) have been reported annually for a long time in Danish coastal areas. The risk of oil spills and maritime accidents along the Danish coast, the Belt and the Øresund is

Recommendations:

- ensure that *cost-effective domestic measures* will contribute to meet the Kyoto Protocol's *greenhouse gas emission reduction target*, especially in sectors *not covered by the EU Emission Trading Scheme*; accelerate *afforestation*;
- place higher priority on *marine protection*, including marine ecosystem protection; take further steps to reduce the discharge of *toxic substances and nutrients*; ensure that Denmark's international commitments are achieved; continue efforts towards appropriate *dismantling* of Danish end-of-life *ships*;
- pursue efforts towards the sustainable management of *commercial fisheries and aquaculture*;
- continue to play an exemplary role in international environmental protection including through *development aid*; continue to contribute to sustainable development and capacity building in developing countries through environmental technology exports and other measures (e.g. support for environmental education and awareness programmes);
- continue efforts to ensure appropriate implementation of multilateral environmental agreements involving *trade* (ozone-depleting substances, hazardous substances, chemicals, endangered species);
- *accelerate the ratification* of international environmental agreements already signed.

high, with the heavy traffic from shipping and fishing activities. Inappropriate dismantling of Danish end-of-life ships in India became an issue in 2005. Concerning *transboundary air pollution*, while Denmark has met the 1998 Sofia Declaration target for NO_x emissions, achieving the Gothenburg target (55% reduction by 2010 from the 1990 level) will require further action.

2 AIR*

Features

- Emissions trends
- Air quality problems
- Managing particulate matter
- Low energy intensity
- Road transport and pollution

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1999. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy. It takes into account the latest Economic Surveys of Denmark.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Denmark:

- continue to reduce emissions of *NO_x and VOCs from mobile sources*, including through the use of economic instruments in the most cost-effective way;
- strengthen the *management of particulate matter*, including the monitoring of PM_{10} and $PM_{2.5}$ concentrations and emissions; develop emission standards for residential *wood burning stoves*; implement and enforce *low emission zones* in cities;
- continue to encourage the provision of economically and environmentally attractive *public transport systems* in urban areas; strengthen transport demand management to limit passenger car use in congested areas (e.g. road pricing, parking fees, spatial planning, intelligent transport systems); implement the Bicycle Strategy 2007; address air pollutant emissions from ships;
- integrate *transport and environmental policies*; set quantitative targets, further use demand-side management, and facilitate co-operation among state and territorial authorities and concerned parties;
- continue to *improve energy efficiency* (e.g. transport and building sectors, public sector, distribution companies); review *energy taxation* to establish appropriate price signals.

Conclusions

Denmark has continued to register progress in managing air pollution and meeting its national and international objectives. *Emissions* of SO_x, NO_x and VOCs were strongly decoupled from economic growth during the review period. SO_2 emission intensity (emissions per unit of GDP) is the lowest in the OECD area, partly due to the tax on SO_2 emission introduced in 1996. CO_2 emissions also were strongly decoupled from economic growth, and CO_2 emission intensity is below the OECD-Europe average. Ammonia emissions from the agricultural sector have also decreased. As a result, Denmark successfully reduced emissions of acid substances in recent years. On the whole, *ambient concentrations* of criteria air pollutants decreased during the review period. New NO_2 ambient standards were adopted in 1999. Other ambient air quality standards were reviewed and new limit values set (applying in 2005 or 2010 depending on the substance). Denmark adopted *a strategy and action plan to protect public health* against, inter alia, air pollution in 2003. Monitoring of PM_{10} (in cities and urban background) began in 2001. The government is aiming to reduce particulate emissions from traffic in towns by 50% by 2010, notably by introducing low emission zones in

city centres. The *energy intensity* of the Danish economy was improved over the review period and is one of the lowest among OECD countries. Renewable energy represents 25% of total electricity generation. A long-term energy strategy, Energy Strategy 2025, was launched in 2005. Registration tax reductions were introduced for very energy-efficient cars (1999) and for diesel cars equipped with particulate filters (2006).

However, several challenges remain, mainly concerning *NO_x and PM* emissions and concentrations. One fifth of the Danish population is exposed to unacceptable air quality. In Copenhagen, PM_{10} concentrations exceed the limit value. Emissions of PAHs (polycyclic aromatic hydrocarbons) increased during the review period as a result of increased wood combustion for residential heating. Higher priority should be given to monitoring of *hazardous air pollutants*. There is a need to know more about the health effects of fine particulates ($PM_{2.5}$). Although private car ownership is low by OECD standards (35 vehicles per 100 persons), the number of diesel-powered cars increased over the review period. Despite investment in public transport infrastructure projects (e.g. the Copenhagen metro, the Copenhagen Circle Line Project), *public transport* is still losing out to private cars. Background ozone levels are on the rise, and more should be done to reduce NO_x and VOC domestic emissions and their transboundary transport. Although Copenhagen has the highest rate of cycling of any major European city, Denmark did not have a national policy to develop cycling as a mode of transportation until recently.

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1. Policy Objectives

Denmark's air management objectives are mainly defined by the *EU Directive on National Emission Ceilings* (the NEC Directive) and the EU directives on air quality. Denmark has also ratified the Gothenburg Protocol under the UN Convention on Long-range Transboundary Air Pollution (the CLRTAP). The NEC Directive set ceilings for emissions of SO_2, NO_X, VOCs and NH_3 in 2010 (Table 2.1). Under Denmark's new climate strategy, in 2003, the domestic CO_2 target was replaced by a target for total greenhouse gas emissions under the Kyoto Protocol and the EU burden-sharing agreement.

Denmark's *ambient air quality standards* have been revised and new limit or target values apply from 2005 or 2010 depending on the substance. The revised limit values are based on the 1996 EU framework directive for ambient air quality assessment and management, which is completed with daughter directives for individual substances. The directives have been transposed into Danish law and the

Danish Environmental Protection Agency (EPA) is responsible for meeting the standards. The limit values are close to the World Health Organisation (WHO) recommendations based on the known health effects of the pollutants. During the review period, Denmark adopted the EU daughter directives for SO_2, NO_2, PM_{10} and lead in 1999, for CO and benzene in 2000, and for O_3 in 2002. In 2005, a daughter directive for Cr, As, Cd, Hg and PAH was adopted.

During the review period, the Danish government paid special attention to particulate air pollution due to its significant health implications. The government is aiming to reduce particulate emissions from traffic in towns by 50% by 2010 through the introduction of "*low emission zones*".

The assessment of air management performance here includes consideration of the recommendations of the *1999 OECD Environmental Performance Review* of Denmark:

- 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;

Table 2.1 **Emissions of air pollutants,** 1990-2004, NEC ceiling

	Emissions (1 000 tonnes)				Reduction target for 2010
	1990	1995	2000	2004	NEC ceiling
SO_x	184	148	28	24	55
NO_X	276	251	198	181	127
VOCs	186	161	127	116	85
NH_3	. .	. .	. .	95	69

Source: MoE.

– 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.

2. Air Quality Trends

Annual *SO_2 concentrations* have fallen steadily since the mid-1980s. They dropped far below the limit values during the review period. Since 2000, SO_2 levels have been below the detection limit (Figure 2.1).

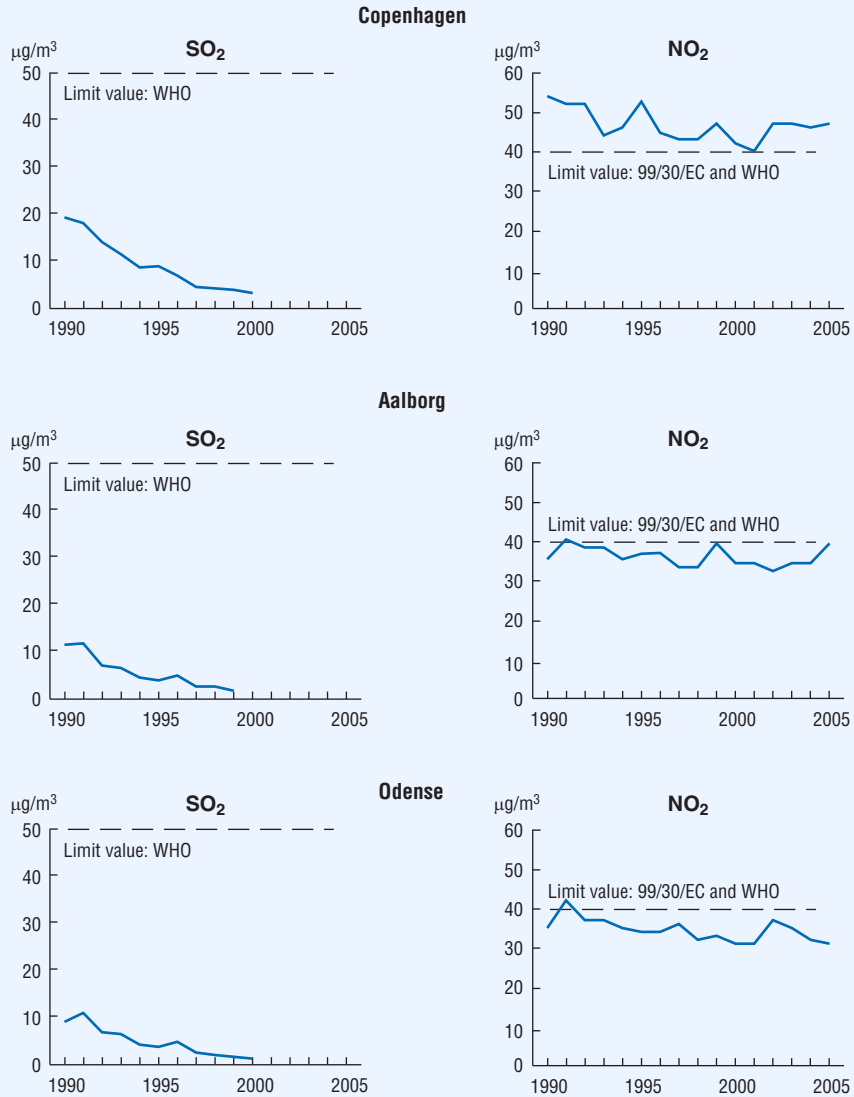
Annual *NO_2 concentrations* have not shown consistent trends across the major cities (e.g. Copenhagen, Aalborg, Odense) since 1999 (Figure 2.1). The former limit value of 50 µg/m^3 is now replaced with a new EU limit value of 40 µg/m^3 in accordance with the first daughter directive (1999/30/EC) under the Air Quality Framework Directive. Since the entry into force of this directive, there have been several breaches of the yearly average: Copenhagen was unable to meet the *new EU limit value* of 40 µg/m^3. The daily limit value of 200 µg/m^3 as 98% percentile for NO_2 has never been exceeded.

Annual *ozone concentrations* were well below the target values (in Directive 2002/3/EC) in 2005. In 2003, 2004 and 2005 the information threshold of 180 µg/m^3 was not exceeded. The alert threshold of 240 µg/m^3 was never exceeded. It was therefore not necessary to implement any emergency plans during the review period.

CO, benzene and lead concentrations have been decreasing for more than two decades and are far below their limit values. For these compounds, the EU requirements on cleaner fuel have been shown to have a pronounced effect on air quality. There has been a significant decrease in air concentrations of benzene and a dramatic decrease in lead.

Particulate matter (PM) concentrations are a major health concern. The PM emission inventory has only been produced for 2000-04. Emission levels did not change significantly over this period. The inventory includes the total emissions of TSP, PM_{10}, and $PM_{2.5}$. Concerning *TSP emissions*, the largest sources are the agricultural sector and the residential sector. TSP emissions from transport are also important and include both exhaust emissions and the non-exhaust emissions from brake and tyre wear and road abrasion. The non-exhaust emissions account for 26% of TSP emissions from road transport. Concerning *PM_{10} concentrations*, up to 2005

Figure 2.1 **Trends in urban air quality,** selected cities,[a] 1990-2005



a) Average annual concentration.
Source: Statistics Denmark.

the level was very stable. The highest values were measured at stations close to traffic with yearly averages just below the limit of 40 µg/m^3 and with one station exceeding the limit by 3 µg/m^3 in 2005. The 24-hour limit value of 50 µg/m^3 was not exceeded more than 35 days[1] a year until 2005, when even this margin was exceeded several times. This is the result of a significant national effort to reduce PM pollution. *$PM_{2.5}$ emissions* were estimated at 21 095 kg in 2004. The largest $PM_{2.5}$ emission sources are the residential sector (55%), followed by road traffic (18%) and other mobile sources (13%). For the road transport sector, exhaust emissions account for the major part (85%) of the emissions. Some 80% of $PM_{2.5}$ emissions from stationary combustion are emitted from residential wood combustion. Overall, *wood combustion* represents 49% of Denmark's total PM emissions.

3. Controlling Air Emissions

While the Danish economy grew steadily during the review period (average 3% growth a year), *SO_X, NO_X and VOCs emissions* were decoupled from economic growth (Figure 2.2). The major success was the reduction in SO_2 emissions; Denmark now has the lowest SO_2 intensity (emissions per unit of GDP) of any OECD country. *CO_2 emissions* also were decoupled from economic growth, and CO_2 intensity is now below the OECD-Europe average.

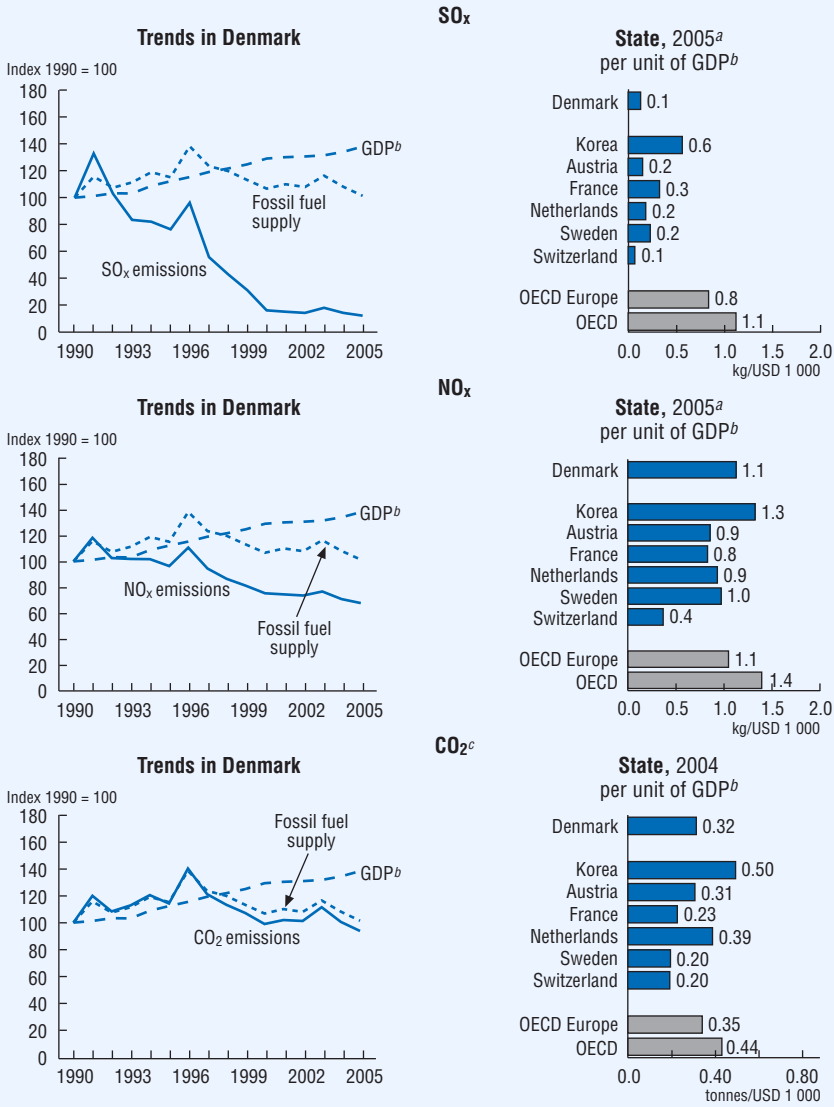
Between 1985 and 2004, *emissions of ammonia* from the agricultural sector decreased by 32% resulting in a reduction in related acid deposition. On the other hand, *emissions of polycyclic aromatic hydrocarbons* (PAHs) have been increasing, and *PM emissions* showed little change between 2000 and 2004.

Considerable work has been carried out *to improve the emission inventories*. Denmark's air emission inventories are based on the "Revised 1996 IPCC Guideline for National Greenhouse Gas Inventories", the "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories" and the CORINAIR (Co-ordination of Information on Air emissions) methodology.

Acidifying gases

Total SO_2 emissions were estimated at 24 000 tonnes in 2004, an 84% decrease from their level in 1995. SO_2 emission per unit of GDP, or SO_2 intensity, is now the lowest in the OECD (Figure 2.2). The large reduction is mainly due to installation of desulphurisation equipment and use of fuels with lower sulphur content in public power and district heating plants. The introduction of a sulphur tax on fuels and emissions since 1996 also contributed to the reduction in SO_2 emissions.

Figure 2.2 **Air pollutant emissions**



a) Or latest available year.
b) GDP at 2000 prices and purchasing power parities.
c) Emissions from energy use only; excludes international marine and aviation bunkers; Sectoral approach.
Source: OECD Environment Directorate; OECD-IEA (2006), CO2 emissions from fuel combustion; OECD (2006), OECD Economic Outlook No. 80; OECD-IEA (2007), Energy Balances of OECD Countries 2004-2005.

Total NO_x emissions were estimated at 181 000 tonnes in 2004, a 28% decrease since 1995. Transport was the sector that contributed most to NO_x emissions in 2004. Some 39% of Denmark's NO_x emissions came from road transport, national navigation, railways and civil aviation; 29% came from energy industries (public power and district heating plants). In 2004, the emissions per unit of GDP were equal to the OECD-Europe average (Figure 2.2). The reduction is due to improved vehicle exhaust emissions standards and the installation of low-NO_x burners and de-nitrifying units in power and district heating plants.

Total emissions of NH_3 were estimated at 94 754 tonnes in 2004, a 12.5% decrease since 1995. Almost all atmospheric emissions of NH_3 result from agricultural activities, while only a minor fraction originates from road transport. Denmark's reduction in NH_3 emissions is due to its active national environmental policy, particularly the three successive action plans for the aquatic environment and the ammonia action plan, which led to measures to prevent loss of nitrogen in agricultural production.

Other pollutants

Total VOC emissions were estimated at 116 000 tonnes in 2004, a 28% decrease from 1995 levels. Emissions of VOCs originate from incomplete combustion and evaporation. The main contributors to VOC emissions from incomplete combustion processes are road vehicles and other mobile sources such as sea vessels and off-road machinery. Road transportation vehicles are still the main contributors, even though emissions have declined since the introduction of catalytic converters in cars in 1990. Total anthropogenic emissions have decreased mainly due to the increasing use of catalytic converters and reduced emissions from the use of solvents following the Danish implementation of Directive 1999/13/EC. Effects of the agreement between the industry and the Danish EPA have continued beyond 1999. *Total CO emissions* were estimated at 619 000 tonnes in 2004, a 23% decrease since 1990, due mainly to the decrease in emissions from road transportation. Since the introduction of catalytic converters for gasoline-powered vehicles in 1990, CO has ceased to be a significant problem.

Significant attention is given to *particulate pollution* nationally and locally. The present strategy on environment and health aims for a 50% reduction in particulate emissions by 2010 compared with 1998, but nothing specific is said about fine particulates. Most busses for public transport in the larger cities now use particulate filters. Recently, nationwide monitoring of PM_{10} (since 2001) and $PM_{2.5}$ (since 2005) has started. For 2004 and 2005, the Finance Act reserved EUR 4 million for a scheme to support installation of particulate filters on buses and heavy vehicles. The result was relatively modest, maybe due to the modest size of the subsidy (30%). From 2006, the particulate filters on new cars are exempted from registration tax. This

translated into a fivefold increase in the number of cars sold with a filter during the first six months. Estimates show that the concentration of $PM_{2.5}$ can be reduced 20% by installing *filters* on all diesel-powered/heavy vehicles in Denmark, hence avoiding about 450 deaths each year (Ministry of Traffic, 2003).

A measure that has long been under preparation relates to the creation of *environmental zones*. In 2002, the Traffic Act was changed to allow for environmental zones in the large cities. Both Copenhagen and Aalborg applied for such zones, but their projects were dismissed by the Ministry of Justice. Copenhagen has also considered the possibilities for using congestion charging as a means to reduce pollution. In 2006, a new law on environmental zones was passed, allowing the large cities to introduce environmental zones for heavy vehicles (Box 2.1).

Box 2.1 **Low emission zones in Copenhagen**

A new programme to reduce air pollution in Copenhagen by creating "low emission zones" (LEZs) began in January 2007. Mandated by the Danish Environmental Protection Act, the programme targets emissions of particulate matter from heavy-duty vehicles (HDVs), which make up only 7% of Copenhagen's traffic but are responsible for 50% of PM emissions. Under the programme, HDVs will not be allowed to enter LEZs unless they are equipped with filters (approved by the Danish Road Safety and Transport Agency) which reduce particulate emissions by 80%. The filters will be required on Euro 0-2 HDVs from July 2008 and on Euro 3 HDVs from July 2010, except for vehicles more than 30 years old. In addition, the Danish Minister of Environment might require filters on light-duty vehicles (LDVs) from July 2010.

Requirement specifications

The effectiveness of the programme will depend on the effectiveness of the filters. The filters approved by the Danish Road Safety and Transport Agency aim at 80% reduction in particulate emission tested according to EU standards. The filter status must be continuously monitored (UBD) with a device activated inside the vehicle if back exhaust pressure exceeds 20 kPa at maximum engine power. In addition, yearly inspection will check filter effectiveness and provide a sticker if the check is successfully passed to permit driving inside LEZs. Foreign vehicle owners will have to present documentation proving their vehicle is equipped with a filter fulfilling Danish specifications.

Source: Thomsen.

Where the measures taken to improve air quality have not yet given the necessary results, additional measures are carried out to reduce exposure to unhealthy air. An example is the *web-based warning system* in Copenhagen showing how climate conditions will influence the air quality in certain streets and areas and proposing alternative roads for people walking or cycling in the city.

Air toxics

According to the UNECE Heavy Metal Protocol, the priority metals in Denmark are *lead,cadmium and mercury*. Emissions of these metals decreased substantially between 1990 and 2004. Lead emissions, estimated at 5 254 kg in 2004, dropped by 96%; mercury emissions dropped 68%; copper emissions, estimated at 8 447 kg in 2004, dropped by 18%; *emissions of PAHs*, estimated at 11 605 kg in 2004, are increasing due to the increasing combustion of wood in the residential sector.[2] *Emissions of dioxins were* reduced by about 68% over the same period; the major emission sources in 1990 were municipal waste incineration, steel reclamation and residential wood burning, while in 2004 the major sources had changed to residential wood burning and fires.

Greenhouse gases

Danish *greenhouse gas emissions* have decreased only slightly since 1990[3] (Table 7.1). One example of Danish efforts in this area is the expanded use of environmentally friendly fuels in decentralised cogeneration of heating and power and renewable energy, and energy savings. Under Denmark's energy action plan from 1996, "Energy 21", more than 100 initiatives have been started, each contributing to a reduction of CO_2 emissions.

Methane emissions were 274 531 tonnes in 2004, a decrease of 5% since 1995. Emissions of CO_2 from energy use only were 51 million tonnes in 2004, having decreased by 11% between 1998 and 2004. CO_2 emissions per unit of GDP were 0.32 in 2004, which is below the OECD-Europe average of 0.35 (Figure 2.2). However, CO_2 emissions per capita (9.4 tonnes/capita) were higher than the OECD-Europe average of 7.8.

4. Integrating Air Management Objectives into Energy Policy

The goal of Denmark's energy policy is to create well-functioning energy markets within frameworks that secure cost-effectiveness, security of supply, environmental concerns and efficient use of energy. The markets are intended to be transparent with efficient competition in order to ensure the lowest possible energy prices for energy consumers (IEA, 2006).

Energy intensity

Both total primary energy supply (TPES) and total final consumption (TFC) in Denmark have increased over the last 15 years. In 2005, TPES was 20 Mtoe, having grown *9.6%* between 1990 and 2005, and TFC of energy was 15.8 Mtoe, having grown 13.5%. In 2005, Denmark's *energy intensity* (TPES per unit of GDP) was 0.12 toe per USD 1 000, one of the lowest rates among OECD countries and the lowest among EU countries (Figure 5.2). *Denmark's energy intensity* improved by 21% from 1990 to 2005, representing a weak *decoupling* of domestic energy use from economic growth.

The *integration of environmental concerns in energy policy* has been supported by energy action plans and strategies (1990 "Energy 2000 Plan", 1996 "Energy 21 Action Plan", 2005 "Energy Strategy 2025"). Since the Energy 21 Action Plan, Denmark's energy strategy has been comprehensive and designed to meet future challenges including global climate change with a balance between security of energy supply, respect for the environment and economic growth. Energy Strategy 2025 is based on the 2005 political agreement on future energy saving initiatives.

The 2005 *Action Plan for Renewed Energy Conservation Efforts* outlines targeted energy savings (on average 7.5 PJ annually) during the period 2006-13. They represent 1.7% of final energy consumption excluding transport. Additional savings will be achieved by the network and distribution companies for electricity, natural gas, district-heating and oil. There are also new initiatives for improving energy efficiency in the building sector.

Energy mix

Denmark's energy supply is still dominated (85.6%) by *fossil fuels*, including oil (42.1%), gas (22.6%) and coal (19.1%). Renewables represented 16.3% in 2005. The share of oil in the energy mix has declined (from 50% in 1985), while natural gas and renewable energy have increased. Sources of renewable energy in Denmark include hydro, geo, solar, wind, combustible renewables and waste (Figure 5.2).

Denmark's use of *renewable energy* has more than doubled since 1996. Renewable energy contributes to both primary supply and electricity generation. Renewable energy accounted for only 3.1% of total electricity generation in 1991, but 25% in 2004. *Wind power* has had the greatest growth, expanding at an average annual rate of 18.3% since 1993. In March 2004, an agreement with a broad majority in the Parliament established the framework for expanding the number of wind farms and for a better functioning wind market.

Energy pricing

Denmark's *tax reform*, which started in 1993, has broadened the tax base and reduced marginal income tax rates,[4] while "*green*" *taxes and other indirect taxes have increased*. In 2005, a revised *CO_2 tax* scheme entered into force and the CO_2 tax rate was lowered to DKK 90/tonne CO_2 emissions. To maintain the overall tax burden, the energy tax rate has been increased correspondingly. However, Denmark is experiencing a "*tax freeze*" period (Table 5.3).

The introduction of a *sulphur tax on fuels and emissions* in 1996 contributed to reductions in SO_2 emissions during the latter part of the review period. Fuels with a sulphur content above 500 ppm are subject to a tax of DKK 20 per kg of sulphur, and the release of SO_2 emissions into the air is subject to a tax of DKK 10 per kg SO_2.

5. Integrating Air Management Objectives into Transport Policy

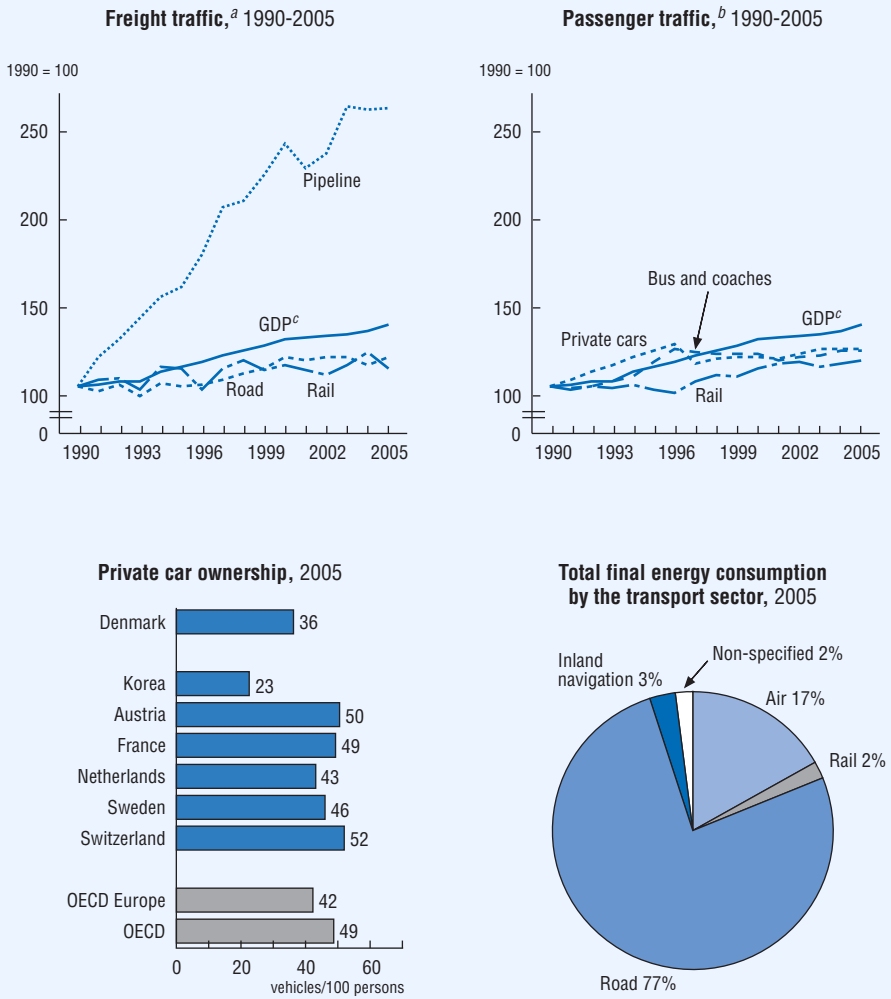
The transport sector is the single largest source of final energy demand in Denmark; it represented 34.1% of TFC in 2005, of which 77% was for road transport (Figure 2.3). It is also the fastest growing sector (IEA, 2006). The transport sector is the largest source of NO_x emissions and the second largest source of $PM_{2.5}$ emissions. In 2006, the average age of private cars was 9.1 years. Estimated *external costs of the transport sector* (road and railways), in terms of impacts on the climate and the environment, range between DKK 9 billion and DKK 13 billion annually (Ministry of Transport and Energy, 2004). Much of the infrastructure development in Denmark has favoured road freight transport to and from Sweden and Germany. Very large such infrastructure projects have been completed (e.g. Oresund Bridge, Great Belt Bridge). As a result there is now continuity in motorways linking Sweden, Norway and Denmark to core European markets. This has translated into significant *road freight transport* increases to, from and through Denmark.

Vehicles emissions

Individual vehicles sold in Denmark must comply with EU regulation on product standards, which is strengthened over time. They must also have yearly inspections of their exhaust emission performance. These mechanisms allow for significant progress in the performance of individual vehicles. However, the high level of taxation on vehicle ownership has resulted in i) a relatively low rate of vehicle ownership in Denmark and ii) a relatively high average age of the vehicle stock.

From 1985 to 2004, *diesel and gasoline fuel use* in the transport sector increased by 32% and 29%, respectively. In 2004, the fuel use shares for diesel and gasoline were 58% and 39%, respectively. The share of diesel passenger cars has increased in

Figure 2.3 **Transport sector**



a) Index of relative change since 1990 based on values expressed in tonne-kilometres.
b) Index of relative change since 1990 based on values expressed in passenger-kilometres.
c) GDP expressed in 2000 prices and purchasing power parities.
Source: OECD Environment Directorate; OECD-IEA (2007), Energy Balances of OECD Countries 2004-2005.

recent years; in 2004, 24% of new passenger cars in Denmark were powered with diesel engines.

During the review period, special attention was given to particulate air pollution and its significant health implications. In a 2003 review, it became a national priority to introduce "*low emission zones*" in major Danish cities, with *filter requirements for heavy duty trucks and busses* (Box 2.1).

Vehicle taxation

Danish taxation on cars consists of a green owner tax, a countervailing charge and a road tax, in addition to the registration tax and the vehicle excise duty. While Danish taxes on gasoline and diesel fuel are somewhat lower than taxes in other EU countries (Figure 5.1), *vehicle taxes associated with car ownership are heavy* in Denmark.

The *registration tax* is calculated as 105% of the part of the dutiable value[5] under DKK 65 900 and 180% of the part over DKK 65 900. A registration tax reduction for highly energy-efficient cars, introduced in 1999, was modified in 2007 (Table 2.2). A tax supplement of 1 000 DKK per km/l is levied on vehicles with lower performance. This measure is expected to curb CO_2 emissions from the transport sector by 2%. A registration tax reduction (by DKK 4 000) also applies to new diesel-fuelled vehicles if they meet emission requirements for particulate matter. A registration tax exemption applies to electric vehicles up to two tonnes.

Table 2.2 **Reduction in car registration tax**

Fuel consumption (km/l)		Registration reduction		
Gasoline	Diesel	2000-05	2006	2007
25-28.6	28.1-32.1	1/6	0	Gasoline[a]
28.6-33.3	32.1-37.5	1/3	1/5	> 16: (X^b – 16) x DKK 4 000 < 16: tax increase of DKK 1 000
33.3-40.0	37.5-45	1/2	2/5	Diesel[a]
> 40	> 45	2/3	3/5	> 18: (Y^c – 18) x DKK 4 000 < 18: tax increase of DKK 1 000

a) The amount is deducted from the tax base value.
b) Fuel consumption of the taxed gasoline car (km/l).
c) Fuel consumption of the taxed diesel car (km/l).
Source: Ministry of Taxation.

Box 2.2 **Cycling in Copenhagen**

Cycling in Denmark is both a means of transportation and a means to good health. Copenhagen is known far and wide as the "*City of Cyclists*" due to its cycling tradition and its "City Bikes" which are specifically designed for hire. In Copenhagen, 34% of commuters use their bicycle for going to and from work. The proportion of trips made by bicycle in Copenhagen (modal split) is among the highest in major European cities. This contributes greatly to the city's relatively favourable traffic and environmental situation. An analysis of the socio-economic consequences of investing in cycling showed cost-benefit ratios much higher than normally expected from transport projects (Krag *et al.*, 2005). Concerning health benefits, studies have shown that people who bike to work have a 28% lower mortality rate than the population average.

In Copenhagen, *cycle planning* is an integral part of traffic planning. A *Subplan for the Improvement of Cycling Conditions* was passed in 2000 together with a bill ensuring funds for implementation. The subplan includes five quantitative goals for 2012: i) increase the proportion of people *cycling to workplaces* in Copenhagen from 34% to 40%; ii) decrease cyclist *risk of serious injury* or death by 50%; iii) increase the proportion of Copenhagen cyclists who feel *safe cycling* in town from 57% to 80%; iv) increase cyclist *travelling speed* on trips of over 5 km by 10%; v) improve cyclist *comfort* by ensuring that no more than 5% of cycle track surfaces are deemed unsatisfactory.

Quantitative goals make it possible to carry out a continuous assessment of the cycle policy. This is done in the *Bicycle Account*. To improve traffic conditions and encourage cycling, the city is carrying out work in nine focus areas: creation of more cycle tracks and reinforced cycle lanes; creation of green cycle routes; improved cycling conditions in the city centre; combining cycling and public transport; bicycle parking; improved signal intersections; better cycle track maintenance; better cycle track cleaning; campaigns and information.

In Denmark as a whole, the "Bike to Work" campaign by the *Danish Cyclists Federation* has been focusing for many years on workplaces. The "Freewheeling" campaign is directed towards schools and encourages children to bike to school. Each class participates as a team, and prizes are awarded to the winners. In 2003, about one-tenth of Danish school children took part in the campaign (EPA, 2004). Several *NGOs* are carrying out campaigns to establish good cycling habits amongst school children, to lay a good foundation for a healthy and active life, outlining what different actors like parents, school and the authorities can do to contribute (Nielsen, 2007).

Source: City of Copenhagen; Environmental Protection Agency.

From 1997, the annual vehicle tax was replaced by the *green owner tax* which is based on fuel consumption to promote energy efficient cars. Diesel car owners are required to pay a countervailing charge which counteracts the difference in the tax on gasoline and diesel oil to create equality between cars. The government has plans to review and revise car taxation to contribute to environmental objectives. The share of bio fuel in both gasoline and diesel is exempt from the *CO_2 tax* (Chapter 5).

Sustainable transport

The Ministry of Transport and Energy provides support for the development of sustainable transport policies at territorial level, but no overall sustainable transport plan or strategy has yet been adopted. A new strategy for the use of inter-modal transport was published in October 2006. The Ministry of Transport and Energy launched a Bicycle Strategy in May 2007. The strategy's two key measures are the operation and maintenance of the national cycling routes and the promotion of cycling, especially with municipal authorities. Compared to other major European cities, Copenhagen has among the highest share of cycle trips (Box 2.2).

6. Transboundary Air Pollution

Between 1990 and the early 2000s, Denmark sharply reduced emissions of SO_x and NO_x (for SO_x, –87%; for NO_x, –36%). Denmark has met or is well on the way to meeting its *international commitments* under the Geneva Convention on Long-Range Transboundary Air Pollution (CLRTAP) and its protocols. It has more than met the targets to reduce total *sulphur emissions* set by the Oslo and Gothenburg Protocols (Table 2.3). It has also met the target of the Sofia Declaration to reduce *NO_x emissions* by 30% by 1998, although achieving the Gothenburg target seems to need further action. Denmark has met the Geneva Protocol target of reducing *VOCs emissions* by 30% by 1999 and is well on the way to achieving further reductions. Denmark fully participates in the monitoring activities under the EMEP[6] programme and is actively supporting the development of the updated emission inventory guidebook.

During the period 1996 to 2004, SO_x *deposition* decreased by 33% (from 38 900 tonnes to 26 100 tonnes) and NO_x decreased by 18% (from 22 400 tonnes to 18 400 tonnes). Although the effect of increasing acid deposition on ecosystems is not fully understood, it would be advisable for Denmark to consider how to address the problem regionally. The last OECD EPR reported that acid deposition was still much higher in Denmark than in other Nordic countries and exceeded critical loads in almost all the country due largely to transboundary imports. While Denmark significantly reduced its contribution to sulphur deposition in Denmark, further effort

is needed to reduce its contribution to nitrogen deposition (Table 2.4). Denmark has the second lowest rate of SO_x emissions per capita in the OECD and the lowest rates of emission intensity (i.e. per unit of GDP). However, it receives SO_x (e.g. from the United Kingdom, Germany and Poland). Denmark remains a net exporter of NO_x (e.g. to Sweden, Russia and Norway) and has a modest ranking in NO_x emissions per capita and per unit of GDP in Europe (Figure 2.2).

Table 2.3 **Denmark's performance under the Convention on Long-Range Transboundary Air Pollution**[a]

	Protocol	Commitments		Results	
		Target period	Target (%)	Observed period	Observed change (%)
Sulphur dioxide (SO_2)	Helsinki (1985)	1980-93	*–30*	1980-93	*145/449 = –68*
	Oslo(1994)	1980-2000	*–80*	1980-00	*28/44 9 = –94*
	Gothenburg (1999)	1990-2010	*–70*	1990-04	*24/184 = –86*
	2001/81/EC ceilings	2010	*55 kt*	2004	*24 kt*
Nitrogen oxides (NO_x)	Sofia (1988)	1987-94	*0*	1987-94	*268/298 = –11*
	Sofia Declaration (1988)	1986-98	*–30*	1986-98	*221/306 = –28*
	Gothenburg (1999)	1990-2010	*–55*	1990-04	*171/266 = –36*
	2001/81/EC ceilings	2010	*127 kt*	2004	*171 kt*
Volatile organic compounds (NMVOCs)	Geneva (1991)	1988-99	*–30*	1988-99	*205/288 = –29*
	Gothenburg (1999)	1990-2010	*–52*	1990-04	*115/164 = –30*
	2001/81/EC ceilings	2010	*85 kt*	2004	*115 kt*
Ammonia (NH_3)	Gothenburg (1999)	1990-2010	*–43*	1990-04	*98/134 = –27*
	2001/81/EC ceilings	2010	*69 kt*	2004	*98 kt*
Heavy metals	Aarhus (1998)				
Cadmium		1990 cap	*0*	1990-04	*0.6/1.7 = –57*
Lead		1990 cap	*0*	1990-04	*5/122 = –96*
Mercury		1990 cap	*0*	1990-04	*1.1/3.3 = –67*
POPs	Aarhus (1998)				
PAHs		1990 cap	*0*	1990-04	*11.6/7 = –66*
Dioxins/furans		1990 cap	*0*		. .
Hexachlorobenzene		1990 cap	*0*		. .

a) 1979 Geneva Convention.
Source: EMEP; OECD.

Table 2.4 **Acid deposition,** 1996-2004

(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	52/13	23/6	52/13	23/6
Germany	108/23	53/25	34/6	31/24
Finland	1/0	1/0	9/2	17/15
Netherlands	4/2	13/8	3/0	2/1
Norway	1/0	3/3	15/5	22/24
Poland	43/27	12/9	20/4	27/26
Sweden	4/3	7/3	59/9	52/43
United Kingdom	34/27	33/36	6/0	8/6
Czech Republic	22/6	5/4	2/0	4/3
Russian Federation	4/1	1/2	17/5	32/51
Others (including marine sources)	120/159	75/90	331/69	333/260
Total	389/261	224/184	548/113	551/459

Source: UN-ECE.

Notes

1. Hence in accordance with the EU directive.
2. The other important source of PAH emissions is road transportation.
3. According to the Danish authorities, the relatively high variations in previous total emissions and removals of greenhouse gases are mainly due to variations in Denmark's exchange of electricity with neighbouring countries (e.g. relatively high import of electricity in 1990). Furthermore, emissions of CO_2 from energy consumption vary considerably from year to year, depending on winter temperatures.
4. Denmark's highest rate of personal income tax (54.3%) is the third highest in the OECD. The disposable income of the average production worker in Denmark as a share of gross income (e.g. 57.8% for a single person) is the lowest in the OECD.
5. The dutiable value is the vehicle's normal price including VAT on sale.
6. Cooperative Programme for Monitoring and Evaluation of Long-range Transmission of Air Pollutants in Europe.

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3 WATER*

Features

- Inland and coastal water quality
- Nutrient pollution from agriculture
- Cost-effectiveness in meeting objectives
- Territorial government reform and river basin management

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1999. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Denmark:

- carry out a comprehensive assessment of the *economic efficiency and environmental effectiveness* of water pollution abatement measures in different sectors (municipal, industrial, agricultural), in the context of implementation of the EU Water Framework Directive;
- consider the further use of *economic instruments to address diffuse pollution*; target fiscal incentives to environmental outcomes and improve cost-effectiveness;
- speed up identification of *areas at high risk of nutrient and pesticide contamination* and take measures to protect them, including establishing groundwater protection zones, 10-metre buffer zones along rivers, and buffer zones around lakes;
- reinforce the *interface between water management and nature protection*, in the wake of local government reform and pursuant to VMP III objectives; in particular, speed up creation of new wetlands and define ecological quality objectives for rivers;
- move toward *river basin management* according to the new water districts; in particular, prepare water plans as required by the EU Water Framework Directive;
- increase the *efficiency of public water supply and waste water management*, in particular by exploiting economies of scale in the wake of local government reform and pursuant to the proposed water reform objectives.

Conclusions

Use of farm inputs (nitrogen and phosphorus) was decoupled from agricultural production during the review period, following implementation of an instrument mix (economic incentives, voluntary and regulatory measures) under the second Action Plan for the Aquatic Environment 1998-2004 (VMP II). The target of reducing *nitrogen leaching* by half from 1985 levels was met (in 2003 rather than 1993, the initial deadline). Denmark now complies with requirements of the EU Nitrates Directive. *Pesticide use* was also decoupled from agricultural production, due to the switch to low-dose agents and to the pesticide tax introduced in the mid-1990s (whose rate has since been increased). *Water pricing* covers the cost of providing services (user charges) plus some environmental costs (taxes) for both public water supply and waste water treatment. The increase in water prices brought a significant reduction in household water consumption over the review period, but not in industry or agriculture where tax exemptions still apply. *Municipal waste water treatment* is

widely available (89% of the Danish population is connected) and most treatment is advanced (tertiary). Available evidence suggests that *drinking water quality* was kept high, although monitoring should be further improved, particularly for small waterworks. The pressure on water resources from industry has been reduced, mostly due to delocalisation of industrial production.

However, Denmark *still has water quality problems*, particularly in lakes and coastal areas (fjords), but also in rivers and groundwater. The new Action Plan for the Aquatic Environment 2005-15 (VMP III) aims to further reduce nitrogen leaching by 13% and to address phosphorus pollution (through a tax on phosphorus added to animal feed). Reduction targets have been set countrywide, but without looking at *cost-effectiveness* in meeting site-specific water quality objectives; indeed the whole of Denmark's land area is classified as vulnerable under the EU Nitrates Directive, and all Danish waters are sensitive under the EU Urban Waste Water Treatment Directive. There is a need for a holistic (river-basin) approach when addressing water quality and quantity issues, and efforts are needed to compare the cost-effectiveness of measures among households, industry and agriculture sectors. This is the source of major inefficiency in addressing nitrogen pollution. The setting of *water quality objectives* has been put on hold, pending implementation of the EU Water Framework Directive in 2009. Little has been done to renew sewerage networks and allow separate collection of stormwater, due to the low efficiency in providing water services resulting from the present water pricing regime. Efficiency gains are expected from a *water sector reform* under preparation, through benchmarking of water utilities and price regulation. There is considerable scope for further efforts on restoration of Danish watercourses, only 2% of which follow a naturally meandering course. Contaminants other than nitrogen, phosphorus and pesticides have been given too little attention (e.g. heavy metals, toxic chemicals, endocrine disrupters).

◆ ◆ ◆

1. Policy Objectives

Nutrient pollution in Danish waters, mainly from agriculture, is a major issue (Table 3.1). Key objectives of the *first and second Action Plan for the Aquatic Environment*[1] (VMP I 1987-97, VMP II 1998-2004), were to reduce the nitrogen discharge to the aquatic environment from municipal and industrial sewage and from agriculture by 50%, and to reduce phosphorus discharge from municipal and industrial sewage by 80%. Key objectives of the *third Action Plan for the Aquatic Environment* (VMP III 2005-15) are to further reduce nitrogen discharges from agriculture by 13%

by 2015 and to reduce excess phosphorus from agriculture by 50% by 2015. Implementation of VMP III is to be evaluated in 2008 and again in 2011.

Another key objective (since 1997) of Danish water policy is to improve the *treatment of waste water from scattered settlements* in the countryside. Waste water from scattered settlements is one of the main reasons why the country has not met its water quality objectives with regard to rivers and lakes. No timeframe was set for the plan, which involves 90 000 households.

Another key objective (since 1998) of Danish water policy is to protect drinking water sources from pollution, in particular through the *mapping of groundwater resources*.[2]

Pesticide use and its impact on the environment have been subject to several action plans. Further to the first (1994-99) and second (2000-03) plans, the third *Pesticide Action Plan* (PAP III 2004-09) set a target for reducing the treatment frequency[3] to 1.7 treatments per year by the end of 2009, from a rate of 2.17 at the end of 2003.

Important new obligations will derive from implementation of the EU *Water Framework Directive*, in particular with the move toward a more basin-based

Table 3.1 **Sources of pollutant discharges into inland and coastal waters,** 2004

(%)

	Inland waters			Coastal waters		
	Organic matter	Nitrogen	Phosphorus	Organic matter	Nitrogen	Phosphorus
Point sources	54	9	48	68	15	56
WWTP[a]	6	4	14	10	8	26
Sewer overflow	8	1	9	8	1	6
Sparsely built-up areas	22	2	18	15	2	14
Fish farms	18	2	7	19	3	8
Industry	–	–	–	16	1	2
Non-point sources	46	91	52	32	85	44
Agriculture	13	80	34	12	75	26
Background loss	33	11	18	20	10	18

a) Waste water treatment plants.
Source: DANVA (2006).

management and planning by the end of 2009. The directive was transposed into Danish law (through a separate act) in December 2003.

Denmark's performance can also be evaluated in the light of the *recommendations of the 1999 OECD Environmental Performance Review*:

- 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).

2. Quality Management

2.1 Quality trends

Denmark's counties have different *water quality objectives*, which makes a national compliance assessment difficult. However, pursuant to the EU Water Framework Directive, the water quality objectives should be unified nationwide by the end of 2009 and a new objective of good ecological condition achieved by 2015.

Drinking water and drinking water sources

Compliance with standards of the EU Drinking Water Directive (98/83/EC) was almost 100% for the years 2002-04.[4] The limit value for *nitrates* in drinking water (50 mg/l) is met by nearly 99% of the groundwater wells used for public water supply. However, the quality of the groundwater depends on the depth from which it is pumped. Nearly half of the uppermost (newly formed) groundwater contains nitrates above the limit value. The highest concentration of nitrate is found in areas

with sandy soil in Jutland, even though the situation has improved in sandy areas since implementation of VMP I in 1987.[5] The limit value for *phosphorus* in drinking water (0.15 mg/l) is exceeded at 20% of water supply wells, largely reflecting natural concentrations. Phosphorus concentration in the uppermost groundwater is high in a small proportion of wells.

Denmark applies the principle (set without any cost-benefit consideration) that drinking water should not need purification.[6] However, *residues of pesticides* are increasingly found in groundwater and in 2004-05, 10 of the 2 400 wells used for drinking water abstraction had to be abandoned to maintain the principle. Due to the closure of pesticide-contaminated wells,[7] the frequency of pesticide detection in waterworks wells decreased from 35% in 1998 to 26% in 2004. Similarly, the proportion of waterworks wells with pesticide residues above the limit value for drinking water (0.1 µg/l) decreased from 10% in 1998 to 5% in 2004.

Watercourses

In 2004 *approximately half of Danish watercourses were of acceptable biological quality*, as measured by concentrations of invertebrates through the Danish Stream Fauna Index (DSFI). This represents a slight improvement over the review period.[8] The level of compliance with regional biological quality objectives[9] was 58% in 2004.

Danish watercourses are not subject to any general requirements as regards *nutrient concentrations*, which are of little significance for their biological quality.

Table 3.2 **Trends in water quality of watercourses,** 1989-2004

(mg/l)

Catchment category	Total nitrogen			Total phosphorus		
	1989	1998	2004	1989	1998	2004
Waste water and agriculture[a]	8	9	7	0.7	0.2	0.2
Agriculture[b]	8	8	6	0.2	0.2	0.2
Fish farms[c]	4	4	4	0.2	0.2	0.2
Semi-natural	2	2	2	0.1	0.2	0.2

a) Cultivated catchments exposed to significant discharges of urban and industrial sewage.
b) Cultivated catchments.
c) Catchments exposed to significant discharges from freshwater fish farms.
Source: NERI (2006).

However, nutrients are transported to downstream lakes and marine waters, where they are the main pollutants. Overall, mean flow-weighted nitrogen concentration in Danish watercourses decreased over the review period; the decrease was highest in watercourses exposed to urban, industrial and agricultural pollution (Table 3.2). Phosphorus concentration in watercourses decreased markedly during the first half of the 1990s, mainly due to the earlier upgrading of waste water treatment plants with phosphorus removal, and has remained relatively unchanged since (Table 3.2).

Pesticides, particularly herbicides, are widely detected in watercourses. The effects on aquatic flora and fauna are not fully understood. In 2004 three of the five most commonly used herbicides were detected in concentrations exceeding the detection limit in the five larger watercourses: the herbicides were glyphosate (found in 77% of samples), 2-methyl-4-chlorophenoxyacetic acid (37%) and terbuthylazine (25%). Use of four herbicides is no longer permitted (trichloroacetic acid, 4-nitrophenol, 4.6-dinitro-o-cresol and atrazine). No Danish quality criteria have been set for herbicides in watercourses.

As regards *heavy metals* in inland surface waters, quality criteria were adopted at the national level for cadmium in 1996 and were proposed for lead, copper, mercury and zinc. In the five larger watercourses monitored in 2004, median concentrations of all heavy metals were lower than the (adopted and proposed) quality criteria.

Increasing attention is given to studying the effects on health and the environment of *endocrine disrupters* (Chapter 6). A survey in 2000-02 of brown trout in Danish streams impacted by sewage effluent revealed high level of plasma vitellogenin in males, indicating estrogenic exposure (Bjerregaard *et al.,* 2006).

Lakes

The main environmental problem in Danish lakes is the excessive amount of phytoplankton due to *phosphorus inputs*. Phosphorus removal at waste water treatment plants and the cessation of waste water discharges have been positive steps, but considerable phosphorus loading still takes place from cultivated land and via waste water from sparsely built-up areas and stormwater runoff from urban areas. In addition, lake sediments continue to release accumulated phosphorus derived from waste water discharges in earlier years.

Although the situation has improved overall (Table 3.3), the environmental objectives were met by only 5 of the 23 major lakes in 2004. The nutrient levels in the 1 074 smaller and shallower lakes subject to extensive monitoring are higher than in the major lakes, and compliance with the quality objectives is therefore hardly likely to be better. Overall, in 2004 only *a third of Denmark's lakes fulfilled their regional quality objectives*.

Marine waters

The main pollution pressure on Danish marine waters results from land-based sources of nutrients. Denmark's shallow marine waters are particularly vulnerable to eutrophication because of limited water exchange with the open sea. Water nutrient concentrations are generally greater in fjords, due to inputs from freshwater runoff, than in open marine waters. The *concentrations of nutrients*, particularly nitrogen, decreased in fjords/coastal waters over the review period (Table 3.4). This is mainly because leaching of nitrate from cultivated land has decreased and because

Table 3.3 **Trends in water quality of selected lakes,**[a] 1989-2004

(number of lakes)

	Improved	Unchanged	Deteriorated
Phosphorus concentration	10	9	2
Nitrogen concentration	13	8	0
Secchi depth[b]	8	12	1
Chlorophyll[c]	7	14	0

a) Includes 21 intensively monitored lakes.
b) Secchi disk depth is a measure of water clarity.
c) Chlorophyll concentration is an indicator of phytoplankton abundance.
Source: NERI (2006).

Table 3.4 **Trends in water quality of marine waters,** 1989-2004

(µg/l)

	Total nitrogen			Total phosphorus		
	1989	1998	2004	1989	1998	2004
Fjords/coastal waters	600	600	400	70	35	30
Open marine waters	300	300	250	30	20	20

Source: NERI (2006).

phosphorus is now removed from urban waste water.[10] As a result, the amount of phytoplankton has decreased and water clarity (as measured by the Secchi depth) has increased.

These improvements, however, have not yet led to increases in the distribution of submerged aquatic vegetation (including eelgrass) or benthic invertebrates. Nor is there any sign of general improvement in the oxygen content of the bottom water (for both coastal waters and open marine waters). The quality objective for Danish marine waters is that the flora and fauna should be at most only slightly affected by human activity. This *biological quality objective was only achieved in the Skagerrak and the open part of the North Sea*, and is close to being met in the open northern and central Kattegat. In the remaining Danish marine waters the objective was not met primarily due to nutrient loading, but also, in some fjords and coastal waters, due to high concentrations of tributyltin (TBT), organochlorines, polycyclic aromatic hydrocarbons (PAHs) and/or heavy metals in sediments. In 2003 the effects on gastropod molluscs of TBT, which has been used as an antifouling agent in hull paints, were found to be widespread, even in open seas such as the North Sea and the Skagerrak (NERI, 2005).

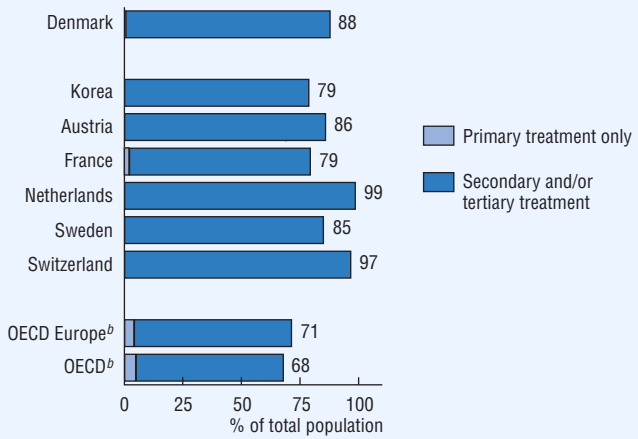
2.2 Point-source pollution

Point source discharges account for a minor share of nitrogen loads into inland and marine waters, but they account for *more than half of discharges of organic matter (BOD) and phosphorus* (Table 3.1). In general, both municipal waste water treatment and industrial discharges comply with both national standards and regional demands. On a national scale, *it does not seem cost efficient to further reduce these point source discharges* compared to the loads from diffuse sources, especially with regard to nutrients.

Household and industrial waste water

Concerning *household waste water*, the share of population connected to a waste water treatment plant (WWTP) has increased little since 1995, when it was already high by OECD standards, but *the degree of treatment has improved* (Figure 3.1). In 1999, Denmark decided to apply stringent treatment (tertiary treatment of nitrogen and phosphorus) over all of its territory. All WWTPs serving agglomerations of more than 15 000 population equivalent (p.e.) are required to have both nitrogen and phosphorus removal, and those serving more than 5 000 p.e. are required to have phosphorus removal. In 2004, Denmark fully complied with its requirements for waste water collecting systems, degree of treatment (tertiary) and performance of treatment (discharge standards and % removal of organic matter, nitrogen and

Figure 3.1 **Population connected to public waste water treatment plant,** 2005[a]



a) Or latest available year.
b) Secretariat estimates.
Source: OECD Environment Directorate.

phosphorus) (Commission of the European Communities, 2004). Between 1984 and 2004, municipal sewage discharge to the aquatic environment was reduced by 81% for nitrogen and by 93% for phosphorus, more than meeting the VMP reduction objectives of 50% and 80%, respectively.

However, treatment of *waste water from scattered settlements* still accounts for a significant share of the pollution load into Danish waters (Table 3.1). Waste water treatment was improved for only 10 000 (out of 90 000) households living in sparsely built areas in the period 1997-2005.

Of the approximately 160 000 tonnes (dry matter) of *sewage sludge* produced each year, the share re-used as agricultural fertiliser has been reduced to less than 60% since the mid-1990s, though composting has increased in recent years. The quantity handed over for combustion has also decreased to less than 20%. Mineralising plants receive an increasing share as do other disposal destinations, such as sales to the concrete industry or processing into sandblasting grit. Some 6% are still deposited in landfills.

Concerning industrial waste water, *industrial discharges* to the aquatic environment were 469 tonnes for nitrogen and 31 tonnes for phosphorus in 2004,

reaching by a large margin the VMP reduction objectives of 50% and 80%, respectively (or a discharge of 2 000 tonnes N and 600 tonnes P). This is due to improved treatment of industrial waste water but also to the closure of industrial plants following their delocalisation. In Denmark direct *discharges into water bodies* originate mainly from the food processing industry as well as hospitals and medical facilities. The country's three biggest fish-processing plants, with a total organic load of around 40 000 p.e., are in full compliance with the 91/271/EEC Directive (Commission of the European Communities, 2004). Insufficient progress has been made, however, regarding the 1999 OECD recommendation to strengthen the enforcement of environmental regulations for fish farms (Box 3.1).

Financing sewerage and waste water treatment

In Denmark, most (95%) sewerage networks and WWTPs are *owned and operated by municipalities*. In a few cases, their operation has been contracted out to private entrepreneurs and in one municipality (Farum, north of Copenhagen) they have been privatised. About half of construction works, including maintenance or renewal of sewers, are contracted out to private entrepreneurs. Waterworks are owned and operated either by the municipalities (160 companies providing 60% of public water supply) or, in sparsely built areas, directly by consumers (2 500 companies providing the remaining 40%). In a few municipalities, water and waste water services are organised in "independent" companies, though both are owned by the municipality.

Investments in and operation of public sewerage and WWTPs are entirely financed by *user charges* for connected households and industries (there are no national or municipal subsidies). The yearly payments are based on metering of water consumption by both households and industry. Investment in and current expenditure on sewerage and waste water treatment increased over the review period, from DKK 4.5 billion in 1998 (EUR 600 million) to DKK 5.9 billion in 2005 (EUR 792 million). In the period 2002-04, of 33 water and 30 waste water utilities (respectively serving 37% and 43% of the Danish population), one-third of expenditure on public water supply was for investments (mostly investments in replacements) while around half was for sewerage and waste water treatment (of which 45% on new investments) (DANVA, 2006).

Water pricing

As regards *user charges*, full cost recovery applies (since 1992) for both public water supply (PWS) and sewerage and waste water treatment (WWT). All (household and industry) water users are metered, and both PWS and WWT are charged according to the metered consumption. The same rate per m^3 applies to households

Box 3.1 **Fish farming and water pollution**

All Danish fish farms[1] (except eel farms based on re-circulated water) are required to be officially approved as being in accordance with the Danish Environmental Protection Act, particularly as regards limits set for feed.

The level of inspection of fish farm compliance with environmental regulations has not changed since 1998 and the nutrient load from freshwater fish farms has not changed significantly. Although the situation improved over the review period, 58% of *freshwater fish farms* have still not been environmentally approved.[2] One reason for this poor record is that municipalities suspended their approval procedures in 2001-02 while awaiting the results of an ad hoc advisory board (for freshwater fish farming) which included the Ministry of the Environment, the Ministry of Food, Agriculture and Fisheries, NGOs and the aquaculture industry. Recent years have seen some positive developments. In 2000-02 the board evaluated opportunities for freshwater fish farms to expand production, while at the same time reducing their environmental impact. Under new rules, a *pilot scheme* allows production to increase by up to 130% if it is strongly linked to equipment investments, control and management for environmental purposes. The pilot, launched in 2004 with the eight largest freshwater fish farms in Denmark (10% of total production), has attracted considerable interest among Danish as well as European fish farmers.

A ban on establishing and extending *marine fish farms*, issued in 1996 by the Danish Environmental Protection Agency, was lifted in 2001. At the same time, an ad hoc advisory board (for marine fish farming) was established. The environmental rules for marine fish farming are in a process of readjustment to provide for a flexible regulatory system based on documentation of environmental effects rather than strict production limits by way of fixed feed quota.

In 2003, an ad hoc advisory shellfish board was established along the same lines. Based on interim recommendations from the board, certain areas of the Lime Fjord (in the northern part of Jutland) were assigned to *shellfish production* (primarily Blue mussel and European oyster), and licensing began in 2004.

In 2004, new Danish rules came into force for farming freshwater and saltwater fish under an *organic label*. The label allows farmed fish to be treated only once with antibiotics and prohibits adding colour to the feed or using genetically modified feed or fish. A number of Danish fish farmers have shown interest in having the organic label. Negotiations on common EU regulations for organic fish are expected in the near future.

1. Aquaculture production in Denmark is mainly concentrated on rainbow trout farmed in freshwater ponds and in off-shore or land-based marine aquaculture.
2. The number of environmentally approved freshwater fish farms increased from 95 (out of 422) in 1998 to 140 (out of 330) in 2005.

and industry. PWS and WWT are billed at the same time, on a yearly basis (as part of the municipal estate tax).

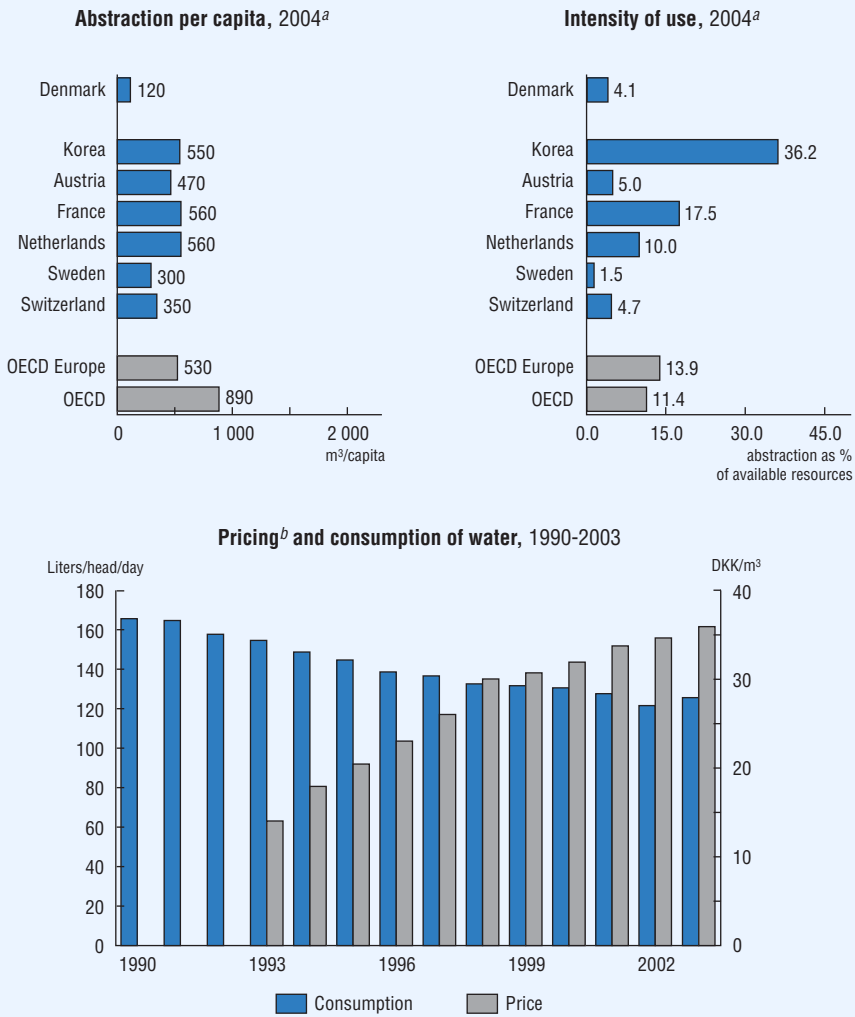
In addition to user charges on PWS, a "*water tax*" is imposed on water consumers. Introduced in 1994 at a rate of DKK 1/m^3 (and progressively rising to the full rate of DKK 5/m^3 in 1998), the tax purpose was not to respond to a general shortage of drinking water, but rather to reduce the amount of waste water. However, the PWS tax was also intended to alleviate local water shortage problems. For this it would have been more effective to make rates reflect water scarcity, instead of applying a standard rate nationwide. Despite the OECD recommendation in 1999 to extend the water tax to water users other than households, the tax is still refunded to industry (together with VAT) and is not levied on agriculture.

In addition to user charges on WWT, a "*waste water tax*" is also imposed on water consumers. The WWT tax applies to both households and industry (but not to agriculture). The tax is due for the total discharge of nitrogen, phosphorus and organic matter (BOD), independent of the license for WWTPs. Single (scattered) households in the countryside must also pay the tax, based on measured water consumption and standard treatment rates dependent on the local treatment efficiency. Introduced in 1997, the rate has remained unchanged since 1998, at DKK 11/kg for BOD, DKK 20/kg for nitrogen and DKK 100/kg for phosphorus. The waste water tax led to reductions of pollutant discharges at yearly rates of 3% for organic matter, 5% for nitrogen and 17% for phosphorus over the period 1997-2000. It also helped to improve the rate of compliance by WWTPs. But industries with high discharge loads can claim a rate reduction, thereby potentially contradicting the polluter-pays principle. There is a uniform rate nationwide whatever the quality objective or diluting capacity of receiving waters.

When taxes are not considered, the price per m^3 of sold water increased by 26% in real terms over the period 1993-2004 (DANVA, 2006). When taxes are considered, the rise was 54%. This led to a significant fall in water consumption, from 155 to 125 litres per head per day over the period, ranking Denmark among the "low-use" group by OECD standards (Figure 3.2). The *share of taxes in total water price* decreased over the review period (to 34% in 2004), due to an unchanged nominal tax rate on PWS and a decreasing nominal tax rate on WWT, while VAT remained at 25%[11] (Table 3.5). User charge rates increased in real terms for both PWS and WWT, with high regional variations.

The *right to water* is not embedded in the Danish Constitution, but the Water Supply Act provides for the right to clean drinking water. There are no social tariffs (water pricing is purely volumetric), and affordability of water and waste water services is ensured via income support through Danish social policy. Private water

Figure 3.2 **Freshwater use**



a) Or latest available year.
b) Public water supply and wastewater treatment.
Source: OECD Environment Directorate; MoE.

suppliers are allowed to cut water supply when households do not pay their bill, but public suppliers are not. Municipal waterworks have the right to distrain for unpaid water bills.

Reforming the water sector

From a situation of very low water prices prior to 1994, the introduction of taxes has made *water price levels high by EU standards* (Table 3.6). Efficiency gains in delivering water and waste water services are expected, which would also speed up the renewal of sewers.[12]

In 2003, the Danish Competition Authority estimated that *efficiency gains of more than DKK 1 billion per year could be achieved* in the Danish water industry if the less efficient water utilities were upgraded to the level of the most efficient ones. In response, the government made the following key proposals for reforming and increasing the efficiency of the water sector: abolish the "full cost recovery and no profit" principle and introduce a price cap regulation; establish a national economic regulator of the water and waste water industry within the Danish Competition

Table 3.5 **Trends in water prices,**[a] 1998-2003

(DKK/m^3)

	1998	2003
User charges		
Public water supply (PWS)	6.99 (*23%*)	9.20 (*26%*)
Variable charge	4.75	6.06
Fixed charge	2.24	3.14
Sewerage and waste water treatment (WWT)	10.90 (*36%*)	14.03 (*39%*)
Variable charge	10.90	13.65
Fixed charge	0	0.38
Central government taxes	12.27 (*41%*)	12.77 (*35%*)
PWS tax ("water tax")	5.00	5.00
WWT tax ("waste water tax")	1.24	0.57
25% VAT	6.03	7.20
Total	30.16 (*100%*)	36.00 (*100%*)
Total in EUR/m^3	4.1	4.8

a) Average prices.
Source: MoE.

Authority; turn utilities that are part of the municipal administration into independent companies with their own board of directors; introduce corporate taxation of water utilities; make benchmarking of water utilities mandatory; share the proceeds of selling a municipal water utility with the central government; encourage water utilities to adopt eco-management and audit schemes; and encourage water utilities to establish a fund for technology development.

The proposals (included in a *discussion paper on the Danish water sector* released in October 2005) met broad political agreement in February 2007. Legislation is being prepared, which would take effect in 2009.

Table 3.6 **Price of water for households,** selected countries, 2003

(EUR/m^3)

	Price[a]
Italy	0.68
Spain	1.30
Sweden	2.32
Belgium	2.50
Finland	2.56
France	2.58
United Kingdom	2.69
Netherlands	3.35
Germany	4.45
Denmark	4.53

a) Price paid for 120m^3/yr per household (weighted average of the price of water supply, sanitation and taxes in the five main cities of each country in 2003). The difference in price is considerable and is partly caused by the amount of subsidies provided by public authorities and the degree of waste water treatment undertaken.

Source: NUS Consulting; BIPE/SFDE, 2005.

2.3 Pollution from agriculture

Non-point source discharges account for a *major share of the nitrogen loading of Denmark's inland and marine waters*, and they also account for nearly half of the discharges of organic matter (BOD) and phosphorus (Table 3.1). Non-point sources became the main focus of VMP II and III, VMP I being more centered on point pollution.

Progress and cost-effectiveness in meeting the VMP II objectives for surface water

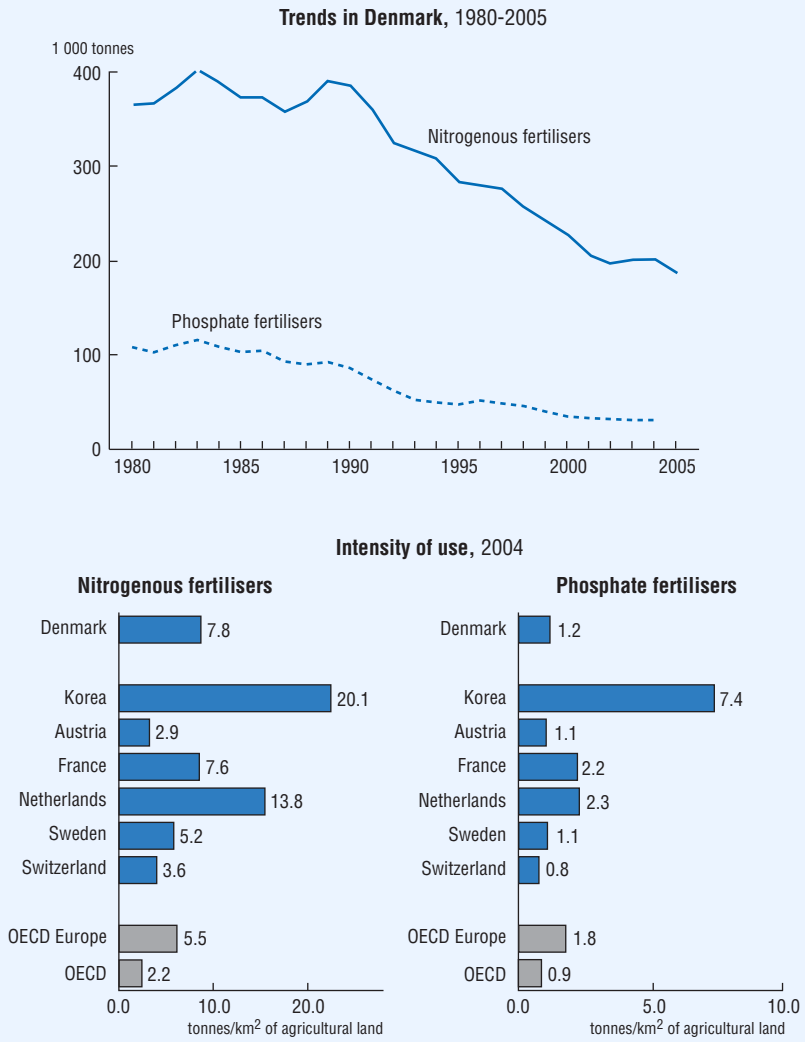
As regards agriculture, VMP I was based on an estimate of total nitrogen leaching in 1985 (the reference year) of 260 000 tonnes, of which 230 000 tonnes came from the field (diffuse sources) and 30 000 tonnes were directly discharged from farms (point sources). VMP I required that *nitrogen discharges from agriculture* be reduced by 49%, i.e. by 127 000 tonnes/year, including 100 000 tonnes from the field and 27 000 tonnes from farms. VMP II was based on new estimates of nitrogen leaching in 1985 of 311 000 tonnes.

An evaluation of VMP II done in 2003 by the National Environmental Research Institute and the Danish Institute of Agricultural Science revealed that nitrogen leaching[13] had fallen to 168 000 tonnes in 2002 and that an additional 6 000 tonne reduction was expected by 2004, i.e. a reduction by 48% (i.e. by 149 000 tonnes[14]) since 1985, thereby nearly fulfilling the 50% reduction objective. The main reason for the reduced leaching is the *significant reduction in the use of commercial fertilisers*, among the highest rate of reduction across OECD countries. The use of nitrogenous fertilisers was reduced from 406 000 tonnes N in 1984 to 206 000 tonnes N in 2002 (Figure 3.3). The use of manure was also reduced, from 263 000 tonnes N in 1984 to 234 000 tonnes N in 2002, parallel to a decrease in livestock density (in manure equivalent[15]). As a result, the countrywide soil surface nitrogen balance, as estimated by the OECD, was reduced by over 30% between 1985 and 2004.

However, while phosphorus surpluses per hectare of agricultural land[16] are close to the EU-15 average,[17] nitrogen surpluses (128 kg N/ha) remain well above the EU-15 average (89 kg N/ha) for 2002-04. Livestock density and the *intensity of use of nitrogenous fertilisers remain high* by OECD-Europe standards (Figures 3.3 and 3.4).

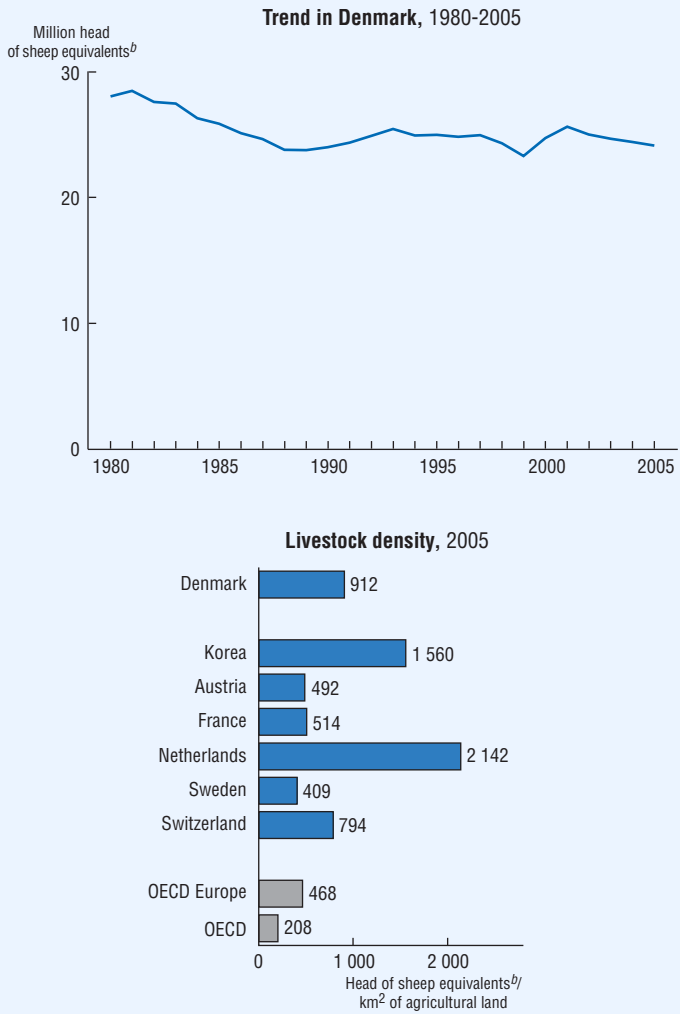
Despite the OECD recommendation in 1999 to enhance the use of economic instruments to reduce agricultural nutrient loadings, in the context of VMP II, the good progress in reducing the use of fertilisers can be mainly attributed to regulatory approaches (Box 3.2). Since 2005 farmers have had to comply with regulatory measures as a condition for benefiting from EU Common Agricultural Policy support (cross-compliance). More specifically, the *VMP II instrument mix* to reduce nitrogen leaching includes regulatory and voluntary measures (farm-related measures) and financial incentives (area-based payments) (Table 3.7). The abatement costs of the different measures vary considerably, even more when compared to predictions at the start of the action plan in 1998. As regards *financial incentives* (Box 3.3), it proved more cost-effective to support the creation of wetlands (in which bacteria convert nitrate to nitrogen released to the atmosphere) than to encourage organic farming (involving more stringent requirements on the maximum level of fertilisation) or afforestation (as part of EU farm forestry measures).

Figure 3.3 **Commercial fertiliser use**



Source: International Fertilizer Industry Association (2007); OECD Environment Directorate; Statistics Denmark.

Figure 3.4 **Livestock**[a]



a) Cattle, horses, mules, asses, hens, pigs, goats and sheep.
b) Based on equivalent coefficients in terms of manure: 1 cow = 6 sheep; 1 horse = 1 mule = 1 ass = 4.8 sheep; 1 hen = 0.1 sheep; 1 pig = 1 goat =1 sheep.
Source: FAO (2006), FAOSTAT data.

Box 3.2 **Regulating fertiliser use**

Denmark's rules for fertiliser use are mostly contained in the 1998 Regulation on agricultural use of fertilisers and plant cover. The fertiliser accounts ("Gødningsregnskaber") have existed since 1993/94 and have increasingly been used to regulate fertiliser use and management. Danish farms[1] that receive more than 25 tonnes of manure or other organic fertilisers (e.g. urea), or that have more than ten livestock units (LU)[2] or more than 1 LU per hectare, are required to register. In practice, *most farms are registered*.

The regulation principle is that a non-compliance fine applies to use of nitrogen beyond the amount allowed by the *fertiliser account* (up to DKK 20 /kg nitrogen). For each individual farm, the fertiliser account is based on the soil types and crops grown. For each crop and soil, *a fertiliser application standard* is estimated as the economically optimal dosage minus 10%, a much stricter approach than what is applied in other OECD countries. The standard also takes account of the previous crop on the field and precipitation. Each year (by late April) the registered farmer must submit a plan for nitrogen use to the Danish Plant Directorate, with a request for a nitrogen fertiliser quota as well as a report on compliance with the previous fertiliser account (the quotas are subsequently adjusted depending on weather conditions). The plan must contain a map of the crops and a soil classification. If the farmer buys fertilisers or produces manure, which in total represents too much fertiliser, he must either store, sell, or give away the surplus to another registered business. Fertiliser sellers control whether the buyer is registered as a "user of manure and fertilisers" and report the sale to the Danish Plant Directorate.

The information is also used to monitor violations of *limits on livestock density*. Such limits (called the "harmony" rules) aim to balance livestock manure production and the area of adjoining farmland on which it is applied. VMP II had set limits of 2.3 LU/ha/year for cattle farms and 1.4 LU/ha/year for other farms (pigs and poultry), through derogation to the 1991 EU Nitrates Directive[3] granted by the European Commission in 2002.

All accounts are subject to an e-control. Each year, approximately 3 000 farms (out of 55 000 from the register) are controlled administratively and 900 receive a farm visit to control that the information given is correct. Compliance increased over the review period: warnings decreased from 360 in 1999/2000 to 263 in 2003/04, and fines from 57 to 18. The minimum fine is DKK 2 000. In case farmer non-acceptance, the case is brought before a court of law. Public expenditure on *enforcement* (34 employees of the Danish Plant Directorate and 30 inspectors located in six districts, which are shared with other sectors) is estimated at DKK 17 million a year.

1. All farms with an annual turnover from agriculture above DKK 20 000 can register.
2. An LU is equivalent to the annual manure production of 100 kilogrammes of nitrogen.
3. The directive sets an average standard of 1.7 LU/ha/year to be fulfilled in vulnerable areas by 2003. The whole of Denmark is designated as a vulnerable area under the directive.

As regards *regulatory measures*, it proved more cost-effective to increase requirements for utilisation of nitrogen contained in livestock manure[18] than to restrict fertiliser application (below the economically optimal dosages for individual crops) or to require green cover during the autumn and winter. The shift to feed with low nitrogen content (a *voluntary measure*) is quite cost-effective (though it requires that the farmer increase the purchase of mineral fertiliser). The least cost-effective measures have been to impose limits on livestock density (an EU requirement under the Nitrates Directive) or to implement agri-environmental measures. Improved feed use has developed as expected, as well as measures targeted at the use of manure or fertilisers. In contrast, measures on land use, particularly the establishment of wetlands, have not been implemented as quickly as expected, reflecting the low attractiveness of financial incentives.

There has been little follow-up to the OECD recommendation in 1999 to compare the *economic and environmental effectiveness* of measures in different sectors (municipal, industrial, agricultural). Overall, the cost-effectiveness of VMP II measures in agriculture was estimated at EUR 2 per kilogramme of avoided nitrogen leaching (Table 3.7), in line with the waste water tax for households and industry (DKK 20/kg N or EUR 2.7/kg N in 2003) and the fines for exceeding the farm-level nitrogen quotas[19] (DKK 20/kg N in significant cases), and four to five times the price paid per kg N in artificial fertilisers (OECD, 2007).

VMP III

Since 2005 the *VMP coverage has been more* "*holistic*", being no longer limited to reducing nitrate discharges, but also covering reducing phosphorus discharges and enhancing nature protection, in anticipation of requirements under the EU Water Framework Directive and Habitats Directive.

To help *further reduce nitrogen leaching* by 9 950 tonnes a year, VMP III provides for additional financial incentives to expand wetlands, afforestation and sensitive farming areas, as well as strengthened regulations on the use of nitrogen from manure and on green cover (Table 3.8). Notably, the share of catch crops in green cover[20] should increase from 6-10% to 10-14%, and the minimum share of nitrogen in manure should increase by a further 5%. It is expected that structural adjustment of the agricultural sector in the context of Common Agricultural Policy reform, land set-aside and improved feed will reduce nitrogen leaching by an additional 11 200 tonnes/year (Jacobsen *et al.*, 2004).

VMP III also addresses the reduction of *phosphorus discharges*, for which an innovative tax on mineral phosphorus added to feed (DKK 4/kg) was introduced, the only such case in the EU. Revenues from the tax are returned to the agricultural sector

through a reduction in land taxes, in the context of the government tax freeze introduced in 2001 (Chapter 5). To prevent phosphorus discharge into water, 50 000 ha of ten-metre buffer zones must be established along rivers and lakes in existing sensitive farming areas, through the transfer of land already set aside and the granting of additional acreage payments. Establishing these zones is a major challenge for farmers.[21] VMP III also includes regulations[22] to reduce the impact of *ammonia emissions* on nature,[23] by requiring a 300-metre buffer zone between livestock holdings and vulnerable natural habitats.[24]

Table 3.7 **Measures to reduce nitrogen discharges from agriculture under VMP II,**[a] 2003

Measures	Land affected (ha)[b]	Reduced N leaching (T N[b]/year)	Government costs (EUR million[b]/year)	Farm costs	Abatement cost (EUR/kg N)	
					Actual (2003)	Ex ante prediction
Area-related measures		6 000	27.1		0.8	. .
Wetlands	2 900 (*18%*)	800 (*14%*)	0.7		0.9	. .
Organic farming	111 500 (*66%*)	3 700 (*218%*)	14.0		3.8	. .
Afforestation	3 000 (*15%*)	800 (*73%*)	4.7		5.9	. .
Sensitive farming areas (SFAs)	25 600 (*29%*)	700 (*37%*)	7.7		11.0	. .
Farm-related measures		29 900		43.1	1.4	2.5
Use of nitrogen in manure[c]		10 110 (*95%*)		6.7	0.7	2.6
Improved feed		3 800 (*158%*)		5.7	1.5	0.0
Fertiliser application standards[d]		12 850 (*122%*)		22.8	1.8	1.5
Green cover[e]		3 000 (*100%*)		6.4	2.1	6.8
Livestock density[f]		140 (*47%*)		1.5	10.7	13.7
Total	143 000 (*48%*)	35 900 (*97%*)	27.1	43.1	2.0	. .

a) VMP II: Second Action Plan for the Aquatic Environment.
b) Data in brackets indicate the extent to which the initial/predicted (1998) objective was met.
c) A 15% increase over 1991 rules.
d) A 10% reduction from the economical optimum nitrogen commercial fertiliser application.
e) A further 6% of farmland to be sown in catch crops.
f) Pursuant to the EU Nitrates Directive.
Source: Jacobsen (2004); Kuik (2006).

Box 3.3 **Financial incentives to reduce nitrogen use in agriculture**

Agri-environmental measures[*] are an integral part of VMP II and III. Their main thrust is to reward farmers who go a step farther than the environmental regulatory constraints imposed on farming practices. Since 1998, payments have been restricted to sensitive farming areas (SFAs) defined by guidelines from the Ministry of Agriculture. Eligible SFAs cover 1 million ha (about 25% of Denmark), mainly semi-wetlands, groundwater protection areas, coastal areas and drylands with high conservation priority. Under the *Environmentally Beneficial Farming Programme*, acreage payments are granted to farmers who: reduce nitrogen fertiliser application to 60% of the needs defined by national standards; re-establish wetlands; establish 12-metre pesticide-free margins or (since 2005) 10-metre uncultivated buffer zones along watercourses and lakes; practice extensive permanent grassland management; cultivate catch crops; or set aside land over a 20-year period. So far, about 105 000 ha of SFAs have been enrolled in the programme, which has a budget (from the Ministry of Agriculture) of DKK 130 million per year with an additional DKK 375 million for the period 2005-09 to establish buffer zones and speed up re-establishment of wetlands.

Under the *Action Plan for Organic Farming*, organic farmers must not use chemical fertilisers, must limit the use of manure to 1.4 LU/ha/year, and, after four years, must organically farm all the land. A three-year regressive conversion payment allows for income losses. In 2005 Denmark had some 3 000 organic farms representing an organic area of 140 000 ha (compared to 2 200 farms and 44 000 ha in 1998).

The *Ministry of the Environment* also supports farmers who take former wetlands out of agricultural production. Participants are either compensated for the loss of farmland (at land market price) or offered a corresponding area of farmland. A budget of DKK 142 million has been made available for the period 2005-14.

* Co-financed by the EU through the Danish rural development programme.

The measures adopted under VMP III are *not always those that proved most cost-effective* in reducing nitrogen leaching under VMP II. Moreover, there is a higher marginal abatement cost to further relying on nitrogen from livestock manure or making wetland creation more attractive to farmers. Clearly the most cost-effective way to reduce nitrogen leaching is not to further expand sensitive farming areas (by 9 700 ha), although additional benefits are expected, notably the protection of habitats and landscapes. The cost-effectiveness of measures to reduce phosphorus losses is still very uncertain; further related investigation has been budgeted as part of VMP III.

The current regulatory measures (equivalent to setting a farm-level nitrogen quota) have proved *effective but costly*. They have forced farmers to better plan and actually reduce the use of nutrients (with associated financial gains). The high administrative costs associated with implementing such a control-and-command approach (e.g. to enforce annual fertiliser accounts) should diminish with time, as both government and farmers get used to it. However, it would be more cost-effective to replace the current approach with a *tax based on the nitrogen surplus for the whole agricultural sector*, as measured by the soil surface nitrogen balance (OECD, 2007). Such a tax levied on all commercial fertiliser inputs and the nitrogen content of feedstuffs would certainly be much simpler to administrate than the complex mix of regulatory and incentive measures. A rebate could be granted to farmers based on the nutrient content of their output, thereby applying the polluter-pays principle while leaving flexibility in the choice of crops and farming techniques. Such a tax-rebate scheme would be most cost-effective (Hansen, 2001). Moreover a tax on phosphorous

Table 3.8 **Measures to reduce nitrogen discharges from agriculture under VMP III,**[a] 2005-14

Measures	Land affected (ha)[b]	Reduced N leaching (T N[b]/year)	Government costs (EUR million[b]/year)	Farm costs (EUR million[b]/year)	Abatement cost (EUR/kg N)	
					Actual (2003)	Ex ante prediction
Area-related measures		2 350				
Wetlands	4 000	1 050	3.0		0.9	2.8
Afforestation	22 800	900	4.7		5.9	5.2
Sensitive farming areas (SFAs)	9 700	400	27.5		11.0	68.7
Farm-related measures		7 600				
Use of nitrogen in manure[c]		3 000		6.7-12.1	0.7	2.2-4.0
Green cover[d]		4 600		4.2-8.3	2.1	0.9-1.8
Total	36 500	9 950	35.2	10.9-20.4	. .	4.6-5.6

a) VMP III: Third Action Plan for the Aquatic Environment.
b) EUR 1 = DKK 7.45.
c) A 5% increase over 2003 standards.
d) From 6-10% to 10-14% of farmland to be sown in catch crops.
Source: Jacobsen (2004).

surpluses could be piggy-backed on the administrative set-up for the tax on nitrogen surpluses.

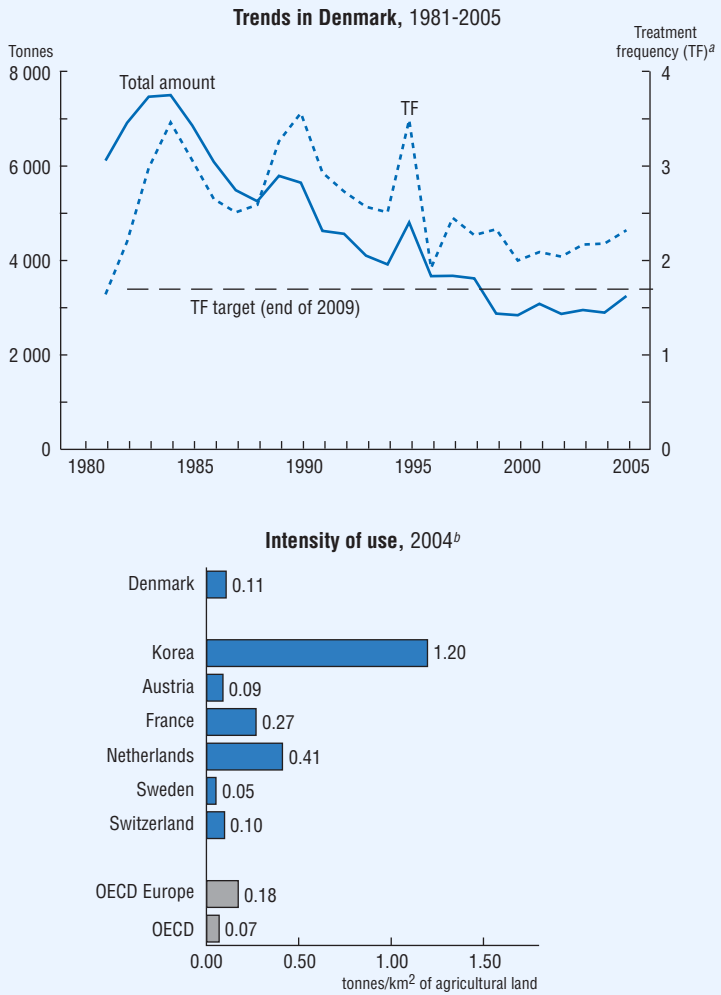
VMP III should be further evaluated in the context of *ancillary costs and benefits* (e.g. greenhouse gas emissions, nature conservation) as well as new (forthcoming) requirements of the EU Water Framework Directive. In that context, any financial incentives should reflect the desired environmental outcomes and not try to compensate foregone revenues from agricultural production.

Pesticide management

In 1994, the first Pesticide Action Plan (PAP I) aimed to cut Denmark's total pesticide consumption and treatment frequency by 50% by 1997 from 1981-85 levels (the reference period). It was thought that the aim of halving the quantity of active ingredients (9 743 tonnes in 1981-85) could be achieved through voluntary (advisory and information services) and incentive-based measures[25] (payments for afforestation, organic farming, extensification, spray-free margin zones), but that the aim of halving the frequency of use (2.67 in 1981-85) could not be achieved without additional initiatives. The Danish Parliament therefore adopted the *Pesticides Tax Act* based on the retail value of pesticides, and the tax came into force in 1996.[26] On 1 November 1998 the pesticide tax rates were increased by an average of 100%,[27] as the 1997 target of 50% reduction in treatment frequency had not been achieved (Figure 3.5). The pesticide tax contributed to meeting the reduced consumption target, though less than the switch to low-dose pesticides which explains the continuous reduction since the reference period[28] (Figure 3.5). The tax has not created enough incentives to meet the target of reduced treatment frequency.

In 2000, PAP II set a less ambitious target for reducing treatment frequency, i.e. to 2.0 treatments annually by the end of 2002. In 2004, PAP III aimed to cut the treatment frequency to 1.7 by the end of 2009. This is to be achieved through dissemination of good farming practices. In addition, to protect surface waters, PAP III set a target of establishing 25 000 ha of spray-free buffer zones along watercourses by the end of 2009, and this target involves new financial incentives. In 2001, the Ministry of Taxation evaluated the *feasibility of readjusting the pesticide tax to a tax on frequency of use*. Proposals were either to add differentiation of the existing *ad valorem* tax or to tax each standard dose of pesticide (area weight). The latter would produce a greater environmental effect but would entail much higher administrative costs. None of the proposed alternatives has been approved by the government. Efforts should be made to link pesticide tax rates to pesticide toxicity.

Figure 3.5 **Pesticide use**



a) Treatment Frequency (TF) is the (calculated) average number of pesticide applications in agriculture per year, provided a (fixed) standard dose is used.
b) Or latest available year.
Source: FAO (2004), FAOSTAT data; OECD Environment Directorate; MoE.

Groundwater protection

VMP II (in 1998) required the identification of areas where geological conditions cause groundwater to be vulnerable to pollution, particularly nitrate pollution. Such *mapping of groundwater resources* (which covers approximately 35% of the Danish land area) is intended to lead to voluntary agreements between waterworks and landowners, where the waterworks provide financial compensation for any restrictions placed on agricultural practices.[29] Mapping and planning of pollution abatement measures are also to be financed by waterworks, through a fee on water abstraction permits. Since 1998 the fees levied have raised approximately EUR 15 million a year. In 1998 it was estimated that mapping and planning could be completed within a ten-year period. However, by 2006 only 50% of the mapping had been concluded, and planning of measures had been completed for only 10-20% of the area. Completion is now projected for 2012.

To protect groundwater contamination by pesticides, an *early warning monitoring system* was set up in 1999, responding to the 1999 OECD recommendation to upgrade monitoring of pesticides in groundwater and drinking water. The system consists of field monitoring of pesticide transport to soil and groundwater at six representative areas. The warning system has confirmed the efficiency of the Danish pesticide approval scheme, as only 2 out of 24 active substances examined have been found in groundwater above the limit value of 0.1 µg/l (yearly average). In these cases banning procedures have commenced.

3. Resource Management

3.1 Resource assessment

The intensity of freshwater use is very low in Denmark (Figure 3.2). Most (98%) freshwater abstractions are from groundwater. Denmark's available groundwater resources (about 1 billion m^3/year) are generally sufficient to meet national water supply requirements (between 600 and 700 million m^3/year in recent years). Increased water prices have led to a significant drop in household water consumption. Combined with stricter demands for licensing abstraction permits, they also led to a *10% reduction in overall water abstractions* over the period 1998-2005.

Drought is generally not a problem in Denmark. *Around the large towns*, however, water extraction can deplete flow in smaller streams during the summer, threatening wetlands and river quality objectives. Inter-municipal co-operation was established for all of Zealand to secure water supply while taking account of pressures from water extraction on groundwater and surface water.

Little effort has been made to respond to the OECD recommendation in 1999 to upgrade the *ecological condition of watercourses*, a key objective under the Water Framework Directive.[30] Despite EUR 100 million being spent (from the public purse) over the last 15 years on restoration works, of which 37% on the Skjern River project, the great majority (98%) of Danish watercourses are still channelled (Chapter 4).

3.2 Moving toward basin-based management

In late 2003, Denmark transposed the *Water Framework Directive* into national law, and the Danish counties were appointed as Water District Authorities (with 12 water districts). In 2005, as part of the process of *local government reform* (Chapter 5), the water authority responsibility was transferred again to the national level (the Minister of Environment). In 2007 the number of water districts was reduced to four.

Pursuant to the Water Framework Directive and responding to the OECD recommendation in 1999 to take a catchment area approach to both pollution and water resource issues, water management is moving toward a more basin-based approach. By the end of 2009 the Regional Plans[31] will be replaced by *Water Plans* for each of the four water districts.[32] The Water Plans (under preparation) will address water quality issues as well as co-ordinate responses to pressures (on both water quality and water resources) from the various stakeholders. The role of the Regional Plans regarding water use and spatial planning will be transferred to a (new) Municipal Plan for each of the (new) 98 municipalities.

Once the Water Plans have been issued, *programmes of measures* will be prepared to implement them at the river catchment level. From 2005, a government committee with representatives from the Ministry of Finance, Ministry of the Environment, Ministry of Food, Agriculture and Fisheries, Ministry of Taxation and Ministry of Economic and Business Affairs has been evaluating the most cost-effective approach to implementing the Water Framework Directive. In June 2007 the committee recommended focusing more attention on the agricultural sector than on other sectors such as households and industry. A follow-up committee will now look further into cost-effective measures in the agricultural sector. More generally, any exception from the general water quality and quantity objectives must be supported by a cost-benefit analysis. The Water Plans must be closely co-ordinated with the corresponding plan for nature protection in Natura 2000 sites. The Water Plans, plans for nature, and the programmes of measures will be prepared by the seven new local offices of the Ministry of the Environment (opened in January 2007).

The *local government reform* has brought other major administrative changes which took effect in 2007 and which will affect river basin management. The reform reduces the number of municipalities to 98 (from 271). The average area of a municipality is now two-to-three times larger than it used to be and the administrative water and waste water catchment area served by each municipality is correspondingly larger, which should bring more capacity to municipal administrations and allow scale economies in water and waste water management. Groundwater mapping was transferred from counties to the state, and municipalities were given the task of preparing plans of measures to reduce nitrate loads, subject to public consultation. The licensing of waste water discharge has become the responsibility of municipalities (it used to be at the county level). All Danish watercourses (public and private) used to be administered by a watercourse authority in accordance with the Watercourses Act. On 1st January 2007, this responsibility was transferred to municipalities.

Notes

1. The Ministry of Agriculture, Food and Fisheries is responsible for implementation of a large part of the Action Plan.
2. Groundwater is by far the main source of drinking water in Denmark.
3. The Treatment Frequency (TF) indicator was developed in the mid-1980s to take account of the increasing use of low dose products (a drop in sales of active ingredient can be accompanied by an increase in the number of applications – and related pesticide load on the environment). TF is the (calculated) average number of pesticide applications in agriculture per year, provided a (fixed) standard dose is used. TF is calculated based on i) sales of pesticides, ii) acreage with crop types, and iii) standard dose for all active ingredients in all crop types in which the active ingredients can be used. The fixed standard doses are based on efficacy trials. In addition, knowledge on how pesticides are used is needed to allocate sales data to crop types. The overall TF can be broken down (e.g. TF for herbicides on winter cereal or TF for fungicides on potatoes). Because TF is based on a standard dose that relates to the biologically active field dose, any TF increase is assumed to reflect (indirect) impacts on ecosystems. According to the so-called Bichel Committee, it would be possible to reduce the TF to 1.4-1.7 without incurring any significant costs for farmers.
4. Quality of drinking water from small waterworks (serving a third of the Danish population) is based on just a few tests per year.
5. Deeper groundwater was generally formed prior to 1987 and hence was unaffected by the initiatives implemented in connection with the successive VMPs.
6. Only excess phosphorus is removed at the waterworks.
7. When looking at all groundwater monitoring sites, the frequency of pesticide detection has actually increased since 1998 for concentrations both below and above the limit value for drinking water, to 35% and 10% in 2004, respectively.
8. The proportion of the monitoring stations rated as DSFI 5, 6 and 7 increased from 40% in 1998 to 51% in 2004 (DSFI 1 means very heavily affected while DFSI 7 is unaffected). The number of monitoring stations increased from 114 in 1998 to 250 in 2004.
9. The biological quality objective for most streams, as defined in regional plans, is a DSFI of at least 5, but the objective can be as low as 3 or as high as 7 for some watercourses.
10. Over the period 1989-2003 land-based pollutant loads on coastal waters were reduced by 43% for nitrogen and by 81% for phosphorus.
11. In Denmark a general "tax freeze" has been in effect since 2001 (Chapter 5). The VAT was increased from 22% to 25% in 1992.
12. A survey by the Danish EPA in 2002 revealed that 16% of public sewers were in need of renovation, though with large differences between municipalities. Pursuant to the Environmental Protection Act, each municipality is required to prepare a sewer renovation plan as part of its waste water management plan.
13. Calculated based on modeling, including the level of total-N added in the crop rotation; spring fertilisation; autumn fertilisation; nitrogen left by grazing animals; effect of ploughing of grass; soil type (clay and humus content); water percolation through the root zone, and crop type.

14. Of which 45 000 tonnes in the period 1998-2003, under VMP II (35 900 t), due to technical developments (8 500 t) and to land use changes (600 t).
15. Livestock manure originates from pigs (53%), cattle (42%) and chickens (5%).
16. Defined as arable land and land under permanent crops plus permanent meadows and pastures.
17. The intensity of use of phosphorous fertilisers decreased over the review period and remains lower than the OECD-Europe average.
18. An assumption is made of how much of the nitrogen in manure is available for crop uptake. Initially (in 1992), a minimum share was set at 45% for pigs and 40% for cattle. The shares have been gradually increased, up to 65% for pigs and 60% for cattle in 2002.
19. A nitrogen quota is calculated for each farm (Box 3.2).
20. Since 1990, 65% of farmland has been required to be under green cover crops, including catch crops, during the autumn and winter to reduce nitrate leaching. This measure has led to considerable land conversion from spring to winter grain cereals.
21. Until now the Watercourses Act has required farmers to leave uncultivated a two-metre zone along watercourses.
22. Beyond those already included in the 2001 Action Plan for Reducing Ammonia Volatilisation from Agriculture.
23. The effects of ammonia deposition on nature are primarily acidification and eutrophication. Acidification can cause changes in the nutrient balance and release aluminum from the soil in toxic concentrations. Eutrophication occurs as a result of high nutrient loading, which causes changes in ecosystem structure or function.
24. A major part of the ammonia is deposited close to the source.
25. The only regulatory requirement was that records be kept of pesticide consumption.
26. Revenues from the tax are returned to the agricultural sector, to fund pesticide monitoring.
27. Rates were increased from 27 to 54% for insecticides, and from 13 to 25% for fungicides/ herbicides.
28. The expected tax increase in 1995 was the reason for an extraordinary rise in pesticide sales that year.
29. Alternatively, the government can enforce specific requirements on agricultural practices.
30. Danish watercourses are currently not subject to any general requirements as regards their physical conditions.
31. According to the Planning Act, each region (county) must conduct coherent water and spatial management planning through a Regional Plan, which governs land-use planning and sets quality and quantity objectives for surface water and groundwater.
32. The two main districts Zealand and Jutland/Funen and the small district of the island Bornholm in the Baltics and a small international district in the south of Jutland shared with Germany.

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4

NATURE AND BIODIVERSITY MANAGEMENT*

Features

- Aquatic ecosystems
- Spatial planning and the territorial reform
- Climate change and nature
- Nature protection and agriculture
- Proposal on national parks

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1999. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Denmark:

- establish *national parks* in priority conservation areas and clarify their role in relation to other protected areas; complete *management plans for all protected areas* including the Natura 2000 areas, incorporating biodiversity objectives and ecological integrity indicators, and establish a network of corridors linking them; develop and adopt *ecosystem quality objectives* for terrestrial and aquatic habitats, including as part of implementation of the EU Habitats and Water Framework Directives;
- develop time-bound objectives for the *national nature and biodiversity conservation action plan*, including with regard to integration of biodiversity considerations in *agriculture*, *fisheries* and other sectoral policies; develop and implement a *comprehensive planning system*, with a sea use planning component and with cumulative impact assessment and climate change impact scenarios;
- adjust the *levels of economic incentives* and revise the land use legal framework, so as to enhance biodiversity conservation, production of ecological services (e.g. reduction of nitrogen and phosphorus leaching) and groundwater protection (e.g. in priority contaminated areas) on private land;
- expand *restoration projects for major ecosystems*, including major rivers and future national parks, to re-establish their capacity to produce ecological services and to support biodiversity;
- accelerate the rate of *environmental certification* of fish farms.

Conclusions

After the OECD Environmental Performance Review in 1999, Denmark took several steps to emphasise the conservation of biodiversity. It adopted the National Strategy on Biological Diversity (2004) and the *Action Plan for Biodiversity and Nature Conservation* (2004-09). It prevented housing construction in a widened *coastal and dune protection zone* (from 100 to 300 metres). In the context of *Natura 2000*, Denmark has designated 254 special conservation areas and 113 special protection areas, including 27 Ramsar sites, covering 8.4% of its terrestrial areas (i.e. 3 600 km^2) and 12.3% of its marine areas (i.e. 13 050 km^2). Environmental monitoring was extended to nature conservation through the creation of the National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environments (NOVANA). A number of *species*, like the white-tailed eagle, peregrine falcon, common crane, Eurasian spoonbill and corncrake, are starting to return to Denmark.

Roe deer and red deer are increasing, as are grey seal populations in the seas. Denmark has initiated seven pilot projects in support of the creation of national parks, although none has been created yet.

However, agriculture (including aquaculture and intensive livestock farming), urbanisation and increased infrastructure development continue to exert negative impacts on nature and biodiversity. The Danish fish catch represents a major part of the total catch from the North Sea. Depleted fish stocks (due to overfishing), recurring fish kills in the Baltic (due to water pollution), and finding of deformed fish and snails changing sex, of fish unfit for human consumption, and of invasive species (some as a result of climate change) all point towards an *impoverished and degraded aquatic environment*. Further efforts are needed to follow up on several of the 1999 OECD recommendations. The national Action Plan for Nature and Biodiversity Conservation lacks clear time-bound objectives. It has yet to integrate comprehensive biodiversity conservation targets in *fisheries and agricultural policies*. The management plans for protected areas are incomplete and the goal of increasing the forest cover is behind schedule. Despite NOVANA, Denmark has not fully developed indicators and a monitoring system to evaluate progress toward the 2001 Gothenburg EU Summit objective of halting the decline of biodiversity by 2010. Denmark's next challenge will be to move towards ecosystem-specific quality objectives. This will require cross-sectoral co-ordination, particularly among landscape and seascape planning, agriculture and fisheries, and urbanisation and infrastructure development. It will also require improved institutional integration, enhanced use of economic instruments and the application of a risk management approach, particularly with regard to climate change impacts. In 2006, the European Commission launched infringement procedures against Denmark over violations of both the Birds and the Habitats Directives.

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1. Nature Conservation Policy Objectives

Denmark has outlined its nature conservation policy objectives in a range of documents: the *National Strategy for Sustainable Development* (2002) sets targets and principles for sustainable development including the objective of securing a high degree of biodiversity and preserving Denmark's ecosystems; the *Wilhjelm Committee report* "Danish Nature: Status, Trends and Recommendations" (2001), issued partly in response to the 1999 OECD Environmental Performance Review, proposes future biodiversity policies and contains specific targets;[1] the *National Strategy on Biological Diversity* (2004) brings together laws and establishes targets

for the conservation of biodiversity; the *Action Plan for Biodiversity and Nature Conservation* (2004-09) specifies actions to protect nature and biodiversity in accordance with the National Strategy and with EU legislation and the Convention on Biological Diversity; the *Action Plan for Nature Conservation* (2005) specifies criteria for prioritising nature conservation by site of natural landscape or recreational value, when conservation cannot be done by use of other instruments.[2]

Denmark's performance can also be evaluated in light of the *recommendations of the 1999 OECD Environmental Performance Review*:

- 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 such 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 nationwide monitoring programme.

2. Habitats, Ecosystems, Fauna and Flora

2.1 State and pressure

Denmark uses its land and sea areas intensively. *Pressures from human activities* continue to adversely affect nature and biodiversity. The marked decrease in the quantity of open natural habitat and the decline in the quality of the habitat that

remains, as a result of intensive agriculture, urbanisation, land reclamation and infrastructure development, have led to the *extinction of 340 species* over the past 150 years. In addition, aquaculture, intensive domestic animal farming (e.g. pig, chicken and cattle) and *climate change* exacerbate these negative pressures on the environment (Box 4.1). Indicators such as depleted fish stocks, recurring fish kills in the Baltic Sea, deformed fish, snails changing sex, fish unfit for human consumption, and invasive species point toward an impoverished and degraded natural environment. Although some progress has been observed, these negative indicators also show that Denmark's environmental policies and measures to protect nature and biodiversity have *not adequately addressed* the severity of the situation.

The reduction in meadows, marshes, dry grasslands, streams and lakes is reflected in the reduced *populations of birds and animals*. Over the past 20 years, most Danish species have declined in number and very few have gained ground. The number of breeding birds in the open countryside has fallen by one quarter. The decline of birds that live on arable land, such as the lapwing and the swallow, has continued since the last OECD Environmental Performance Review, while the whitethroat seems to have stabilised. Some species like the white-tailed eagle, peregrine falcon, common crane, Eurasian spoonbill and corncrake are starting to return to their Danish habitats. Roe deer have also proliferated due to their tolerance for agriculture and the abundance of food they find in the fields. Hares continue to decline due to the disappearance of hedges from farm enlargements. The otter is repopulating streams as a result of the order to modify eel traps to prevent otters from drowning if they are caught. In the seas, grey seals have started to breed again (NERI, 2004 and 2005a).

Botanists estimate that one-third of Denmark's *wild plant species* are on the verge of disappearing. The area of original forest, especially valuable to biodiversity, has been steadily reduced over the last 200 years and today makes up only a fraction of Denmark's total area.

2.2 Habitat and ecosystem protection

Habitats in protected areas

Denmark has protected *11.1% of its total area*, less than the OECD average of 16.4%, although a third of Denmark's protected areas are in the International Union for Conservation of Nature (IUCN) categories I and II (Figure 4.1). *Protected open-land habitat types* (dune, heathland, coastal meadow, freshwater meadow, dry grassland and marsh) were most widespread in Denmark 200 years ago when they covered as much as 60% of the country. Today these habitats cover less than 9% of

Box 4.1 **Climate change and nature**

The Danish climate is getting *warmer*, and forecasts for the future predict a warmer, more *humid and windier* climate with more storms and more frequent periods of precipitation. The mean temperature in Denmark has increased by 1 °C since 1870 and is now about 8 °C. During the last century, annual precipitation has gone up by 110 mm to around 750 mm.

According to Denmark's Climate Center, trends toward 2100 show an increase in annual precipitation of 10 to 20% with a clear trend toward a *wetter winter* and increased *drought risk in summer*. The annual average temperature could be 3 °C to 5 °C higher than today, with greater increases in night temperatures. Westerly winds will likely prevail more frequently in the future.

Forests

As the 1999 storm evidenced, more frequent storms and more severe storms will mean greater risk of *windfalls* in Danish forests. Storm damage could be extensive, as a large part of the Danish forest cover is old stands of Norway spruce, a tree that is not particularly resilient to high wind. Norway spruce is naturally occurring in regions with cold winters and the species has already shown signs of poorer health in periods with warmer winters.

The *marginal growth increment* of individual tree species has increased considerably due to increased CO_2 levels and longer growth seasons. The growth season in Denmark has been extended by two to three weeks and is expected to increase further. The expected climate change should enhance growth, particularly of those species that have their northern tree line in southern Scandinavia. The advantages of the longer growing season for these species could however be counterbalanced by the drop in precipitation during summer and the increased risk of drought.

Plants and wildlife

If the temperature increases by 3 °C, the natural northern limit for many plant and animal species' natural habitats could move 300 to 400 kilometres to the north. On the other hand, a warmer climate would make it possible for southern plant and wildlife species to migrate to the north. The extent to which this actually occurs depends on the barriers such species meet in the form of farmed fields, urban areas and road infrastructure. Many species will have difficulty reacting to the rapidly changing conditions by moving (*migration*) or by adjusting physically (*genetic adaptation*) (NERI, 2003). As well, new species adapted to a warmer climate will appear and compete with traditional Danish species and may have negative impacts on crops, forest or natural ecosystems.

Box 4.1 **Climate change and nature** *(cont.)*

The coasts

Anticipated sea level rises of 50 cm up to the year 2100 will increase the water depth locally and trigger or accelerate *costal erosion*. According to the Danish Academy of Technical Sciences, the west coast of Jutland between the towns of Hvide Sande and Thyborøn could retreat by up to 60 to 70 metres if the erosion is not compensated by more beach feeding.

Along Denmark's inner coastline, incidents of *tidal flooding*, which today are rare, could become commonplace. Changed wind patterns alone would mean that what today is a 100-year incident might happen annually if the sea level rises by 50 cm. As the risk of flooding increases, so will the need for adjusting the safety level of the approximately 900 km of dikes along Denmark's inner coastline. More storm activity in combination with rising sea levels increases the risk of *storm flood* incidents and flooding of still larger land areas. A sea rise of 50 cm, for example, would reduce the present safety level of 500 to 1 000 years for the dikes around Thyborøn to 50 to 100 years.

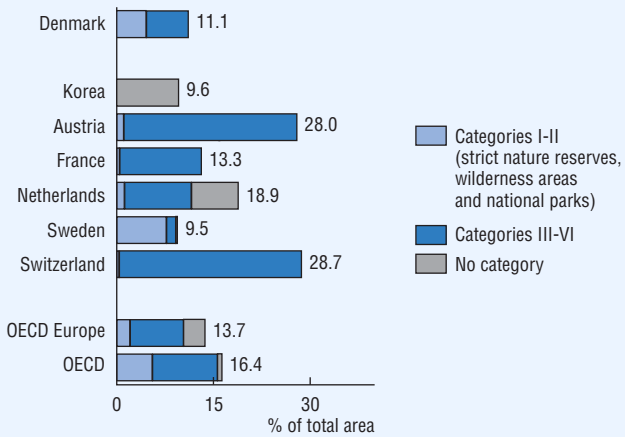
The *Wadden Sea* including the salt meadows along the southern part of the Jutland west coast will be seriously affected by the general rise in sea level. Its location outside the dikes means that the salt meadows and tidal flats will be obstructed from following the coastline as it retreats inland and the natural area will disappear.

The marine environment

Sea temperatures around Denmark are expected to increase by 3 °C to 5 °C in the years approaching 2100. A higher water temperature in the North Sea will also entail the *northward migration of southern species*. This phenomenon has been observed already for benthic animals around the British Isles over the past 50 years. In Danish marine waters, species such as mullet and rockfish, which prefer a warmer climate, are being observed more and more frequently.

Denmark (Table 4.1). The regional distribution of habitat types shows that heathland is most common on the sandy and nutrient-poor soil in West Jutland, whereas dry grassland is the predominant habitat type on the more fertile moraine soil in East Jutland and on Funen and Zealand. Open-land natural habitat types are today protected against further decline by Denmark's Nature Conservation Act. Almost 50% of the areas have been designated as Natura 2000 sites, which gives them double protection. The decline in the area of open-land habitat types has been accompanied by a fragmentation and general reduction of natural areas in Denmark.

Figure 4.1 **Protected areas,**[a] 2004



a) Terrestrial and marine areas. IUCN management categories I-VI and protected areas without IUCN category assignment. National classifications may differ.
Source: IUCN/UNEP-WCMC (2005), World Database on Protected Areas.

Table 4.1 **Protected open land**

Natural habitat type	Area (ha)	Denmark's land area (%)	% situated in Natura 2000 habitat sites
Dry grassland	25 986	*0.6*	*23.6*
Heathland	82 013	*1.9*	*49.7*
Freshwater meadows	103 722	*2.4*	*56.1*
Marshes	89 919	*2.1*	*32.6*
Coastal meadows	43 622	*1.0*	*76.4*
Dunes (estimated)	30 000	*0.7*	–
Total	375 262	*8.7*	*47.2*

Source: NERI.

Denmark's implementation of the *EU Habitats and Birds Directives* and *Ramsar site* designations with respect to Natura 2000 areas now includes: 254 EU habitat areas, 113 EU special protection areas for birds and 27 Ramsar sites, with a total surface area of 6 638 km^2 (Table 4.2). Of these areas, 30% are terrestrial and 70%

marine. By the end of 2006, Denmark had almost completely implemented the recommendations of Natura 2000. The selected habitat types and species are encompassed in the relevant laws, i.e. the Nature Conservation Act and the Act on Environmental Objectives. The latter act establishes a timetable for planning according to Natura 2000 and the Water Framework Directive, and ensures a co-ordinated and coherent implementation of Natura 2000 and the Water Framework Directive. Management plans for Denmark's Natura 2000 areas should be completed according to an EU schedule.

Under the Nature Conservation Act, Denmark has *established protected zones of 300 metres along the coasts* in rural areas, 150 metres around lakes and streams,

Table 4.2 **Protected areas**

	Number	Area km² [b] (%)	Share (%)	
Natura 2000 sites[a]				
Terrestrial[b]		3 591 (*21.6*)	*8.4*	Of the terrestrial area of Denmark
Marine[c]		13 047 (*78.4*)	*12.3*	Of the marine area of Denmark
Total		16 638 (*100*)		
Sites of community importance[d]	254			
Terrestrial		3 173 (*28.5*)	*7.4*	Of the terrestrial area of Denmark
Marine		7 963 (*71.5*)	*7.5*	Of the marine area of Denmark
Total		11 136 (*100*)	*66.9*	Of the total area of Natura 2000
Special protection areas[e]	113			
Terrestrial		2 596 (*17.7*)	*6.1*	Of the terrestrial area of Denmark
Marine		12 112 (*82.3*)	*11.4*	Of the marine area of Denmark
Total		14 708 (*100*)	*88.4*	Of the total area of Natura 2000
Ramsar sites[f]	27			
Terrestrial		1 402 (*19*)	*54.0*	Of the total area of terrestrial SPAs
Marine		5 981 (*81*)	*49.4*	Of the total area of marine SPAs
Total		7 383 (*100*)	*50.2*	Of the total area of SPAs

a) The total area of Natura 2000 sites is not equal to the sum of the Sites of Community Importance (SCI) and the Special Protection Areas (SPA) because some of the latter are identical or overlapping.
b) 2 179 km² of the terrestrial Natura 2000 areas are designated as both SCIs and SPAs, 995 km² are designated uniquely as SCI's, and 418 km² are designated as SPAs.
c) 7 028 km² of the marine Natura 2000 areas are designated as both SCIs and SPAs, 935 km² are designated uniquely as SCI's, and 5 084 km² are designated as SPAs.
d) SCIs under the Habitats Directive.
e) SPAs under the Birds Directive.
f) The Danish Ramsar sites are all within Special Protection Areas.
Source: MoE.

300 metres around woods and churches, and 100 metres around ancient monuments. Following the OECD's recommendation in 1999, Denmark has initiated *seven pilot projects to create national parks* (Box 4.2). In establishing the parks, the government's two main objectives are to designate large, homogeneous reserves to protect and improve biodiversity and the country's scenic and cultural heritage, and to improve opportunities for outdoor recreation (Danish Government, 2004). Designing and managing national parks will require habitat restoration and possible species reintroduction to enhance the representation of biodiversity. Very good experience has been gained in several restoration projects, notably the restoration of the Lower Skjern River (Box 4.3). To date, three out of the seven pilot projects are supported by the public while the other four projects continue to face opposition, which is stalling the process. Nonetheless, a cost-benefit analysis of the project shows that the Danish people have a considerable "willingness to pay" for the establishment of national parks. For "full development" of the parks (i.e. extra measures for nature protection, restoration, protection of threatened species, and pathways), the cost ranges from DKK 1 430 to DKK 1 750 per household per year.

Aquatic ecosystems

At sea, fishing, dumping of material and mineral exploitation have altered the *aquatic ecosystems*. The shallow Danish *marine waters* are especially vulnerable to eutrophication because water exchange with the stratification of the water masses often limits the input of oxygen to the bottom water (NERI, 2004). The amount of oxygen in Danish marine waters has not improved since the previous OECD review and was the worst ever in 2002. The poor condition of *fish populations*, especially cod, has led the EU to impose fishing quotas on Danish waters, which had been considered some of the best fishing grounds in the world. The environmental impact of fishing also includes damage resulting from bottom trawling, which destroys habitat. The quality of marine areas is also strongly influenced by actions on land and by the atmospheric deposition of pollutants (Chapter 7). In addition, *micropollutants* such as organochlorines, hexachlorobenzenes and toxins are released into the marine waters and spread throughout the environment through shipping channels and dredging operations and are ultimately absorbed through the food chain. In 2003, five species of snails displayed widespread signs of reproductive disruption, apparently due to the widespread presence of tributyltin (used in boat paint), a well-known ecotoxin. One positive sign is that trends in nutrient loading are on the right track (e.g. reduction of discharges, emissions and losses of nutrients to marine waters, and quality of the marine environment). Fjords and the open sea have benefited from the reduced nutrient run-off. However, Danish authorities have concluded from an assessment of the conditions in fjords and the marine environment that the overall situation has not improved.

Box 4.2 **Establishing national parks**

Denmark currently has no national parks. In October 2002, however, the government launched a pilot phase *to establish national parks* with seven pilot projects and a National Advisory Committee. The objective was to create large, coherent nature areas and to protect and improve nature and biodiversity, cultural heritage and public recreation with involvement of the local public.

The pilot projects were to build on a bottom-up process *involving local citizens and organisations*. A local steering committee was set up for each pilot project. The proposal was to be based on a voluntary approach and compensation to private landowners.

The report from the National Advisory Committee on National Parks recommended to the Minister *a Danish model for national parks*, including a legal framework, criteria and a procedure for designation, governance and public involvement. The report together with the pilot projects provides the basis for the establishment of national parks.

Many different activities have been carried out to involve the public (e.g. thematic working groups and groups targeted at youth, families with children and farmers). The local citizens have expressed awareness and a sense of *ownership and commitment*, although private landowners have often been sceptical or opposed to the national parks. In two of the seven pilot projects, the Local Agenda 21 networks have been independent partners of the public participation. The main obstacles have been: i) the conflict of interest between private landowners and interest groups supporting nature protection and leisure activities including public access, and ii) the difficulty in involving women and young people. In three of the seven pilot projects a unanimously agreed proposal was made by the local steering committee, but in the four others the opposition resulted in minority proposals concerning the boundary of the national park.

Critics have claimed that the projects have focused more on participation than on actually conserving biodiversity, as evaluations have shown that the larger areas would not be more effective at representing biodiversity (Larsen *et al.*, 2006). In addition, it is not clear that the conservation role of national parks in relation to other protected areas has been clarified. It is obviously difficult in a country where land is used so intensively to find wild or natural areas with abundant biodiversity. *Designing and managing national parks* will require habitat restoration and possibly species reintroduction to enhance the representation of biodiversity. It will also demand that recreational activities be limited to specific sections of the parks or to certain times of the year so as to protect especially sensitive species. Very good experience has been gained in several restoration projects, notably the restoration of the Lower Skjern River (Box 4.3).

A *cost-benefit analysis*, which found that the Danish people have a considerable willingness to pay for the establishment of national parks, also found that: the public's willingness to pay for additional protection and restoration of natural areas and site-specific animals and plants amounts to approximately DKK 580 per year per

Box 4.2 **Establishing national parks** *(cont.)*

household; that willingness to pay for more pathways and access in parks is slightly less than DKK 70 per year per household; and that willingness to pay for a "full development" scenario (i.e. additional effort for general nature protection and restoration, specific efforts to protect threatened species, and additional access options and pathways) ranges from DKK 1 430 to DKK 1 750 per year per household, depending on the site. The public's preferred locations for new national parks (based on responses to a survey that asked respondents to rank possible sites) are Lille Vildmose and Vadehavet; the least preferred locations are Læsø and Nordsjælland. This ranking of public preference is directly reflected in the public's willingness to pay for the different areas (e.g. willingness to pay for a national park in Lille Vildmose is DKK 309 higher than for one in Læsø).

A *draft Act on National Parks* based on the National Advisory Committee recommendations was published in September 2006 and subsequently presented to Parliament in January 2007. It is expected that by mid-2007, the Minister of Environment will have, as a start, chosen three areas to go through the legal procedures. The first Danish national park would then be established in 2008, at the earliest.

A large number of *watercourses* have been straightened, canalised or subjected to rigorous maintenance. Today, only about 2% of Denmark's remaining watercourses follow a naturally meandering course (Wilhjelm Committee, 2001), and of this 2%, much is the result of watercourse restoration projects (Box 4.3). *Water quality in lakes* is improving: the concentration of nitrogen nearly halved from 1990 to 2003 and the water has become clearer.[3] However, this has not been sufficient to improve the water quality significantly, mainly because of the large quantities of phosphorus in lake sediments and the high concentrations of pesticides in streams and lakes, which exceeded their limits in 2003 by about 10%. In 2003, targets for water quality were met only 34% of the time and achievements indicated no changes since the 1990s (Chapter 3). The government intends to change its policy focus from controlling the discharge of toxics to achieving specific ecological goals in the aquatic environment, which takes into consideration the ecological capacity of each stream or water catchment.

While 90% of *domestic and industrial waste waters* are cleaned effectively, non-point source discharges are not (Chapter 3). The *agricultural sector* continues to be by far the largest contributor of nutrients (e.g. nitrogen, phosphorus and BOD) to aquatic ecosystems (NERI, 2004). Reducing pesticide and nutrient loading is essential, but enhancing the use of natural non-point source pollution and nutrient

Box 4.3 **Restoration of the Lower Skjern River**

The Skjern, the *largest river in Denmark*, drains 2 490 km^2 of cultivated, sandy plains in western Jutland and discharges into the Ringkøbing Fjord lagoon and the North Sea coast. In 1987, the Danish Parliament decided to restore the lower reaches of the Skjern River and its valley. A project proposal and environmental assessment were published in 1997. The objectives were to restore the nutrient retention capacity of the lower 19 kilometres of the river and its river valley of about 22 km^2, to restore an internationally valuable wetland, to promote fishing and to increase the recreational and tourist values of the project area.

This section of the river was channelled and deepened in the 1960s and the river valley wetlands were reclaimed for agricultural cultivation, partly by pumping the drainage water into the channelled river. The *restoration project* included re-establishment of a meandering river, natural water levels, and water level fluctuation in the river and its valley. The purposes were to improve living conditions for the flora and fauna, assure a high level of water quality in the river and in the downstream lagoon, and improve possibilities for outdoor recreation. According to the cost-benefit analysis by the Wilhjelm Committee, this project gives net present value of DKK 225 million at a discount rate of 3%, while it falls to DKK 8 million but still positive at a 7% rate with an infinite time horizon.

Monitoring of the *interim results of the project* in 2003 found that: a 22 km^2 natural and semi-natural river valley ecosystem had been restored and a *coherent ecosystem* formed, including the largest Danish river and the shallow lakes and ponds, wetlands and meadows created in the restored river valley; the restored area had become a significant breeding area for *waterfowl*, an important resting area for migrating birds and, consequently, a popular area for bird watching; the restoration had improved the breeding and survival possibilities for *amphibians* because of the formation of a large number of shallow ponds and bogs surrounded by uncultivated meadows; the restoration had not led to negative impacts on *rare species* in the area, except for a minor increase in the mortality of migrating smolts of salmon and trout caused mainly by increasing predation by cormorants and herons; the number of *otter* counted in the restored area had increased; the retention of *nitrogen and phosphorus* was small (e.g. less than 10%) compared to the total transport of nutrients through the river into the coastal Ringkøbing Fjord (it was not possible to calculate the amount of nitrogen and phosphorus retained in the restored river valley).

During the coming years, the flora and fauna in the project area are expected to further develop towards a new ecological equilibrium corresponding to the new conditions. Management plans will have to be adapted to the changing ecosystem conditions. Since 2004, the environmental monitoring programme for the project area has been part of the national *NOVANA monitoring programme*.

recycling is also critical. This could be achieved by applying binding high quality environmental objectives with watershed or landscape level planning, incorporating specific ecological goals for each stream or water catchment.

Terrestrial ecosystems

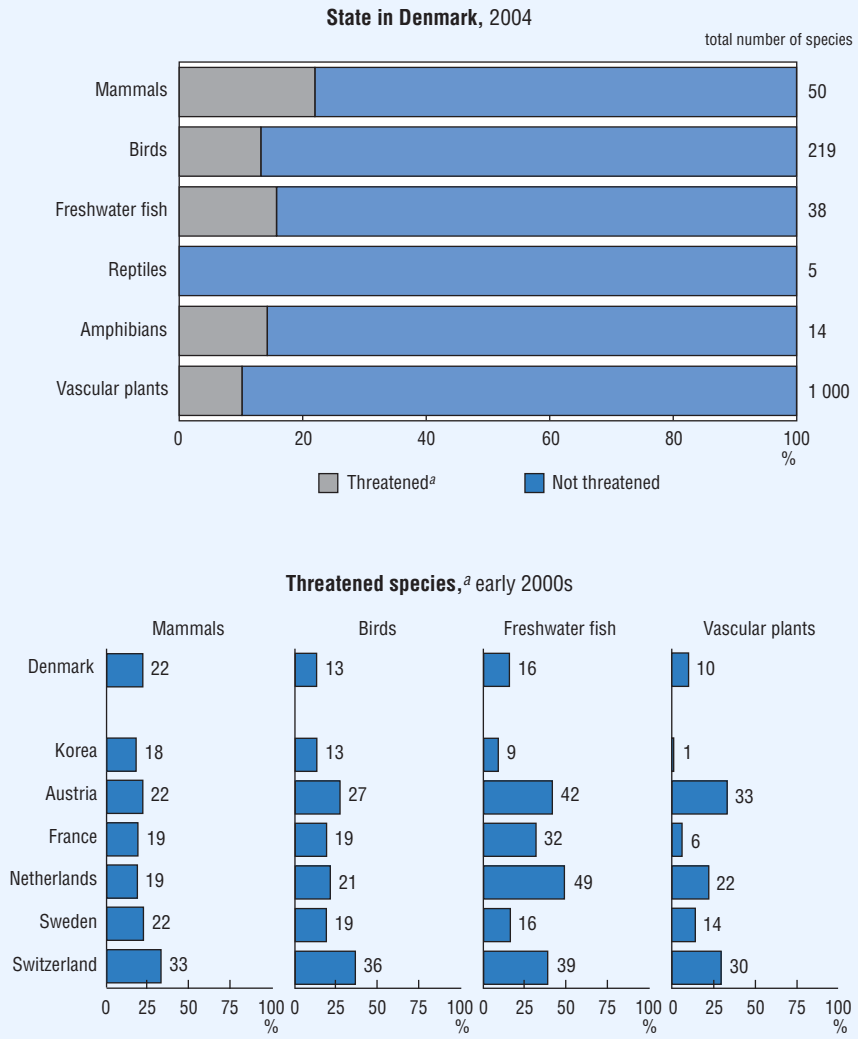
Denmark is a country of large arable lands and relatively few natural areas. Over the past 100-200 years, the landscape has been transformed by *intensive land use*, primarily attributable to the expansion of farmland, the intensification of agriculture and the development of built-up areas. This transformation has eliminated numerous habitats for fauna and flora, causing a loss of biodiversity. Many of the remaining natural and semi-natural areas are relatively small and are scattered in the landscape, making it difficult for species to disperse. Past land reclamation and drainage projects, together with groundwater pumping, have reduced *wetlands* and water flow in streams. This is unfortunate as wetlands constitute a very rich and productive habitat for biodiversity and can play a key function in cleaning up water from non-point source pollution. *Forest surface* areas are gradually increasing; the total forested area now covers 4 862 km^2, or 11% of the landmass. While the quality of the forests has improved over the last decade, more emphasis should be placed on creating natural forest ecosystems. Denmark has adopted a new regulation to prevent construction in a widened *coastal and dune protection zone* (from 100 to 300 metres) to reduce pressures on these habitats. The total area under protection has increased from 80 000 to 160 000 hectares. This new rule should be expanded to other areas of the country to ensure the protection of sensitive and valuable habitats.

2.3 Fauna and flora protection

Denmark has yet to follow the OECD recommendation to develop a *national biodiversity conservation strategy* with time-bound objectives, including the integration of biodiversity considerations in agriculture, fisheries and other sectoral policies. This recommendation should be the underpinning of its conservation policies. Although Denmark like other EU countries has agreed to stop the decline in biodiversity by 2010, this goal has not been fleshed out or interpreted at the national level (NERI, 2005a). A *technical criterion* has been developed for favourable conservation status for the various habitat types and species covered by the EU habitats and birds protection directives.

A preliminary assessment for the *NOVANA system* of 13 habitats and 79 species found that 3 habitats and 22 species were in unfavourable condition and 13 species had disappeared. Some 22% of Denmark's mammals, 13% of birds, 16% of freshwater fish, 14% of amphibians and 10% of vascular plants are threatened

Figure 4.2 **Fauna and flora**



a) IUCN categories "critically endangered", "endangered" and "vulnerable" in % of known species.
Source: OECD Environment Directorate.

according to the IUCN categories (Figure 4.2). Around 30% of marine fish species are currently red-listed (e.g. excessive fishing), and initiatives have been taken to reduce fishing capacity (Chapter 7). As most of Denmark's land is privately owned, it is difficult to protect endangered species with *habitat prescriptions*. These measures, to be effective, would require funding for financial compensation of landowners to give priority to the conservation of an endangered species.

All *indigenous species* are protected under the Nature Conservation Act. Wildlife reserves (Hunting and Wildlife Management Act) and nature reserves (Nature Conservation Act) are areas protected for breeding, resting and foraging wildlife, especially birds. Currently, Denmark has more than 100 such reserves, covering more than 330 000 ha. Most of these areas are marine (i.e more than 90%, about 294 000 ha). The rest are found in fresh water (30 000 ha) or on land (7 000 ha). Since 2003, 4 355 species have been assessed (the species belong to eight major groups such as birds, reptiles, amphibians, invertebrates, vascular plants (orchids only) and fungi. Hunting and game management are regulated through the Hunting and Wildlife Management Act. Indigenous species cannot be hunted unless state game authorities give special permission for species and conditions. Currently, 45 species can be hunted. Illegal hunting is not considered to be a problem in Denmark. The government subsidises game release if various criteria are met. In 2005, DKK 3.7 million was allocated for game release.

A rising number of *invasive species* appears in Denmark every year. Most arrive by way of imports related to forestry, agriculture and aquaculture and also as stowaways in the ballast water of boats or in the soil of plants. Some of the species are relatively innocuous but others, like the hogweed, can cause environmental damage and necessitate costly control/restoration measures. Recently, new species of insects have appeared due to the rising temperatures associated with climate change. A Strategy for Invasive Species is foreseen for 2007.

3. Policy Measures for Nature and Biodiversity

3.1 Legal and institutional framework

The following laws create the legal framework for nature and biodiversity conservation in Denmark. The *Nature Conservation Act* (modified in 1997 and 2004) provides Denmark's main legislative framework for nature conservation. It comprises four pillars: general protection for habitats; coastal zone protection; land acquisition; and specific regulatory powers for the protection of nature. Natura 2000 and Ramsar sites are established under this act. It protects: natural lakes of more than 100 m^2, watercourses or parts of watercourses that have been designated as protected areas,

heaths, bogs, marshes, moors, salt marshes, swamps, coastal meadows, humid permanent grassland and uncultivated dry grassland of more than 2 500 m^2. The *Forest Act* allows for the protection of natural forest areas in both state forests and privately owned forests. The *Planning Act* offers protection of the open land and coasts. It is realised through national plans, regional plans, and plans for separate municipalities and specific local areas within municipalities. These plans may contain provisions for green corridors and afforestation areas. The *Hunting and Wildlife Management Act* regulates the hunting of game species and permits the designation of protected areas for wildlife and birds. The *Marine Environment Protection Act* allows the Ministry of Defence to take action in case of an oil spill that could adversely impact the marine environment, including Natura 2000 and marine reserves. The *Fisheries Act* aims to protect marine resources and areas by setting aside spawning sites in marine species habitats. Under this act, quotas to limit the fishing of fish or shellfish species may be established. The *Act on Environmental Objectives* sets out the framework for protecting water bodies from deterioration, and for the planning and future management of international nature protection areas.

Several *other laws* have an important but indirect impact on nature and biodiversity conservation. These include the Acts on: Environmental Assessment of Plans and Programmes; Operations; Fertilisation; Watercourses; Environment Protection; Rural Development Support; Environment and Genetic Engineering.

The *Ministry of the Environment* co-ordinates the implementation of the Action Plan for Biodiversity and Nature Conservation (2004-09) and is responsible for ensuring compliance with the National Strategy on Biological Diversity. As such, it is responsible for the conservation and restoration of endangered species, including the genetic variation within wild species. The ministry is in charge of the conservation of EU habitat and bird protection areas as well as the development of economic instruments and environmental indicators to support conservation. Through the Forest and Nature Agency and the state forest districts, the ministry manages important habitats. It is also responsible for international negotiations on nature conservation. The Ministry of the Environment is also responsible for administrating the subsidies to the forest sector, including those that promote biodiversity in forests. These subsidies include private afforestation, reforestation, close to nature management and green forest planning.

The *Ministry of Food, Agriculture and Fisheries* is responsible for assuring the sustainable management of marine and freshwater fisheries. Also, via the National Land Fund, the ministry manages certain kinds of nature restoration and afforestation projects and areas with special natural assets. It is responsible for the conservation and sustainable use of farm plant and animal genetic resources.

3.2 Spatial planning

The *Planning Act* (1992) applies to all of Denmark's land and coastal areas but not its marine area.[4] Since 1971, public administration has been based on a division of responsibility between the national, regional and municipal levels. At the *national* level, the Minister of Environment presents after every parliamentary election a national spatial planning report with policy guidelines for national territorial development. This report aims to ensure that the planning synthesises societal interests with respect to land use and contributes to protecting the country's nature and environment. *County* plans, revised every four years, govern the rural zone, landscape, environmental themes, distribution of new area for urban development and subordinate infrastructure. *Municipal* planning governs comprehensive municipal planning, detailed local planning and permits for construction and changes in land use in rural zones. A *major territorial reform* took effect on 1st January 2007 abolishing counties and reducing the number of municipalities (Box 4.4).

Denmark is divided into *urban zones*, *summer cottage areas* and *rural zones*. Special rules apply to development in rural zones where agriculture is the priority economic activity. Whereas new independent dwellings, urban businesses and institutions require a rural zone permit, new agricultural buildings can be built without a permit. This protects recreational and valuable landscapes, and ensures that agriculture retains good production opportunities. However, considering that agriculture is the most important contributor to aquatic contamination, it would be opportune to revisit this rule. It is commonly known that farm buildings can have a significant impact on the environment, especially on surface and groundwater contamination, depending on their nature and location.

Special rules for planning are in place for *coastal zones*. The Danish coasts (including what are now summer cottage areas) have been *remarkably protected* by a 100-metre protection zone since the 1930s. This zone is enlarged to 300 metres in open coastal areas. In urban areas, the protection zone, from 0 to 300 metres, has to be designated by a special Coastal Protection Committee. A special three-kilometre coastal area planning zone is determined in the Planning Act. The planning zone requires justification by special planning or functional reasons prior to locating buildings and construction works in coastal areas. The aim is to keep them as free as possible of development and installations that do not need to be located near the coast.

Although one of the *five goals of the new planning systems* stipulates that spatial planning should be based on respect for nature and the environment, the planning approach does not incorporate the principles of integrated landscape or watershed planning, which are based on the need to preserve and enhance ecosystem functions. Municipal councils are asked to include both the local perspective and the perspective

Box 4.4 **Territorial reform and land-use planning**

Up until 1st January 2007, the planning system was based on a top-down management framework in which plans could not contradict the planning decisions made at higher levels. The municipal councils were responsible for comprehensive municipal planning, detailed local planning and permits for construction and changes in land use in rural zones. The state could veto the planning of regional and municipal authorities to uphold national interests. Legal issues with respect to planning decisions could be appealed to the Nature Protection Board of Appeal. All draft plans and programmes were subject to public consultations.

Since 1st January 2007, a *structural territorial reform* has been put in place. Counties have been abolished and replaced by five regions without planning responsibilities. In addition, 271 municipalities have been combined to make 98 that have full planning responsibilities. The regional plan, which contained regional planning guidelines with regard to environmental matters such as nature protection, landscape values and water quality, will be abolished and such environmentally-related planning guidelines will become part of the *new municipal plans*. The future municipal plans will contain objectives, restrictions and administrative guidelines for management and development in both urban and rural areas. The future municipal plans will be the key document for citizens and businesses with respect to land-use regulation. The future municipal plans will include administrative guidelines linked to land use for forestry, agriculture, infrastructure, tourism, nature protection, and historical and cultural heritage. Denmark's nature and environmental protection laws have not been changed, but municipalities will take over the responsibility for administration and implementation.

Counties used to play a central role in planning and administering the use and protection of water resources, including the responsibility for drawing up *river basin management plans* (water district plans). Following the territorial reform and pursuant to the Act on Environmental Objectives, since January 2007 the number of water districts has been reduced from 13 (almost matching the former county borders) to 4. The water district plans have become a national responsibility, but municipalities are now required to draw up municipal action plans that specify local priorities and initiatives for water management, which goes beyond the requirements of the EU Water Framework Directive. Similarly, the drawing up of *Natura 2000 plans* was transferred from counties to the state, and new municipal action plans have been introduced to enhance local initiatives for the protection and management of Natura 2000 sites.

The Ministry of the Environment is setting up *seven new decentralised national environmental centres* (Miljøcentres), which will be the supervising and consultative authorities regarding legislation for nature and environmental protection. This is a challenging and significant transition that will demand the appropriate transfer of expertise and resources to the newly created bodies to allow them to adequately carry out their enhanced responsibilities. Operations like this are both time and energy consuming. It is thus recommended that the Ministry of the Environment provide *support and guidance* to the newly formed municipalities to ensure that the EU Directive, the national conservation objectives, and the ecosystem-level objectives are implemented according to schedule and that the progress to achieve them is monitored.

across municipal boundaries in their planning for nature and the environment, and this might fall short of a plan based on an ecosystem approach. The incorporation of the Water Resource Plan, Natura 2000 and the Regional Raw Material Supply Plans to be completed in 2009 also shows a lack of integrating ecosystem functions and ecological objectives.

Concerning *landscape preservation*, outdoor advertising in the countryside is generally prohibited with some exceptions, provided signs do not dominate the landscape and are not visible over a long distance. Public structures in the countryside must be located and designed with the greatest possible consideration of scenic value and environmental interests. The location and design of major roads and electric wires must be approved by the Ministry of the Environment. In a country almost completely surrounded by water and comprising more than 400 islands, it is surprising that the Planning Act and the planning framework do *not include the marine seascape*. Numerous activities occur in the marine environment, and these need to be integrated into a seascape planning system that carefully analyses and integrates their interactions in order to preserve the marine ecosystem's biodiversity and its capacity to produce essential ecological services. Denmark's landscape has been significantly changed by the establishment of some 5 500 wind turbines.

The use of *an ecosystem-based planning approach* would facilitate thinking in terms of landscape or seascape processes and dynamics as opposed to static zones. This is highly important in the event of changes to the land and seascape resulting from climate change, particularly rising sea levels that could affect a large portion of the Danish coastline (NERI 2006). Pro-active anticipatory modelling techniques should be used to anticipate the potential combined effects of rising sea levels, frequent storms and a warmer climate with more precipitation.

3.3 Agriculture, forestry and aquaculture policies

Agriculture

About 66% of total area of Denmark (i.e 28 900 km^2) is used for agriculture. The agricultural sector produced 1.5% of GDP in 2005, but has been on a steady decline since 1990 when it represented 4.5% of GDP.[5] The sector continues to have a *strong impact* on nature and the environment. The adoption of *intensive farming* increased the average size of holdings from 16 ha in 1965 to about 48 ha in 2000, while the number of holdings decreased from about 200 000 to 55 000 during the same period.[6] It also increased the number of livestock. This intensification can result in pollution becoming more concentrated in certain areas but it can also favour a more efficient use of nutrients and pesticides, if appropriate pollution prevention measures are

adopted. The type of crops produced may also change due to the European demand for biofuels and to the increasing demand for organic products, which currently represent around 5% of Danish food consumption. Intensive farming practices result in reduced variation in landscape and reduced wildlife in and around the fields.

Several Danish policies aim to reduce the environmental impact of agriculture by promoting organic farming, re-establishment of wetlands, environmentally sound farming practices, the controlled use of genetically modified organisms, and the reduced use of pesticides and nutrients (Box 4.5, Chapter 3). For instance, farmers are encouraged to take *wetlands* out of agricultural production and re-establish them. Farmers are compensated for the loss of the farmland value or offered a corresponding area of farmland elsewhere. However, Denmark's goal of establishing 8 000 to 12 000 ha of wetlands on private lands by 2003 was almost entirely missed, which prompted the authorities to choose a less ambitious goal. This new goal of converting 6 500 ha of agricultural land to wetland between 2004-06 was supported by a DKK 142-million fund (co-financed by the EU), but was still not reached because of the high economic value of agricultural land compared to wetlands.

Forestry

To reach the *forest policy objective* of doubling the country's forest area in 80-100 years, the amount of forested land would have to increase by 5 000 ha a year. Denmark is currently reaching only half of this goal. Meanwhile, for the past two years the interest in afforestation and applications for subsidies have been rising (Figure 4.3). The priority areas for afforestation are those where groundwater needs to be protected as a source of drinking water. For the Action Plan for the Aquatic Environment III, the afforestation goal of 22 800 ha should be actively supported by an adequate budget. The challenges are to reduce the costs of afforestation and to mobilise alternative sources of financing, such as carbon sequestration, groundwater protection measures and co-financing to augment the ecological services derived from forests.

In general, forest management has started to shift towards *sustainable forest management*, which is a challenge considering that many forests are very homogeneous and look like plantations. An important objective of the National Forest Programme (2002) is to promote a conversion to "close to nature forestry". An action plan for the introduction of close to nature forestry in the state forests (2005) identifies the use of native or other well-adapted tree species, the retention of permanent forest cover by avoiding large clear-cuttings, use of natural regeneration, development of diverse forest structures, and single tree management as the key principles for the close to nature policy. The exploitation of all state forests (25% of Danish forests) is now environmentally certified, which confirms the trend towards emphasising non-timber and environmental values. The relatively extensive

Box 4.5 **Nature protection and agriculture**

Several policies aim to *reduce the environmental impact of agriculture* by re-establishing wetlands, promoting organic farming and environmentally sound farming practices, controlling the use of genetically-modified organisms, and reducing pesticide and nutrient application (Chapter 3).

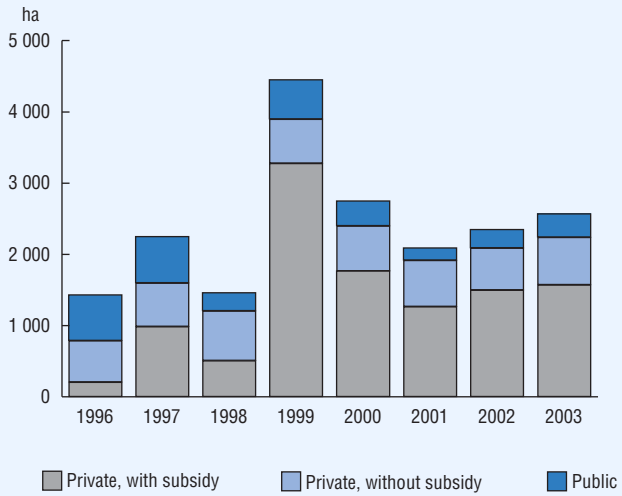
For *wetlands*, a voluntary scheme encourages farmers to take reclaimed wetlands out of agricultural production and re-establish them as wetlands. Participants are either compensated for the loss of the farmland value or offered a corresponding area of farmland. The counties were responsible for implementing this programme, and the central administration was responsible for co-ordination and financing.

The *1999 Action Plan for Organic Farming* is implemented as part of Denmark's Action Plan for the Aquatic Environment. The plan offers farmers who convert to organic production an annual maintenance payment, education and training, financial support for innovation, and information and promotional activities. Yet after several years of growth, organic farming in Denmark has experienced a recession in both the area and the number of converted farms. Now at 150 000 hectares, the organic area is just half of what was expected in the Action Plan. The sector is in a difficult situation with overproduction of organic milk and low income on small arable farms. Several technological, regulatory and economic issues would have to be tackled to move closer to the 1999 objective.

A 1998 support programme encourages *environmentally sound farming practices* in environmentally sensitive agricultural areas. The programme is co-financed by the EU through the Danish rural development programme. All environmentally sensitive areas (one million ha or about 25% of Denmark) are eligible. A payment per hectare is given to farmers who apply specified agricultural practices such as: reducing nitrogen fertiliser application to 60%; cultivation without the use of plant protection products; establishment of pesticide-free border zones; establishment of 55 000 ha buffer zones along rivers and lakes; and establishment of catch crops. The cost to the government is DKK 130 million per year, and a budget of DKK 375 million is planned for the 2005-09 period.

The *Pesticides Action Plan 2004-09* (PAP III) aims to reduce the frequency of field treatments to 1.7 times per year, to promote the re-adjustment of agriculture to non-pesticide cultivation, and to facilitate the establishment of 25 000 ha of pesticide-free marginal areas along streams and lakes before the end of 2009. Application frequency has decreased by 13% since 1981-85 (the reference period); in 2005, the frequency was 2.32 times per year (Chapter 3). The third Action Plan for the Aquatic Environment (*VMP III*) also has a positive effect on nature (e.g. setting goals for establishment of wetlands, non-cultivated strips along water courses).

Figure 4.3 **Afforestation,** 1996-2003



Source: Danish Forest and Nature Agency.

management regime of forests favours many of the endangered plants and animals that live in, or have connections with, forests. The limited use of fertilisers and pesticides in forests is also favourable to groundwater reserves essential to Danish drinking water.

Aquaculture

Aquaculture can also stress ecosystems (Box 3.1). The demand for more effective technologies to reduce pollutants in effluents and more effective use of extracted water has led to a shift from many small farms to fewer but larger operations. Fish farms are required to obtain *water extraction permission and an environmental approval*.[7] Fish farm owners must send the government information about the type and amount of feed and drugs used and the results of the freshwater fish farm's self regulation. Denmark must also perform an environmental assessment of the fish farms in accordance with the EU Habitats and Birds Directives and the Ramsar Convention.

A large number of *complaints* are registered against fish farms because of concern about their impacts on the local water environment due to the presence of nutrients from

leftover food and antibiotics. Nonetheless, waste feed and discharges of phosphorus and nitrogen were halved for fish production between 1989 and 2006 (NERI, 2004).

3.4 Financing and expenditure

Financing for nature and biodiversity protection in Denmark consists of both direct and in-kind funding. The main sources of direct funding are public funding (state, counties until end of 2006), municipalities, EU and private funding. The Nature Conservation Act provides funds for acquisition of property to implement major nature restoration projects and state afforestation projects. The act also provides loans or subsidies to municipalities (and provided them to counties until the end of 2006), as well as to organisations and private landowners who wish to tend and restore natural areas and improve the opportunities for recreational activities. In-kind or voluntary funding is generally through management or monitoring activities by the public.

Total government *expenditure on nature conservation* including county and municipality expenditures was DKK 2 528 million in 2005, up from DKK 2 118 million in 2000 (Table 4.3). While overall public funding has increased for nature protection, contributions from the national government dropped from DKK 1 012 million in 2000 to DKK 968 million in 2005. In the last ten years, public funds were distributed roughly into 40% for nature conservation, 40% for afforestation and 20% for recreational activities (Enemark, 2002). The number of personnel involved in nature conservation and protection was reduced by 20% (from 1 271 in 2002 to 1 024 in 2006).

Table 4.3 **Public expenditure[a] for nature protection**

(DKK million)

	2000	2003	2005
Total national government expenditure	1 012	912	968
County expenditure	809	975	1 101
Expenditure by municipalities	297	353	458
Total	2 118	2 240	2 528

a) Management of state-owned areas included.
Source: MoE, National Forest and Nature Agency.

Since the OECD Environmental Performance Review in 1999, Denmark has benefited from *EU funding* for many projects associated with nature and biodiversity. The EU Common Agricultural Policy (CAP) programmes exert a very strong influence on nature by promoting multifunctional agriculture. Additionally, the EU LIFE programme has contributed significant funds for conservation projects. In view of the importance of forests for the production of ecological services like the regeneration of groundwater, government funding of DKK 6.5 million is made available annually for private landowners for consultation purposes and developing plantations. The low rate of reforestation leads one to believe that the incentive programmes could not compete with the return on investments from competing sectors, such as agriculture or industrial livestock production.

No data are available on *private funding* for nature conservation or protection in Denmark. However, two organisations are major actors in nature protection through land purchase and management: the Danish Bird Protection Foundation (with more than 850 ha in 17 bird sanctuaries) and the Aage V Jensen's Foundation (several properties in the country). Several other large private foundations exist and contribute to Danish nature conservation and research.

3.5 International co-operation

By 2006, Denmark had ratified almost all *international conventions* concerning nature and biodiversity, including the Convention on Biological Diversity (1993) with all three elements (i.e. genes, species, ecosystems) and the protocols on genetically modified organisms (GMOs) and access and benefit sharing.

Denmark has worked toward the objective of *halting the loss of biodiversity by 2010* in accordance with the targets set at the Gothenburg EU Summit in 2001 and the World Summit on Sustainable Development in Johannesburg in 2002. Denmark is a signatory of the Ramsar (wetlands), the Washington (CITES) and the Bonn (migratory wild species) Conventions, which are implemented through various government programmes.

Denmark is also a party to all the *regional agreements* that are important to it, including: the Wadden Sea Seal Agreement, the African-Eurasian Waterbirds Agreement (AEWA), the Agreement on Conservation of European Bats (EUROBATS), and the Agreement on the Conservation of Small Cetaceans of the Baltic and North Sea (ASCOBANS) (Chapter 7). Denmark has also signed the UNECE forest initiatives as well as the regional conventions (e.g. Oslo, Helsinki, and the Bern and Landscape Conventions of the Council of Europe).

Lately, Denmark ratified the *Convention on the Law of the Sea* and the Agreement related to implementation of its part XI (2004). Denmark has not ratified the *International Convention for the Control and Management of Ships' Ballast Water and Sediments*. Ratification and adoption of a vigorous plan of action are both required to address the adverse effects of alien invasive species on local biodiversity.

Denmark's *international development assistance* supports projects that encourage the conservation of nature and biodiversity and are consistent with the Convention on Biological Diversity objectives of substantially reducing the loss of biodiversity by 2010. It has identified five priority issues to advance biodiversity and nature conservation: sustainable forest management and combating illegal logging; mutually supportive efforts to combat climate change and preserve biodiversity; integration of biodiversity considerations in climate change mitigation and adaptation; establishment of a global network of protected areas on land and at sea; combating and preventing the introduction of invasive alien species; development of an international regime on access to genetic resources and benefit sharing.

Notes

1. The Danish government appointed the Wilhjelm Committee in 2000. The committee was composed of 35 members representing farmer, fisher and forest associations; non-governmental organisations; research institutions; ministries; and local government associations.
2. In addition, the *National Forest Programme* (2002) aims at increasing forested land use to 25% of the total land by 2040 through afforestation, including by implementing Natura 2000 recommendations related to forested landscape; the *Aquatic Action Plans I, II (1987-98) and III (2004)* include responsibilities for implementing the EU Nitrates Directive that aims to reduce the nitrogen discharge from agriculture; the *National Pesticide Plan* (2004-09) aims to reduce the frequency of pesticide treatment to 1.7 times per year, to obtain 25 000 ha of pesticide-free buffer zones along streams and lakes by 2009, and to ensure that the discharge of pesticides into streams is within accepted limits; the *National Spatial Plan* (2007) integrates social and environmental aspects, including nature, in a new spatial context; the *EU's Sixth Environmental Action Plan* (2001) aims to halt the decline of biodiversity by 2010.
3. By 2004, emissions of ammonia, nitrogen and phosphorus from agriculture had fallen by 30% (since 1985), 43% (since 1989) and 81% (since 1989) respectively. Pesticide use has also decreased by 58% since the early 1980s. These reductions have resulted in lowering the concentrations of nitrogen by 30% and phosphorus by 28% in water streams since 1989.
4. Denmark's marine area covers 105 000 km^2 and is more than twice the land area of 44 000 km^2.
5. Employment in agriculture shows a similar trend: civilian employment in the primary sector declined from 4.4% in 1995 to 3.1% in 2005 (OECD, 2006).
6. The crop yield now comes from a slightly smaller land base and it is estimated that this trend will continue until 2015, causing a further agricultural surface reduction of 6.5% and the disappearance of 22 000 farming units (approximately half of the total) (NERI, 2005b).
7. The number of registered freshwater fish farms was reduced from 422 to 326 while the number of environmentally approved freshwater fish farms increased from 105 to 140 (43%) between 1998-2005.

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The government documents, OECD documents and other documents used as sources for this chapter included the following. Also see list of websites at the end of this report.

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5

ENVIRONMENTAL-ECONOMIC INTERFACE*

Features

- Sustainable development
- Policy integration (energy, transport, agriculture)
- Environmentally-related taxes and subsidies
- Implementation and territorial government reform
- Economic instruments
- Management of chemicals

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1999. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy. It takes into account the latest Economic Surveys of Denmark.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Denmark:

- continue to rely on and, where relevant, expand the use of *environmental taxes* to *internalise externalities*; adjust tax rates for inflation;
- continue to examine the existing support schemes from the point of view of their *environmental effectiveness and economic efficiency*;
- develop a *sustainable transport plan*, as a follow-up to the forthcoming national sustainable development strategy;
- review existing *transport taxes* with a view to restructuring them in a more environmentally friendly way (e.g. taxing both car use and ownership; removing the tax break for commuting); consider the introduction of *road pricing* as a means to halt congestion;
- step up efforts to promote *more sustainable consumption patterns* (e.g. concerning waste, transportation, land use) by adopting appropriate regulatory and economic instruments, and by focusing on demand management;
- further develop the *environmental strategic and planning framework* with specific environmental quality objectives as well as targets and deadlines, in the context of the sustainable development strategy; pursue efforts to use cost-benefit and cost-effectiveness analyses in policy setting and implementation;
- set up capacity building mechanisms to *help municipalities carry out new environmental management tasks* resulting from the territorial government reform; foster exchange of expertise among municipalities;
- adjust the *rates of green taxes* to internalise externalities; reduce tax concessions and the associated administrative cost of their implementation;
- adopt a *national action plan for promoting environmental technology* based on appropriate economic analysis, and implement it;
- prioritise *monitoring* of national environmental action plans.

Conclusions

Integration of environmental concerns into economic decisions

Denmark gives importance to *sustainable development* nationally and internationally. In 2002 it adopted a national sustainable development strategy which is to be presented to Parliament every four years and followed up through sectoral

plans and a set of indicators published in principle every year. Implementation also takes place at the local level through Local Agenda 21. Over the review period, Denmark successfully *decoupled* environmental pressures from economic growth in several areas, including SO_x emissions, NO_x emissions, water abstraction, nitrogen fertiliser use and pesticide use. Energy intensity also decreased during the review period. *Institutional integration* of environmental concerns into sectoral policies progressed *in agriculture* (e.g. agri-environmental measures, increase in organic production) and *energy policies* (e.g. emphasis on climate change, energy efficiency, renewable energy). Three quarters of government bills underwent *strategic environmental assessment*. At project level, regulations on environmental impact assessment were updated to include an EIA-permit and extended public information. *Market-based integration* relies on a wide range of economic instruments (i.e. charges, taxes, other instruments), although significant subsidies remain (in agriculture, fisheries, tax concessions to industry).

However, Denmark is faced with numerous environmental challenges resulting from unsustainable consumption patterns (e.g. in waste generation, transport, land use). The generation of household waste is growing nearly twice as fast as the economy, and has reached one of the highest generation rates in the OECD. Greenhouse gas emissions have not been decoupled from private car use. High mobility associated with longer commuting distances generates pressure on peri-urban areas otherwise needed for agricultural or recreational purposes. With the adoption of the national sustainable development strategy, Denmark no longer has a white paper on environment, and environmental efforts are scattered throughout a large number of programmes, policies and ministries. The *environmental strategic and planning framework* and associated objectives should be linked to the sustainable development strategy. *Little progress* has been made in integrating environmental concerns into *transport policy* at the strategic level. Although the transport sector accounts for a third of final energy consumption in Denmark and is showing the fastest energy growth, it is explicitly excluded from the (June 2005) political agreement on greater energy efficiency. Transport policy mainly aims at increasing or upgrading road infrastructure supply; insufficient effort is made to modernise and increase the efficiency of the Danish railway. Little consideration is given to transport demand management.

Strengthening the implementation of environmental policies

Environmental regulations continue to play a major role in Danish environmental policies. Land-use regulations, particularly those applicable to rural and coastal areas, are rigorous, and spatial planning contributes effectively to protection of the

environment, nature, landscapes and coastal areas. Stringent waste incineration regulation has been a driving force for the development of cogeneration and district heating. The concept of producer responsibility was embodied in Danish waste legislation (further to EU directives on end-of-life vehicles and on waste electrical and electronic equipment). More generally, Denmark performs very well in transposing and implementing *EU environmental legislation*. Policy making continues to be *open and consultative*. Denmark uses *economic instruments* (environmental charges, environmental taxes, other economic instruments) extensively. The *full cost-recovery principle* has been tacitly applied in water management for some time and was included in the 2001 Environmental Protection Law. *Green taxes* apply to air, water and waste management policies. The tax on sulphur emissions (1996) contributed to drastic decreases in SO_2 emissions. The waste water tax (1997) led to a significant reduction of nitrogen, phosphorus and organic matter in waste water. Since the 1999 review, Denmark has introduced several new environmental taxes (e.g. CO_2 tax on gasoline, tax on ozone-depleting greenhouse gases, taxes on PVC and phthalates, tax on mineral phosphorous added to feed). Increasing emphasis is placed on the use of *cost-effectiveness analysis* in ex ante evaluations of environmental actions to optimise the mix of instruments applied. Overall, public environmental expenditures are covered by environmental charges or taxes, and the *polluter pays principle applies to households and, to a lesser extent, industry*.

Despite these excellent environmental policies and many positive trends, Denmark's environmental performance is not always high by OECD standards except for a few indicators (i.e. SO_x emission intensity, public waste water treatment, energy intensity). The actual results are in the middle range for some indicators (e.g. pesticide use, NO_x emission intensity), and below OECD standards for others (municipal waste per capita, nitrogenous fertiliser use). Some health indicators are also of concern. This suggests that Denmark's environmental policies have not always been strong enough to counter the pressures exerted on the environment from transport, agriculture, fisheries and other economic activities, as well as from consumption patterns. The *effectiveness of economic instruments* has been hindered by a series of factors. First, tax concessions should be eliminated (e.g. the very low energy tax paid by industry on electricity consumption, the industry exemption from the water supply tax). Second, their incentive effect should be increased: for example, since 2001, most tax rates have not been adjusted for inflation. Third, their scope could be further extended, although this has become difficult following the *tax freeze* introduced in 2001. Further, there is uncertainty about the extent to which the full cost-recovery principle (enshrined in the 2001 Environmental Protection Act) is applied to municipal waste collection. It is not clear whether the territorial government reform will allow improvement in enforcement of environmental

legislation. The *number of environmental inspections* has decreased drastically to focus on IPPC facilities. Finally, Denmark's sustainable development strategy has not always been used as a platform to develop environmental strategies, though individual environmental action plans do exist (e.g. National Action Plan for the Aquatic Environment, National Action Plan on Chemicals).

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1. Sustainable Development

1.1 Decoupling environmental pressures from economic growth

During the period 1998-2005, Denmark's GDP[1] increased by 13%, while the population increased by 2% (Box 5.1). Industrial production increased by 11%, road freight traffic by 9%. Agricultural production did not grow and total primary energy supply decreased by 5% (Table 5.1).

Pollution intensities

Over the review period, *reduction of air emissions from major point sources* was the most successful aspect of Denmark's decoupling effort: SO_x, NO_x and CO_2 emissions decreased respectively by 71%, 22% and 17%.

Denmark's *SO_x emissions per unit of GDP* are among *the lowest in the OECD*. NO_x emissions per unit of GDP are close to the OECD-Europe average, three times those of Switzerland and twice those of Japan. CO_2 emissions per unit of GDP are also close to the OECD-Europe average and some 50% higher than in France, Sweden or Switzerland (Figure 2.2).

Energy intensity and energy efficiencies

Denmark's *energy intensity*, i.e. total primary energy supply over GDP, decreased by 21% between 1990 and 2005 to reach 0.12 tonne of oil equivalent (toe) per USD 1 000 of GDP. This was the *third-lowest intensity level in the OECD* (behind Ireland and Italy). These impressive results are partly due to the absence of a large energy-intensive industrial base, but also to the efforts to reduce the country's energy use through implementation of stringent building and appliances codes, an extensive combined heat and power network, high taxes on energy and negotiated agreements with industry.

Box 5.1 **Economic context**

Denmark is a wealthy country. Its gross domestic product reached USD 186 billion in 2005 (at current purchasing power parities). This is equivalent to 34 400 USD/capita, a relatively high figure in the OECD. Income inequality is low by OECD standards (Reference I.C).

The Danish economy experienced several years of sluggish growth before it started steadily expanding in mid-1993. GDP grew 3.7% in 1997. Following a dip in economic activity in 2003 when GDP growth was 0.6%, the Danish economy recovered slightly to 2.1% annual growth in 2004 and 3.1% in 2005. The economy is *expanding*, driven mainly by private consumption stemming from 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 remained below 2.0% during 2005.

Industry accounts for 27% of GDP, with manufacturing accounting for 60% of it. Denmark has few large industrial companies; most are medium or small-sized enterprises. The chemical industry and the electronics industry have grown significantly. *Agriculture* contributed 3% to GDP in 2005. The number of farms fell from 92 000 in 1985 to 47 400 in 2006 due mainly to intensification, specialisation and concentration. The last decade saw a shift from cattle to pigs in livestock farming. In 2004, the Danish pig stock totalled about 13 million, a 24% increase from 1990. The size of the *fish catch* has been significantly decreasing, falling from 1.9 million tonnes in 1995 to 840 000 tonnes in 2005; but the value of the catch has fallen much less (from DKK 2.9 billion to 2.8 billion during the same period). Most of Denmark's fish catch is taken from the North Sea. EU countries are the most important market for Danish fishery products, accounting for 79% of the total export in 2001.

The Danish economy is market-oriented and features high-tech agriculture, comprehensive government welfare measures, comfortable living standards, a stable currency and dependence on foreign trade. Denmark is a net exporter of food and energy and enjoys a comfortable balance of payments surplus. In addition to fish, petroleum and natural gas resources, the country has salt, limestone, chalk and gravel.

Denmark has an open *economy*. Its main trading partners are Germany (about 21% of imports and exports), Sweden (about 13% of imports and exports), the United Kingdom (8% of imports and exports), Norway (5%) and the United States (5%). Manufactured products represent 73.5% of exports. Most of its agricultural production is exported; the agricultural sector account for 9% of exports. Electricity trading, which is very significant, fluctuates between high net imports in some years and high net exports in others.

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% of the population, which is ageing significantly, is over 65. Expenditure on education as a proportion of GDP is high (7.0% in 2003).

Box 5.1 **Economic context** *(cont.)*

The total labour force increased by 2.8% over the last ten years, with 73% concentrated in the service sector in 2004 and 24% in industry. *Unemployment* fell from a high of 12.1% in 1993 to 4.8% in 2005; the youth unemployment rate, 7.9%, is the third lowest in the OECD.

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. Denmark recorded a budget surplus of almost 4% of GDP in 2005. *General government debt* was reduced to just 10% of GDP by the end of 2005, down from about 30% of GDP a decade ago.

Resource intensities

Water withdrawals dropped by 10% during the review period and intensity of water use (i.e. withdrawal as a percentage of gross annual availability) remains far below the OECD-Europe average (4.1% compared to 13.9%). In particular, household water consumption has fallen despite an increase in household consumption overall. A significant increase in the price of water and an increased consumer environmental awareness explain this achievement.

Use of *nitrogen fertilisers and pesticides* decreased during 1998-2005 (by 27% and 10%, respectively). Denmark's consumption of nitrogenous fertilisers has reached 7.8 tonnes/km^2 of agricultural land, compared to the OECD-Europe average of 5.5. The consumption of pesticides, however, is lower than the OECD-Europe average (0.11 tonne/km^2 of agricultural land versus 0.18).

Generation of *municipal waste* grew twice as fast as GDP over the review period (27% versus 13%). The generation of waste per capita (740 kg) is higher than in neighbouring countries. This is explained partly by Denmark's relatively high income per inhabitant.

The latest *material flow* analysis, performed in 1997, showed that 185 million tonnes of materials are directly utilised by the Danish economy (35 tonnes per inhabitant). Denmark has one of the world's highest levels of resource consumption, almost double the EU average (NERI, 2005a).

Assessment

Denmark has achieved *successes in decoupling* environmental pressures from economic growth (e.g. reducing SO_x and NO_x emissions, water abstractions, and use of nitrogen fertiliser and pesticide). SO_x emission intensity and energy intensity are among the lowest in the OECD. However, NO_x and CO_2 emission intensities are in the middle range among OECD-Europe countries.[2] Nitrogen fertiliser per unit of agricultural land is higher than the OECD-Europe average notwithstanding nitrogen production from livestock. The generation of household waste has not been decoupled from economic growth, nor has emission of greenhouse gases resulting

Table 5.1 **Economic trends and environmental pressures**

(% change)

	1990-2005	1998-2005
Selected economic trends		
GDP[a]	38	13
Population	5	2
Agricultural production	1	0
Industrial production[b]	38	11
Road freight traffic[c]	18	9
Passenger car traffic volume[d]	22[e]	5[e]
Selected environmental trends		
Pollution		
CO_2 emissions from energy use[f]	–6	–17
SO_x emissions	–88	–71
NO_x emissions	–32	–22
Energy		
Total primary energy supply	10	–5
Total final consumption of energy	14	2
Resources		
Water abstractions	–46[e]	–10[e]
Nitrogenous fertiliser use	–51	–27
Pesticide use	–43	–10
Municipal waste	. .	27

a) At 2000 prices and PPPs.
b) Includes mining, quarrying and manufacturing.
c) Based on values expressed in tonne-kilometres.
d) Based on values expressed in vehicle-kilometres.
e) To 2004.
f) Sectoral approach; excluding marine and aviation bunkers.
Source: OECD Environment Directorate; IEA/OECD.

from private car use. Prospects for the future are unclear: with a very high level of resource consumption, Denmark should reinforce its efforts to further reduce resource intensities. Environmental pressures associated with passenger and freight road transport will be another major challenge, as well as nitrates and greenhouse gas emissions.

1.2 The National Strategy

At the end of 1998, the then Ministry of Environment and Energy began work on a national strategy for sustainable development, and the resulting National Strategy was published in 2001. Following the change of government, the strategy was revised to focus on economic growth and cost-effectiveness in environmental protection. The resulting *2002 National Strategy for Sustainable Development*, entitled "A Shared Future: Balanced Development", was adopted by the government. The full text was complemented with a set of indicators of sustainability.

Objectives

The National Strategy was prepared by an *inter-ministerial working group* with the Danish Environmental Protection Agency (EPA) serving as Secretariat. Part of the EPA's job was to co-ordinate a consultation process which involved the Danish government, private enterprises, local and regional authorities, non-governmental organisations (including the Danish 92 group) and the public. The strategy was published after a four-month public hearing and consultation process.

The objectives of the National Strategy should be regarded as guidelines for policy making progress towards sustainable development. The strategy contains both *general objectives for sustainable development* and more specific objectives and activities for "action areas" considered central to achieving sustainable development by 2020. Denmark's vision of *sustainable development* is based on *eight aims*: a developed welfare society and economic growth decoupled from environmental impact; a safe and healthy environment with a high level of protection; a high degree of biodiversity and protection of eco-systems; an efficient use of resources; co-ordinated action at international level; accounting for environmental concerns at all levels; market support for sustainable development; shared responsibility and measuring of progress.

For each aim, goals have been formulated in terms of activities to be developed, actions to be undertaken, or quantified targets to be achieved (for instance, by 2020, to eliminate from the market all products containing chemicals with adverse effects on health and the environment; by 2004, to recycle 64% of waste and reduce land-filled waste by 12%; by 2020, to reduce resource consumption to 25% of current levels).

Implementation and monitoring

In addition to the Environment Ministry with its co-ordinating role, other ministries also have tasks to implement their part of the Strategy. The strategy's vision and aims have been followed up at the *government level* through action plans, programmes and other initiatives covering specific topics, such as the Strategy for Pesticide Use (2003), the Action Plan on the Aquatic Environment III (2004), the Action Plan for Biological Diversity (2004), the report (on green market economy) "Making Markets Work for Environmental Policies" (2003), and the Strategy and Action Plan "The Environment and Health are Closely Related" (2003). However, there is no plan for sustainable transport.

A government publication released in November 2003 reports on *progress in implementing the National Strategy* in areas considered priority: these include climate change and renewable energy, international development, trade and environment, biodiversity, environment and health, and sustainable production and consumption.

Indicators related to the Sustainable Development Strategy were published by the government in 2002. The indicators selected, which were developed in a public hearing with more than 250 Danish and international NGOs, are intended to show Denmark's progress in implementing the Strategy and achieving its objectives. The indicators are divided into two sets: the first includes 14 key indicators that describe progress in meeting the strategy's overall objectives; the second has 90 topic-specific indicators that describe progress in the different activity areas. The key indicators are available in hard copy and the complete set is presented in a database on the Internet. Although these indicators were chosen to track progress in implementing Denmark's National Strategy, they are based on international sets of indicators, which facilitates comparison with developments in other countries in relevant areas. The 2002 indicators have been updated for 2003 and 2004 and published in a separate document.

The National Sustainable Development Strategy is undergoing *revision but will continue to focus on the economic and environment links* rather than the full range of social, economic and environmental concerns. An interagency working group of eight to ten ministries is drafting an evaluation of current progress and a status report to be presented to the Parliament. The Ministry of the Environment (MoE) will retain the lead, which may weaken the mainstreaming of sustainable development objectives in other ministries and hamper the ability to resolve conflicts of interest. The 2002 closure of the main advisory council, e.g. the Danish Nature Society, limits independent input into the Strategy. However, consultation will be held with NGOs, stakeholders and the general public.

Local Agenda 21

Implementation also takes place at the *local level* through Local Agenda 21, which has been developed by most of Denmark's municipalities and counties with local community involvement. In 2000, the Danish Parliament amended the Planning Act and imposed an obligation on counties and municipalities to publish a Local Agenda 21 strategy every four years, with the first due in 2003. After a strategy is adopted, it must be published and made accessible to everyone for the purpose of creating local debate. Between January 2002 and November 2005, 344 Local Agenda 21 reports were published, and these can be found at the Local Agenda 21 website of the National Forest and Nature Agency. Many municipalities have established a "green office" and "Agenda 21 Centre", or they have employed a co-ordinator. A Local Agenda 21 network also exists, comprising some 200 contact people.

Promotion of Local Agenda 21 is ensured through a *joint campaign* initiated by MoE, the National Association of Local Authorities in Denmark and the Association of County Councils in Denmark. The purpose of the campaign is to strengthen local environmental efforts by disseminating knowledge of Local Agenda 21 and by ensuring the exchange of experience, including issuing a newsletter and holding conferences. An Internet-based database with more than 500 examples of Local Agenda 21 projects opened in 1999 and continues to be regularly updated. In the near future, the campaign is scheduled to disseminate information about experiences from the first generation of Local Agenda 21 strategies as a starting point for the second generation strategies that, by law, must be published by the end of 2007.

Assessment

Overall, Denmark has been a *leading country* in promoting sustainable development at EU and world levels. In developing its National Strategy, it has brought sustainable development issues to the government level. The National Strategy has been followed up through various action plans and initiatives and a monitoring system with indicators. However, with the adoption of the National Strategy, Denmark no longer has a white paper on environment. The country's environmental efforts are scattered throughout a large number of unrelated programmes, policies and ministries. There is a need to develop a long-term comprehensive environmental plan or framework with specific objectives, including targets and deadlines.

1.3 Sustainable development in practice: market-based integration

Subsidies

Government financial transfers to the *fishing industry* have focussed on reducing overcapacity and projects to readjust the sector. Less money has been spent on aid for

direct investments. Government transfers for the period 2000 to 2006 (national and EU) amounted to EUR 718.4 million, of which EUR 374.1 million was for aquaculture, processing and fishing ports; EUR 82.2 million was for adjustment of the fishing fleet; and EUR 82.1 million was for innovative actions, marketing and pilot projects. The national support scheme includes financial assistance for young fishers, experimental fisheries and fisheries. As a consequence, the number of fishing vessels decreased from some 2 500 in 1999 to 2 095 in 2005 with a corresponding decrease of the gross tonnage from 95 000 GT to 89 476 GT (Statistics Denmark, 2006).

An independent study carried out in 2002 estimated that *environmentally harmful subsidies* in the Danish economy amounted to DKK 1.8 billion. These

Table 5.2 **Environmentally-related subsidies**

(DKK million)

	1998	1999	2000	2001	2002	2003	2004	2005[a]
Total environmentally-related subsidies	10 189	10 408	9 980	10 365	10 122	10 688	11 059	11 721
Pollution-related subsidies	757	963	824	899	963	1 088	1 011	1 079
Waste collection and incineration	215	257	227	218	264	335	316	350
Subsidies per ha/set aside	418	580	462	548	522	554	495	530
Other EU schemes	70	74	89	103	150	173	174	174
Subsidies for fish care	30	33	30	27	27	26	26	25
Subsidies for env. management and audits	24	19	16	3	–	–	–	–
Subsidies for technology use	0	0	0	–	–	–	–	–
Energy-related subsidies	1 252	1 246	710	586	561	233	267	244
Subsidy for electricity production	1 252	1 246	710	586	561	233	267	244
Transport-related subsidies	8 131	8 108	8 289	8 758	8 496	9 300	9 685	10 311
Subsidies for railway operations	5 818	5 717	5 833	6 312	5 989	6 761	6 959	7 519
Subsidies for bus operations	738	771	1 046	1 485	1 524	1 543	1 687	1 800
Government support for private railways	93	87	97	1	1	1	1	1
Municipal support for bus operations	1 482	1 533	1 313	960	982	995	1 038	991
Resource-related subsidies	49	91	157	122	102	67	96	87
Subsidies for state owned Forest Agency	49	91	157	122	102	67	96	87

a) Preliminary figures.
Source: Statistics Denmark.

subsidies, mostly tax reductions, have been granted to industry to increase its competitiveness. Reductions in the CO_2 tax alone amounted to DKK 878 million.

During the period 1999 to 2005, the amount of *environmentally-related subsidies* increased slightly in current terms to reach DKK 11.7 billion in 2005, with the largest and increasing share granted to the transport sector (DKK 10.3 billion), mainly railways. Subsidies to the energy sector, notably electricity, have been decreasing while pollution-related subsidies have remained around the same level (Table 5.2).

Environmentally-related taxes

The current system of environmentally-related taxes is largely the result of the "*green tax reform*" designed in 1993 and carried out from 1994. Environmentally-related tax revenues measured as a share of GDP are of significance in Denmark: the share of GDP that came from such taxes increased from 3.3% to 4.6% in 2002. The share has dropped slightly since then due partly to the fact that the main revenue-generating taxes, i.e. those levied on energy products, have been kept constant since 2002 under the tax freeze (Table 5.3).

Revenues generated from energy taxes account for the largest share of the environmentally-related taxes – around 55% of total environmentally-related tax revenues in 2005 – with transport-related taxes amounting to 39%. The share of revenues generated by pollution and resource taxes is slightly higher in Denmark on average than in other EU countries (6% versus less than 5%).

Energy taxes on fossil fuels and electricity

The *Danish excise duties on fossil fuels* are divided into three different taxes: the energy tax, the CO_2 tax and the SO_2 tax.

An *energy tax* is levied on all fossil fuels. The tax rates are differentiated across the different energy products according to the energy content of each fuel type, and the tax rates have gradually been increased. The energy tax is *payable only on household and non-commercial uses and industrial space heating*. The space-heating tax on firms has been gradually increased to the level of household energy taxation. Exempting fuel used in electric power generation allows both domestically-generated and imported electricity used in Denmark to be taxed at the same rate. Today, the energy tax constitutes the most significant part of the excise taxes on fossil fuels but does not appear to have a specific environmental justification.

A *CO_2 tax* of DKK 100 per tonne of CO_2 was introduced in 1992 with the aim of creating economic incentives for consumption of less CO_2-intensive energy sources. In 2005, a revised CO_2 tax scheme entered into force and the basic rate of the CO_2 tax

rate was lowered to DKK 90 per tonne of CO_2 emissions. To maintain the overall tax burden, the energy tax has been increased correspondingly. Since 1996, the CO_2 tax regime for industry has been designed with the double aim of ensuring that industry contributes to the fulfilment of the CO_2 reduction targets and avoiding substantial increases in taxes levied on the energy-intensive industries (Table 7.2). Moreover, *tax rebates* have been granted *to enterprises entering into a "voluntary" agreement* with

Table 5.3 **Revenue from environmentally-related taxes and charges,** 1990-2005

(DKK million)

	1990	1995	2000	2002	2005[a]
Energy taxes	14 151	21 142	33 319	35 844	36 749
Tax on coal	851	602	1 317	1 508	1 600
Tax on electricity	4 380	4 482	7 820	8 241	8 575
Tax on gas	39	50	–	–	–
Tax on natural gas	–	–	2 647	3 794	3 850
Tax on certain petroleum products	3 136	5 411	6 642	7 141	7 775
Tax on gasoline	5 744	7 387	10 074	10 432	9 825
CO_2 tax	–	3 210	4 819	4 728	5 124
Transport-related taxes	12 370	19 371	21 052	22 430	26 060
Weight duty	4 363	4 404	6 930	7 943	8 320
Registration tax	8 007	14 967	14 122	14 487	17 740
Pollution and resource taxes	1 046	1 961	4 502	4 572	4 263
Sulphur tax	–	–	198	119	135
Tax on disposable tableware	74	61	65	–	–
Packaging tax	399	479	772	971	870
Tax on CFCs	27	2	0	58	55
Tax on chlorinated solvents	–	–	2	1	1
Tax on pesticides	12	11	375	371	379
Tax on specific growth stimulants	–	–	0	0	0
Tax on waste	404	619	999	1 090	983
Tax on raw materials	129	135	182	157	155
Tax on waste water	–	–	276	265	180
Tax on pipe water	–	654	1 555	1 432	1 420
Tax on nickel/cadmium batteries	–	–	23	21	15
Tax on PVC and Phthalates	–	–	26	60	45
Tax on nitrogen (fertilisers)	–	–	29	27	25
Total environmental taxes	27 567	42 474	58 873	62 846	67 072
GDP	825 300	1 009 800	1 280 800	1 360 700	1 525 886
Environmental tax revenues (% of GDP)	*3.3*	*4.2*	*4.6*	*4.6*	*4.4*

a) Preliminary figures.
Source: Ministry of Taxation.

the Energy Agency to undertake certain investments to improve energy efficiency. Although this scheme entails numerous administrative costs in terms of establishing and monitoring such agreements, an independent evaluation carried out for the government concluded it is effective.

A *sulphur tax*, levied on the sulphur content of fuels, was phased in gradually from 1996 to 2000. The tax was set at DKK 20 per kg sulphur in the energy product or DKK 10 per kg SO_2. Enterprises in the manufacturing industries are not exempted from paying the sulphur tax. However, by installing smoke scrubbers, industrial enterprises may reduce their SO_2 tax payment.

Excise duties on electricity consumption are levied on all electricity consumption regardless of origin. With the 1999 reform opening the electricity market to international trade, and with the introduction of new environmental regulation, a small distribution tax (DKK 0.04/kWh) and a small energy savings tax (DKK 0.006/kWh) were added to the excise duty on electricity (DKK 0.52/kWh). The Danish authorities have also introduced different subsidy schemes to support the production of electricity from renewable energy sources.

The system of energy-related taxes in Denmark is *rather complicated* and it is doubtful that such a system is always effective in meeting its financial or environmental goals. It is not clear why energy taxes on electricity are substantially higher than those on fossil fuels or district heating. As in other OECD countries, the *balance of taxation among the various economic sectors remains uneven*: thus, household energy taxes are considerably higher than those levied on industry and a good portion of the commercial sector. Industry is often provided with exemptions or opportunities for rebates to protect international competitiveness. Another issue is the simultaneous use of both a CO_2 tax borne by end-users and the EU Emission Trading Scheme (ETS), through which producers/emitters have been able to sell or buy CO_2 emission units since 1st January 2005 (Chapter 7). Thus, there is a double price signal for reduction of CO_2. In 2005 the government set up a committee to examine this issue and make proposals.[3]

Denmark's *energy prices* for electricity, fuel oil and natural gas paid by Danish industries and households (excluding transport fuel prices) tend to be higher than the OECD-Europe average (Table 5.4).

Transport-related taxes: fuel and vehicle taxes

Denmark has a long tradition of levying *taxes on transportation fuels*. However, excise duties on transportation fuels have also been used as a deliberate means to regulate the environmentally harmful effects arising from the consumption of transportation fuels. In the late 1980s unleaded gasoline was given a tax rebate in relation to leaded gasoline to give consumers an incentive to choose unleaded

gasoline. Excise duties have also been used to secure the best environmental technology at petrol stations. Since 1995, a DKK 0.03/l tax rebate has been granted on gasoline sold from stations with a vapour recovery system. The 2005 revision of the CO_2 tax legislation introduced *a CO_2 tax on gasoline* in order to make taxation of the different mineral oils consistent.[4] However, the introduction of the CO_2 tax was not intended to increase the overall tax burden on gasoline; therefore the basic excise charge has been lowered to maintain the level of the overall rate. Also in 2005, a tax rebate was granted on sulphur-free road fuels (0.50 EURcent/litre for gasoline; 0.25 EURcent/litre for diesel), which will apply until 2009 (when such fuels become mandatory in the EU). The taxes on motor fuels are similar to those of neighbouring countries (Figure 5.1): this is a deliberate policy lest motorists avoid them by buying their fuel in Germany. Public transport is exempted from fuel taxes, pursuant to (rail) or derogating from (buses) the EU Energy Tax Directive (2003/96/EC).[5]

Table 5.4 **Energy prices in selected OECD countries,** 2005

	Electricity		Oil[a]		Natural gas	
	Industry (USD[d]/kWh)	Households (USD[e]/kWh)	Industry[b] (USD[d]/tonne)	Households[c] USD[e]/1 000 litres	Industry (USD[d]/10[g] kcal)	Households (USD[e]/10[g] kcal)
Denmark	0.096[h]	0.212	434.8	901.6	[j]	901.8
Korea	0.059	0.119	536.6	1 251.8	392.4	707.9
Austria	0.102	0.158	419.0	798.0	. .	662.3
France	0.050	0.126	373.3	726.8	330.2	527.2
Netherlands	[j]	0.211	413.4	1 016.4	222.4[f]	716.4
Sweden	. .	. .	933.1	1 071.9	. .	. .
Switzerland	0.083	0.103	348.2	471.5	401.9	496.1
OECD Europe	0.091	0.156	433.2	752.5	. .	403.9[g]
OECD	0.060[i]	0.109[i]	. .	727.2	316.4	512.4
DKK price/OECD Europe (%)	*117*[h]	136	100	*120*	. .	*175*[g]

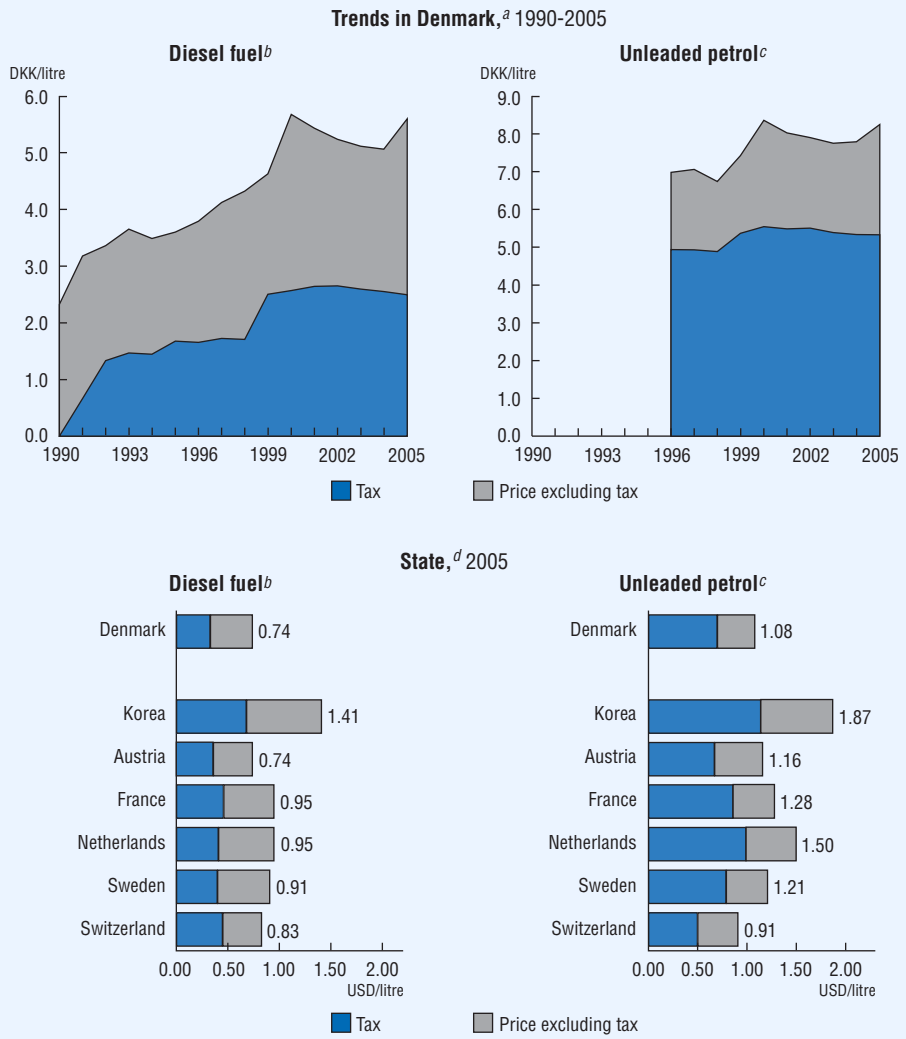
a) 2006 data
b) Low sulphur fuel oil.
c) Light fuel oil.
d) At current exchange rates.
e) At current PPPs.
f) 2003 data.
g) 2000 data
h) 2004 data.
i) 2002 data.
j) Confidential.
Source: OECD/IEA (2007), Energy Prices and Taxes, quarterly statistics, first quarter.

Motor vehicles are subject to a registration tax and an annual circulation tax. Denmark has very *high taxes on private car ownership*. In 2005, *the registration tax* (tax on the purchase price of new motor vehicles) was levied at 105% of the gross value below DKK 62 700 and 180% of the remaining value of the car. Motor vehicles used for freight transportation such as delivery vans and heavy-duty trucks have a significantly lower registration tax. In January 2006, diesel cars equipped with a filter benefited from a reduction of the registration tax which led, in the first six months, to a five-fold increase in the number of models sold. In June 2007 the registration tax was further differentiated with respect to fuel efficiency (Chapter 2). Owners of vehicles registered before 1997 have to pay an *annual vehicle tax* based on weight, with light vehicles being charged a lower rate than heavy vehicles. Since 1997, the annual vehicle tax has been based on *fuel economy* rather than on weight, i.e. on the number of kilometres driven per litre of fuel. In 2005, the annual tax rates were as low as DKK 520 for gasoline-driven vehicles that get more than 20 km per litre and as high as DKK 18 460 for gasoline-driven vehicles that get less than 4.5 km/l. For diesel-run vehicles, the lowest yearly tax rate is DKK 160 for vehicles that get more than 32.1 km/l and the highest tax rate is DKK 25 060 for vehicles that get less than 5.1 km/l.

With such high taxes on private cars, it is not surprising that *car ownership is relatively low* in Denmark in comparison to other EU countries (Figure 2.3). However, *total distances travelled by car* in Denmark *do not appear particularly low*, given average incomes. This means that cars are on average used more intensively in Denmark than in other countries (total private kilometres driven rose from 31 573 million in 1993 to 38 854 million in 2002, and the kilometres driven per vehicle increased by more than 5% over the same period). *Cars are also kept longer* before being scrapped, which slows the rate at which innovations, including those to improve environmental performance, can be diffused. In 1995, Denmark had 137 538 cars less than a year old and 574 179 cars more than ten years old. In 2005, the number of newer cars had dropped to 117 735, while the number of older cars had grown to 719 914. Moreover, high registration taxes, while providing an incentive to buy cheaper, lighter cars with smaller engines that reduce fuel consumption, also tend to dissuade consumers from buying new, more environmentally friendly cars which are often more expensive than similar-sized cars without the environmentally friendly technology. Finally, income *tax breaks are granted to commuters*,[6] which increases road travel and CO_2 emissions.

Denmark's ex-tax prices[7] for gasoline and diesel fuel are near the OECD average; its taxes make the final retail prices relatively high in the OECD (IEA, 2005), but they are still lower than prices in, for example, France, Germany, Italy and Sweden (Figure 5.1).

Figure 5.1 **Road fuel prices and taxes**



a) At constant 2000 prices.
b) Automotive diesel for commercial use; except Korea: for non commercial use. Prior to 1991, the excise tax is not shown as it was refunded to commercial and industrial consumers.
c) Unleaded premium (RON 95); except Korea: unleaded regular.
d) In USD at current prices and purchasing power parities.
Source: OECD-IEA (2006), Database of End-Use Prices.

Assessment

In sum, Denmark continues to rely on a *comprehensive set of market-based instruments* and has a share of revenue from pollution and resource taxes that is slightly higher than other EU countries, although only a few new environmental taxes have been introduced since the last OECD review (on PVC and phthalates, mineral phosphorous in fodder). However, since the 2001 *tax freeze*, the rates of environmental taxes and other environmentally-related taxes have been kept at the same level in nominal terms, which has undermined the incentive effects of such taxes.

The *transport registration tax* serves both environmental and more traditional revenue–raising purposes. Although in principle it provides an incentive to buy cars with better fuel economy, at the same time it discourages people from buying new cars and leads to an older, less efficient car fleet. Furthermore, such a tax does not address most of the externalities from car use, which are mainly proportional to fuel consumption or distance travelled. Denmark *should reconsider the existing transport taxes* with a view to restructuring them in a more environmental way, e.g. by adopting a tax system that penalises vehicle use rather than ownership. This would mean changing the base of the tax so that it would be more closely aligned with the many sources of externalities. Such a change would imply a phasing out of the existing registration tax and a replacement of the lost revenue with an increase in the annual vehicle tax. Finally, the tax break for commuting should be removed.

1.4 Sustainable development in practice: sectoral integration

Agriculture

The Agriculture Act, which regulates ownership and use of farmland in Denmark, dates back to 1967 and has been amended several times. In revising the act, Denmark has integrated nature conservation into the use of farmland and removed the obligation to use the land for agricultural purposes. The new separate act adopted in June 2004 offers many possibilities for farmers to *use their land for nature conservation* and obliges them to keep the land free of trees and bushes to preserve semi-natural areas.

As part of the 2003 reform of the European Common Agricultural Policy (CAP), in 2005 Denmark began, along with the majority of the EU15 countries, implementing the *single payment scheme* which includes "cross-compliance" requirements to respect standards for the environment, food and safety, and animal welfare, and to keep farmland in good agricultural and environmental condition.

Denmark's support for rural development amounted to approximately DKK 690 million in 2003 and DKK 660 million in 2004, including the EU contribution. The country's rural development plan for 2000-06 emphasised *agri-environmental measures* (DKK 385 million in 2004) and covered a large number of measures including support for environmentally sustainable farming and planting of shelter belts. The plan's total budget for 2000-06 was approximately DKK 6.7 billion (OECD, 2005).

Denmark's *organic production* area covered 147 224 hectares in 2004, or 6% of the total agricultural area, placing Denmark in the top five EU15 countries for organic farming. Some 3% of Denmark's agricultural income is generated by 3 166 organic farms (7.1% of all farms) (Statistics Denmark, 2006). In organic livestock, milk production is the sector with the largest volume. Organic eggs account for about 15% of Denmark's total egg production. *Demand for organic products* rose during the 1990s but has levelled out in recent years. In 2004, the market share of organic food products was 5.5%, the value of imported organic products was EUR 41.7 million, and the export value was EUR 35.8 million. The foreign trade of organic products increased 7% between 2003 and 2004. Denmark imports organic products with a low level of processing such as fruits, vegetables and cereals, whereas it exports organic dairy and meat products with high added value. These products are mainly exported to Germany, Sweden and the United Kingdom.

Energy efficiency

Denmark's main energy policy goals include the promotion of energy efficiency and of renewable energy, competitive energy pricing and environmental protection. Denmark has achieved an *impressive record in energy efficiency* through a combination of measures that include stringent building and appliance codes, an extensive combined heat and power/district heating network, high taxes on energy, and negotiated agreements with industry. Available evidence suggests that the country's energy efficiency programmes have so far been significantly more cost-effective than its renewable energy programmes in reducing greenhouse gas emissions and enhancing energy security.[8]

Energy savings in buildings has been a major focus of Denmark's energy efficiency policy for the last 30 years. Between 1975 and 2001, residential heating increased by 34%, but the primary supply needed to heat this space decreased by more than 40%. Two factors explain this trend: the progress in building insulation and the introduction of combined heat and power (CHP) and connected district heating (DH) systems, which improve the efficiency of the delivery system. Denmark has historically designed and implemented strong *building codes* and *energy labelling* to save energy in buildings. New building codes that came into force in 2006 tighten the

energy requirements of new buildings by 25% to 30% compared to previous standards. The codes are expected to be tightened again in 2010.

Denmark's 1994 "Green Tax Package", under which taxes on energy products were raised, can also take much of the credit for the country's high level of energy efficiency. *Voluntary schemes* have been used as part of the Green Tax Package to promote energy efficiency in energy-intensive companies to reduce CO_2 emissions. The 2006 evaluation of the voluntary scheme showed that energy management is its cornerstone. The Danish Standard for Energy Management (DS 2403), developed in May 2001, provides a framework for companies to tailor their energy management system to achieve the most cost-effective savings. By 2004, about 280 Danish companies representing more than half of Denmark's industrial energy consumption had entered a voluntary scheme. By 2005, about 60 of these companies were to be part of the Danish allocation plan for CO_2 quotas and would therefore drop out of the voluntary scheme concerning the energy use that is under CO_2 quotas. However, the companies can still have a voluntary agreement concerning electricity.

Grid companies (including electricity, district heating and gas distribution companies), which provide energy directly to retail consumers, have also been active in energy efficiency activities. These companies are allowed to add a component into their tariffs, the revenues of which must be used to increase their energy efficiency. In 2004, electricity distribution companies raised DKK 180 million, district heating companies DKK 40 million, and gas distribution companies DKK 25 million. For electricity consumers, this equates to about 0.52 øre per kWh. Denmark's 2005 Action Plan for Renewed Energy Conservation increases the collective obligation of the grid companies to save energy, but gives greater leeway to individual companies to achieve such savings. In addition, trading of obligations among distribution companies and purchasing of savings from different actors is now permitted.

Despite the country's generally good record for national energy intensity, Denmark's principal political parties agreed on 10 June 2005 that overall energy consumption, exclusive of transport, should be reduced. In September 2005, the government published the *2005 Action Plan for Renewed Energy Conservation*, intended as a blueprint of measures to achieve the 1.7% annual energy savings target specified in the political agreement. The Action Plan calls for energy savings in the distribution companies, in the public sector and through the adoption of new building codes.

Current government efficiency programmes are more market-oriented than were previous ones, but attention should be paid to the administrative costs and simplicity of their implementation. It would be useful to consider the experience of other countries that have planned or implemented similar schemes (white certificates or

energy-efficiency obligation programmes), such as Italy, France, the Netherlands and the United Kingdom. It is unfortunate that *the transport sector is absent from the government Action Plan for Renewed Energy Conservation*, as transport represents 33% of final energy consumption and is showing the fastest energy growth in Denmark.

Renewable energy

Denmark has a relatively *large renewable energy sector* (Box 5.2). Renewable energy supply more than doubled between 1992 and 2005, when it accounted for 16.3% of total primary energy supply (Figure 5.2). This is the eighth largest share in

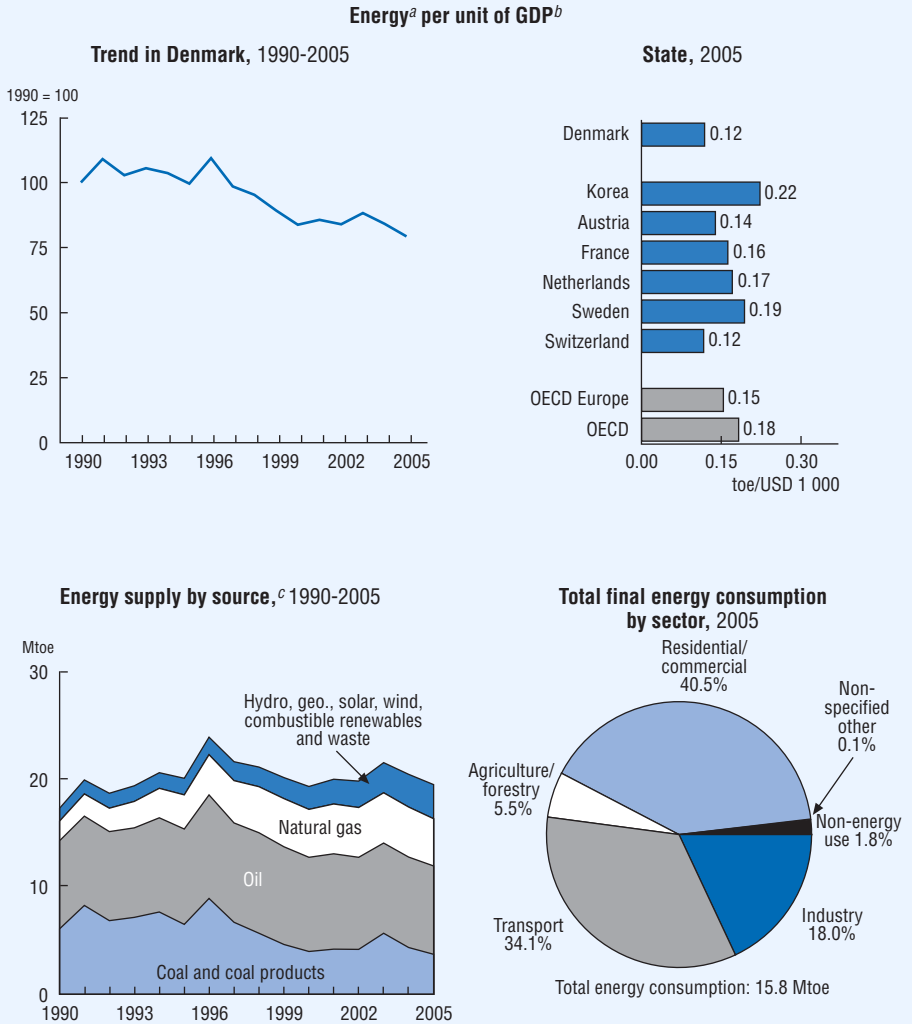
Box 5.2 **Wind power**

Denmark's wind power capacity reached 3 118 megawatts at the end of 2004, with 2 375 MW in western Denmark and 743 MW in eastern Denmark. The total number of turbines was 5 398. As of November 2005, Denmark had 425 MW of offshore wind capacity. The average size of new wind turbines has grown gradually, from 750 kW in 1999 to 2 MW in 2003. Denmark's wind turbines are *owned by* private individuals, private co-operatives, private industrial enterprises, municipalities and power utilities. The wind turbines have typically been installed *in clusters* of three to seven. Such clusters are preferred by local and regional planning authorities although large wind farms are allowed and have been built in a few places.

Offshore wind turbines have higher capital and operating costs because of their location, but enjoy more consistent and generally higher wind speed than onshore turbines. While offshore plants have faced resistance because of their visual effects from the shore and their interference with bird migration and shipping, they are easier to site than onshore plants where many of the more attractive onshore sites have already been used. Wind turbines sited offshore are subject to different and generally more generous support schemes than onshore facilities.

Denmark's *wind power industry* has benefited from government support and has become a world leader in wind turbine manufacturing, creating substantial employment and export revenue. The current world leader in wind turbine manufacture and installation is a Danish company, which has been a pioneer in developing wind power technology and is considered a success story of the Danish industry. In 2004, it installed 2 784 MW of wind turbines, equal to 34.1% of all turbines (by power net capacity) installed around the world. To date, it has installed 36.7% of the 47 912 MW cumulative installed capacity in the world. In 2005, Danish production of wind turbines and associated components amounted to more than DKK 22 billion, with 99% coming from exports.

Figure 5.2 **Energy structure and intensity**



a) Total primary energy supply.
b) GDP at 2000 prices and purchasing power parities.
c) Breakdown excludes electricity trade.
Source: OECD-IEA (2007), Energy Balances of OECD Countries 2004-2005; OECD (2006), OECD Economic Outlook No. 80.

the OECD. For electricity generation, the increase is even more pronounced: by 2004 the renewable energyshare had risen to 25%.

Renewable energy offers Denmark *many benefits*. It results in substantially lower greenhouse gas emissions; it contributes to security of the energy supply; and it creates substantial employment and export revenue, to the extent that Denmark is now a world leader in wind turbine manufacturing (with exports now accounting for approximately half of Denmark's export of eco-efficient technologies, which amount to DKK 45 billion a year).

Renewable energy also *entails a cost, which is paid* through direct subsidy payments from consumers. The above-market payments for electricity generated from renewable sources are recovered from electricity customers as a component of the Public Service Obligation (PSO), a levy placed on every kWh of electricity sold in Denmark. Danish customers paid a total of DKK 2 088 million in 2004, equivalent to *0.2% of the country's GDP or DKK 390 per person*, to support renewable energy. Support for renewable energy also distorts the electricity market. Studies carried out by the Danish Economic Council, the Danish Energy Agency and the IEA show that the cost of reducing each tonne of CO_2 emissions has historically been substantially higher through renewable energy programmes than through other programmes such as energy efficiency or international mechanisms (between EUR 35 and EUR 50 per tonne during the 1990s). Trends, however, favour renewable energy with its decreasing cost over time.

To counter the risk of over-subsidisation, the current government has introduced *more market-based approaches in promoting renewable energy*. It has not set quantitative targets for renewable energy in the 2025 Energy Strategy. The fixed feed-in tariff scheme has largely been replaced with a fixed premium over market prices. This premium will gradually be reduced depending on the year of installation. Green certificates, which are priced according to the difference between the market price and production costs, could in principle solve the problem of over-subsidisation. Denmark could benefit from the experience of other countries such as Australia, Sweden and the United Kingdom. Denmark should continue to rely on more market-based approaches in promoting renewable energy; it should also continue to examine existing support schemes from the point of view of their environmental effectiveness and economic efficiency.

Transport

Transport causes a number of *negative environmental impacts* including air pollution, climate change and noise. Estimates of the external environmental costs of the transport sector (road and railway) in Denmark are between DKK 9 billion and

DKK 13 billion annually, with DKK 5 to 9 billion associated with traffic noise and DKK 4 billion with air pollution and climate change (Ministry of Transport, 2004). Progress has been made in reducing atmospheric emissions of lead, NO_x, carbon monoxides and hydrocarbons, but reducing the emission of particles and the nuisance caused by noise remains a challenge. *Progress* has also been made in integrating environmental concerns in transport *infrastructure projects* by use of environmental impact assessment (EIA). A committee set up in 2003 by the Ministry of Transport and Energy in co-operation with the Ministry of Finance and the Ministry of the Environment made recommendations on how to improve and make more transparent the process of planning and decision-making regarding infrastructure projects.

However, no progress has been achieved at the *strategic level*. The 2002 National Sustainable Development Strategy devotes one chapter to transport. The chapter enunciates broad goals and principles (e.g. integration of health, environmental and safety considerations into transport policy) as well as quantitative objectives and activities for the long term (e.g. a 25% reduction of transport-sector CO_2 emissions by 2030 compared to 1998 levels; a 60% reduction of nitrogen oxide emissions and hydrocarbons by 2010 compared with the 1998 level; a 50% reduction of particulate emissions from urban traffic by 2010 compared with 1998; a 40% reduction of road casualties by the end of 2012; the development of a road noise strategy;[9] and an improvement in the quality of public transport). A report was prepared to provide the basis for a political discussion on the challenges and trends of the transport sector in the years to come, but no sustainable transport plan or strategy has yet been adopted (Ministry of Transport, 2004). The Energy Strategy 2025 cites the transport sector as an important part of a successful energy future. It states that the government intends to focus more attention on this issue but that any initiatives to limit energy consumption for transport must be cost-effective. Yet the *political agreement of June 2005* establishing new energy demand reduction targets explicitly excludes transport from its purview. The related Action Plan (by the Danish Energy Authority) to meet the reduction goals also makes no mention of transport.

Throughout the review period and as far back as 1994, Denmark spent five to six times more money on the road network *infrastructure* (for a total road network length of some 72 000 km) than on the rail network infrastructure (for a total rail network length of some 2 600 km). For instance, DKK 10.8 billion was spent for the road network and DKK 1.8 billion for the rail network in 2004. Since 1990, Denmark has experienced an average annual increase of 2% in *road traffic* (i.e. the number of kilometres driven) due to the growing number of passenger cars, the extension of the motorways, and the increased distance between home and work or school. The number of passengers travelling by train (Metropolitan S-trains and other trains) has also increased regularly in recent years, while commuting by bicycle has significantly decreased[10] (Statistics Denmark, 2005).

Denmark's *public transport system* (train, inter-city and local bus services) is not subject to certain environmental taxes and receives *large subsidies*, amounting to more than DKK 10 billion every year. This corresponds to more than DKK 1 for every kilometre travelled by a passenger in the public transport system. Recent years have seen improvement in the *efficiency of public transport services*, with most services being provided by private contractors chosen by competitive tender and with the level of service specified by the relevant county administration. The average cost per vehicle-hour for bus service, for example, has dropped significantly since the early 1990s. Similarly, the Danish State Railway operating costs per passenger-kilometre were reduced by 15% between 1999 and 2002. Progress has also been achieved in *railway traffic*, with regard to reducing the time and increasing the frequency of longer trips. This especially happened after the launch of the fixed rail links, where shorter travel times combined with more train departures have prompted an increase in train travel between East and West Denmark. The challenge is still to translate the *higher productivity into better service* in terms of train frequency, price and quality. The future travel card is expected to facilitate the use of public transport: passengers will be able to use this single card (as well as traditional fare tickets) on buses and trains, making transfers easier.

Connecting different parts of the country through a national road and railway network is no longer the focus of Denmark's transport policy. The 2003 political transport agreement identifies *congestion* as the major problem to be addressed. Time-loss due to congestion in the Greater Copenhagen Area is estimated at around DKK 5.7 billion a year. *Passenger traffic* projections by the Danish Transport Research Institute point to an annual increase of 1.6% for private car traffic and of 1.2% for lorry traffic through 2015. This growth, however, will not be evenly distributed throughout the country. It is estimated that large parts of the state road network will see growth of 2.0% to 2.5% annually (or about 25% to 35% by 2015). This will bring more congestion, particularly in the Greater Copenhagen Area, which will experience a more rapid growth in motorisation (i.e. cars per capita) together with more mobility (e.g. commuting due to higher housing prices inside the city limits). Road is by far and increasingly the largest mode for national freight transport (in 2004, 188 million tonnes of goods) (Figure 2.3). Lorries account for 94% of all goods transport. However, for international freight (in 2004 89 million tonnes of goods) transport, ships are the dominant means of transport. The new strategy for intermodal transport (October 2006) does not state as a goal the transfer of freight from road to rail or sea, but states that the different modes should be used where they are the most efficient. To limit congestion the government intends to expand infrastructure in combination with a better utilisation of existing infrastructure (e.g. "intelligent transport systems"). It seems, however, reluctant to introduce congestion

charges or road pricing schemes as these would entail some negative economic and distribution-related side effects. Although Copenhagen has one of the highest rates of cycling found in major European cities, cycling at the national level has not made any progress. This has prompted the Ministry of Transport and Energy to launch a Bicycle Strategy, announced in May 2007 (Chapter 2).

Overall, little progress has been achieved in developing *a sustainable transport policy*. Procedures for assessing large transport infrastructures have improved, but Denmark still has no sustainable transport plan or strategy. Transport is not part of the political agreement which establishes new energy demand reduction targets. Modernisation of public transport, particularly the railway system, should receive priority to achieve a high degree of reliability. At the national level, cycling has been declining and remains at the same level as in 1985. The present policy seems to focus mainly on the *supply side* by providing more or better traffic infrastructure and largely ignores *demand management*. In view of the expected passenger and freight traffic growth, Danish authorities should consider introducing road pricing as a means to internalise externalities generated by transport. In November 2006 the government set up a *commission*[11] to assess challenges within the transport sector and the need for transport infrastructure over the next 20-30 years. More efficient public transport in and between urban areas is a key focus area for the commission, which also has to deal with traffic safety and the integration of environmental concerns (e.g. noise, particulate matter, CO_2) in transport policy.

1.5 Environmental expenditure and financing

Between 1999 and 2004, *public pollution abatement and control expenditure* decreased in constant terms by 4.9% to reach *1.3% of GDP* in 2004. During this period, expenditure for waste and waste water treatment increased (to reach 36.5% and 25.7% respectively of total public environmental protection expenditure in 2005), while expenditure for air and climate and environmental assistance decreased. Expenditure for biodiversity and landscape increased slightly while expenditure for soil and groundwater and for research development remained unchanged (Table 5.5). Municipalities cover the major part of public environmental protection expenditure (70%) followed by the national government (20.6%) and the counties (9.4%). Expenditure for waste and waste water are financed by environmental charges or taxes, which means that the *polluter-pays principle* applies to households and industry. Other expenditure (soil and groundwater protection, biodiversity and landscape) are financed from the public budget.

Data on *private environmental expenditure* are still not available although the previous OECD review recommended improving the availability of such data, particularly by industry.

There is still no evidence that environmental measures and expenditure in Denmark have adversely affected its economic growth or international competitiveness. On the contrary, *environmental protection has become an important element of competitiveness in Danish industry*. Exports of eco-efficient technologies amount to DKK 45 billion a year and the sector is experiencing substantive growth. Exports of wind turbines account for about half of Danish exports of eco-efficient technologies. The exports of water technology amount to about DKK 6 billion a year and these exports doubled between 1998 and 2002. Danish companies producing eco-efficient technologies are highly dependent on export markets: for many companies

Table 5.5 **Environmental expenditure and revenues for counties, municipalities and national government,** 2005

(DKK million)

	National government	Counties	Municipalities	Total	Share (%)
Operating and capital expenditure, total	5 082	2 320	17 259	24 661	*100*
Air and climate	539	0	0	539	*2.2*
Waste water	3	0	6 340	6 343	*25.7*
Waste	273	0	8 739	9 012	*36.5*
Soil and ground water	140	629	55	824	*3.3*
Biodiversity and landscape	968	1 101	458	2 527	*10.2*
Research and development	1 377	0	0	1 377	*5.6*
Environmental assistance[a]	1 262	0	0	1 262	*5.1*
Other	494	590	1 666	2 750	*11.2*
Share (%)	*20.6*	*9.4*	*70*	*100*	
Operating and capital revenue, total	962	261	14 827	16 050	*100*
Air and climate	20	0	0	20	*0.1*
Waste water	0	0	6 149	6 149	*38.3*
Waste	1	0	8 415	8 416	*52.4*
Soil and ground water	53	43	3	99	*0.6*
Biodiversity and landscape	252	58	42	352	*2.2*
Research and development	578	0	0	578	*3.6*
Environmental assistance[a]	1	0	0	1	*0*
Other	54	161	218	433	*2.7*
Share (%)	*6*	*1.6*	*92.4*	*100*	

a) Grants for specific environmental projects in developing countries e.g. Eastern Europe, Asia, Africa and Latin America.
Source: Statistics Denmark.

the export share is more than 90%. The environmental business is one of Denmark's largest business clusters. A recent survey identifies 420 companies with 60 000 employees involved in the environmental business along with 46 knowledge institutions which focus on eco-efficient technologies.

2. Implementation of Environmental Policies

2.1 Objectives

Broad environmental goals are an integral part of Denmark's 2002 National Strategy for Sustainable Development. Policy objectives are included in more specific national strategies and action plans, notably on climate (Chapter 7), the aquatic environment (Chapter 3), biodiversity and nature conservation (Chapter 4), waste and chemicals. But Denmark's environmental policy *lacks an overall strategic and planning framework*, with associated strategic and planning environmental objectives and timeframes.

Denmark relies on *cost-benefit analysis* to both influence and respond to EU directives and other international commitments as well as to selected domestic issues (e.g. creation of national parks). The cost-benefit analysis guidelines of the Ministries of the Environment (1999), Finance (2000) and Transport (2001), as well as of the Danish Energy Agency (2001), are being updated.

The 1999 *OECD Environmental Performance Review of Denmark* recommended that it:

- 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;
- 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.

2.2 Institutional and legal framework

An institutional framework in transition

Environmental management was traditionally (since 1971) based on a three-tiered system: state, counties and municipalities, the state being responsible for strategic planning, development of guidelines, monitoring, handling complaint cases and international relations. Since 1st January 2007 this *environmental administrative structure has been reformed* as a result of the broader and radical territorial governance reform of the country, whereby the 14 counties ceased to exist. Concerning environmental administration, municipalities took over most of the former counties' environmental functions (Box 4.4). Five regions – Hovedstaden (the capital region), Sjælland, Syddanmark, Midtjylland and Nordjylland – were created but with non-environmental responsibilities (e.g. hospitals, public transport and regional development).

At the same time, *the number of municipalities was reduced* from 275 to 98.[12] This follows a transitional year in 2006 in which the old municipalities continued to exist, but under merged councils. In 2004, the government had announced that all municipalities with populations of less than 20 000 would be required either to merge with one or more neighbours or to enter into closer co-operation with other municipalities. The latter would only be permitted in special cases, such as island communities. The aim was both to achieve economies of scale and to create units with enough professional competence to take on new tasks. The new municipalities will have greater responsibility for the environmental, social and labour market services.

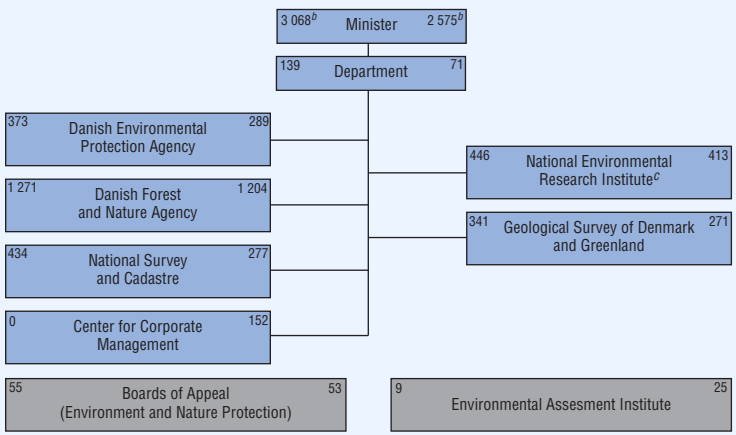
Part of the *challenge of this reform* is for national authorities to give sufficient guidance to municipalities. To guide municipalities in their increased environmental responsibilities, the Ministry of the Environment established seven decentralised offices across the country. Some environmental civil servants of the former councils were transferred to the central environmental administration (in Copenhagen or in the decentralised offices); some were put at the disposal of municipalities. However, the reform may cause loss of skilled staff, including environmental inspectors.

While local authorities may have better knowledge of local socio-economic conditions and environmental issues than counties, devolution of enforcement and inspection entails the risks of i) *development interests overriding environmental considerations*, and ii) not being supported by the granting of new local fiscal powers.

Funding of environmental policy may vary greatly across municipalities,[13] possibly resulting in inconsistent implementation and hindering the achievement of environmental objectives nationwide.

The Environment Ministry's *overall budget was decreased by one-third* over the review period,[14] and by 14% since 2002. As a consequence the number of staff decreased from 3 400 in 1999 to 2 575 in 2006 (Figure 5.3). The EPA staff, which administers environmental legislation and helps local authorities implement it, decreased from 450 to less than 300 over this period. The Danish Forest and Nature Agency staff, which manages state forests and administers legislation on nature protection, was reduced from 1 650 to around 1 000. As of 1st January 2007, the National Environmental Research Institute (NERI), which monitors and provides advice on the state of and pressures on the environment, was transferred from MoE to the University of Aarhus, as part of the Danish government's plan to integrate sectoral research institutes into the Danish universities and to have fewer but larger universities. The *Environmental Assessment Institute*, established in 2002 under MoE, provides independent socio-economic analysis of selected environmental policy issues. It is to be merged in 2007 with the Secretariat of the Danish Economic Council.

Figure 5.3 **Structure of the Ministry of Environment**[a]



a) Includes the number of staff in 2002 (left corner) and 2006 (right corner).
b) Total staff of the Ministry.
c) In 2007, NERI was transferred to the University of Aarhus.
Source: MoE.

Environmental legislation

Most of Danish environmental legislation is based on EU directives and, overall, Denmark is *transposing and implementing EU environmental directives well*. As of the end of 2005, Denmark had only two infringement procedures for non-conformity with EU environmental directives and three for bad application (Commission of the European Communities, 2006).

Since the Prime Minister's issuance in 1993 of the first ministerial order making it obligatory to assess the environmental impacts of government bills, *three quarters of the bills have been assessed* and 17% were found to have major environmental effects (Table 5.6). The ministerial order was revised in 1998 and new guidelines issued in 2005, in line with the EU Strategic Environmental Assessment (SEA) Directive. The guidelines called for closer co-operation between seven ministries, including the Ministry of Finance. In 2006, MoE prepared additional SEA guidelines.

Recent environmental legislation includes the 2003 Act on Environmental Objectives, which transposes the EU's Water Framework Directive (2000/60/EC) and sets out detailed planning and guidelines for establishment and management of Natura 2000 sites. The 2004 Act on Environmental Assessment of Plans and Programmes

Table 5.6 **Strategic environmental assessments of government bills,** 1993-2004

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*
1997/98	300	*19*	*65*	*16*
1998/99	246	*10*	*69*	*21*
1999/2000	288	*6*	*77*	*17*
2000/2001	240	*8*	*72*	*20*
2001/2002	251	*12*	*72*	*16*
2002/2003	228	*10*	*73*	*17*
2003/2004	255	*11*	*73*	*16*
Total	2 860	*23*	*59*	*17*

Source: MoE.

transposes the EU Directive on Strategic Environmental Assessment (2001/42/EC). Some environmental acts have been "consolidated", their successive amendments being combined into one version. For example, the 1973 Environmental Protection Act was consolidated in 1997, the Nature Protection Act was consolidated in 1992 and the Contaminated Sites Act in 1999 (Table 5.7). Other *key environmental acts* include the Water Supply Act, which regulates the use of ground and surface waters, the

Table 5.7 **Selected environmentally-related 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 (amended, 1993, 2000, 2003, 2004, 2006)
1982	Watercourses Act (amended1995, 2001, 2004)
1983	Contaminated Sites Act (amended 1990, 1996)
1985	Water Supply Act (revision 1999)
1988	Marine Environment Protection Act (amended, 1993, 2003, 2005, 2006)
1989	Planning Act (amended)
1989	Act on the Management of Nature
1989	Forest Act (amended,1996, 2004)
1989	Agricultural Holdings Act (includes part of the implementation of Action Plan for the Aquatic Environment I)
1990	Act on Waste Deposits
1991	Environmental Protection Act (amended 1994, 1995, 1996)
1991	Act on Environment and Genetic Engineering (amended 1998, 2002, 2004, 2005, 2006)
1991	Act on the Exploitation of Natural Resources (amended 1996)
1991	Act on Subsidies for Environmental Activities in Eastern European Countries
1991	Regulation on winter green fields, crop change and fertiliser plans and accounts (Action Plan on Sustainable Agriculture)
1992	Planning Act (amended 1997, 2004, 2005, 2006)
1992	Raw Materials Act
1992	Nature Protection Act (amended 1997, 2004, 2005, 2006)
1992	National and Regional Planning Act (revision)
1993	Hunting and Wildlife Management Act (amended 1997, 2004, 2005)
1997	Environmental Protection Act (revision, amended 2001, 2002, 2003, 2004, 2005, 2006)
1998	Regulation on agricultural use of fertilisers and plant cover (amended 2004, 2006)
1999	Soil Contamination Act (amended 2004, 2005, 2006)
2003	Act on Environmental Objectives (amended 2004, 2006)
2004	Act on Environmental Assessment of Plans and Programmes

Source: MoE.

Watercourses Act, which protects private streams, and the Marine Environment Protection Act. The Planning Act provides for environmental impact assessments and regulates urban planning and rural zoning, as well as the completion of municipal and regional plans consistent with national planning processes and guidelines.

The *territorial government reform process* has led to the amending of many environmental acts in recent years, with a view to transferring county-level assignments to municipalities and, to a lesser extent, to the state (e.g. establishment of Natura 2000 sites) or newly established regions (e.g. mapping of resources and planning of extraction of gravel and other raw materials). EU directives are typically implemented through statutory orders issued by MoE. MoE issues guidelines (rather than statutory orders) to municipal authorities, giving them considerable discretionary powers in the implementation of many environmental regulations. A new Act on Quality Control has been proposed to facilitate implementation of environmental legislation at the local level (Baaner *et al.*, 2006).

2.3 Regulation and enforcement

Environmental permitting

Since 1999 Denmark has implemented the *EU Integrated Pollution Prevention and Control (IPPC) Directive* (96/61/EEC), which was transposed as part of the Environmental Protection Act. The integrated approach means that permits must take into account the whole environmental performance of the plant, including emissions to air, water and land; generation of waste; use of raw materials; energy efficiency; noise; prevention of accidents; and restoration of the site upon closure. The licensing system is not limited to the 1 500 registered IPPC installations, but covers approximately 6 000 installations. Pursuant to the local government reform, counties' licensing authority over certain large installations was for the most part transferred to municipalities, except for 230 large enterprises that will be supervised directly by MoE (Baaner *et al.*, 2006).

Industrial risk management is an integral part of the Danish IPPC permitting system. The permit application must include information about possible disruptions or accidents related to the operation of the plant. The authorities can include conditions in the permits aimed at preventing such disruptions or accidents and the environmental consequences thereof. Industrial establishments where dangerous substances are present in large quantities are subject to particular attention to prevent major accident hazards, in compliance with the EU Seveso II Directive that Denmark has transposed.

A *simplified environmental licensing procedure was introduced for non-IPPC enterprises*, which should progressively apply to up to 80% of Danish enterprises subject to licensing. Standard conditions will be introduced for different types of enterprises (Anker, 2004).

New permitting legislation for large *livestock farms* (presently 30 000 farms) is under discussion and should apply to odour, nitrogen, phosphate and ammonia emissions. However, the proposed IPPC permit would be granted for eight years, thereby reducing the frequency of inspection, which is currently every three years. Moreover the permit would be based on national emission standards prior to their revision and on environmental quality objectives set for 2009 (as required by the EU Water Framework Directive).

The proposed transposition of the EU Directive on *Environmental Liability* (2004/35/EC), due by end of April 2007, is minimal, as it i) does not apply to emissions or events expressly covered by the environmental permit (except in cases of strict liability for water extraction), ii) does not consider protected habitats and protected species, and iii) includes most possible exceptions (article 4 of the directive). In contrast, strict liability would apply to any polluting land-based activity as well as to the use of genetically modified organisms, pesticides and fertilisers in agriculture.

Since 1st January 2007, *slightly contaminated soils*, which are mainly found in city centres, have been exempt from registration. The Soil Contamination Act has been amended accordingly. Regulated soil contaminants include lead, cadmium, *polycyclic aromatic hydrocarbons* (PAHs) and four other persistent substances. Pursuant to the territorial government reform, counties' responsibility for contaminated soils was for the most part transferred to the new regions, except for minor cases that were transferred to the municipalities (Baaner *et al.*, 2006).

Monitoring

The *Danish Nationwide Monitoring and Assessment Programme for the Aquatic and Terrestrial Environments* (NOVANA 2004-09) monitors the state of the aquatic and terrestrial environments, pressures on them, and the effects of policy responses. It replaces the Danish Aquatic Monitoring and Assessment Programme, 1998-2003 for monitoring of nutrient discharges to the aquatic environment, which had been in place since 1988.

NOVANA has a wider scope than its predecessor (notably as it incorporates nature monitoring[15]), but not a wider *funding*. As a result, the greater priority given to monitoring aquatic species and habitats in recent years has been at the expense of monitoring nutrients and hazardous substances (NERI, 2005b). The programme

fulfils Denmark's international monitoring and reporting obligations (e.g. Habitats Directive), but is now less focused on national environmental action plans.

Enforcement

Denmark has no specialised environmental prosecutors, and *inspection of compliance with environmental legislation has significantly decreased since 1995*, as it now focuses on IPPC facilities and as the number of active farms has decreased (Table 5.8).

Though no broad overview exists of trends in *cases sent to administrative court*, the general opinion is that they have increased. Complaints to higher instances[16] are also more common (e.g. cases to the Nature Appeals Board increased from around 1 500 in the mid-1990s to around 2 000 in recent years). The Environmental Appeals Board addresses some hundred cases a year, but most relate to issues under the Planning Act. More specifically, a large number of complaint cases deal with the location of new pig farms, which is subject to formal environmental authorisation from the local authority ("EIA screening") to ensure that the land area is large enough for slurry application ("harmony requirement"). Another though less pressing concern is water pollution from effluents of freshwater aquaculture (exclusively located in Jutland). No overview exists of trends inadministrative sanctions.

Table 5.8 **Enforcement of environmental legislation**, 2004

	Counties	Municipalities	Total 2004	Total 1995[a]
Number of facilities supervised				
Licenced facilities	2 161	3 627	5 788	9 611
Non-licenced facilities	–	22 074	22 074	29 600
Livestock farms	–	33 978	33 978	58 681
Waste water treatment plants	1 037	–	1 037	1 480
Person-years for inspections	108	329	437	576
Site inspections	4 538	12 131	16 669	44 000
Recommendations	300	3 600	3 900	15 250
Warnings and injunctions	359	1 300	1 659	5 150
Police reports	7	26	33	300
Prohibitions	2	32	34	210

a) Trends must be interpreted with caution, as 1995 data include small facilities that do not require an IPPC permit.
Source: EPA.

A survey of *245 cases sent to criminal courts* regarding infringement of environmental legislation completed in 2003 and 2004 revealed that *very few cases of prosecution resulted in significant sanctions*, and that there has been a marked decrease in the level of fines for the most serious cases[17] (Nielsen, 2005).

2.4 Economic instruments

Denmark has a tradition of using economic instruments within environmental management. It is one of the few OECD countries that levy a CO_2 tax, as well as a tax on pesticides. During the review period, some new environmental taxes were introduced (e.g. tax on industrial greenhouse gases, PVC and phthalates, mineral phosphorous in feed) (Table 5.9). *Cost effectiveness analysis* of environmental policy measures is common (e.g. NO_x emission reduction, Action Plan for the Aquatic Environment). However, it has become very difficult to introduce new environmental taxes/charges or to adjust existing ones for inflation because of the *tax freeze introduced in 2001*. The implementation of economic instruments sometimes entails excessive administrative costs (e.g. nitrogen tax combined with compulsory nitrogen balance, CO_2 tax rebate combined with agreement on energy efficiency) or lead to contradictory incentives (e.g. tax/charges on air, water or waste combined with support schemes for energy, transport or agriculture).

Air and climate

In the *area of energy*, excise duties on fossil fuels used for heating or for commercial/industrial purposes include an energy tax on oil products (1977), coal products (1982) and natural gas (1996); a CO_2 tax (1992); and an SO_2 tax (1996). Excise duties are also levied on electricity consumption and include an energy tax (1977) and a CO_2 tax (1992). However, a large number of *rebates* apply to industry, including through an agreement scheme on industrial energy efficiency for CO_2. Denmark participates in the EU Emission Trading Scheme on CO_2 (Chapter 7). Various support schemes have been used to promote renewable energy sources. There are plans to introduce a tax on NO_x emissions.

In the *area of transport*, excise duties levied on transport fuels include a basic excise duty (1917) and a CO_2 tax (1992 for diesel, 2005 for gasoline). Taxes levied on motor vehicles include a high registration tax and an annual circulation tax. Denmark participates in the Eurovignette system for heavy goods vehicles (1994). There is no congestion pricing in Copenhagen (in contrast with London and Stockholm) (Chapter 2). Charging a fee per kilometre driven in Copenhagen might be preferable to introducing a "small toll ring", where motorists pay a fixed amount to enter the

Table 5.9 **Economic instruments,**[a] 1996-2005

	Unit	1996	2005	Comments
AIR AND CLIMATE: ENERGY				
Road fuels	DKK/litre			
Unleaded gasoline				
Basic excise duty		3.27	3.86	Since 2005 0.04 DKK/l rebate for sulphur-free gasoline[b]
CO_2 tax		–	0.22	Tax introduced in 2005. Bio fuel is exempt
Light diesel[c]				
Basic excise duty		1.92	2.69	Since 2005 0.02 DKK/l rebate for sulphur-free diesel[b]
CO_2 tax		0.27	0.24	Bio fuel is exempt
Electricity consumption	DKK/kWh			
Energy tax[d]				
Heating purposes[e]		0.32	0.51	
Other purposes		0.36	0.58	
Enterprises		–	0.01	Introduced in 1999. Applies to the first 15 million kWh
CO_2 tax[f]		0.10	0.09	
Fuels for heating or commercial/industrial use				
Light fuel oil	DKK/litre			
Energy tax[d]		1.49	1.86	
CO_2 tax[f]		0.27	0.24	
Heavy fuel oil	DKK/kg			
Energy tax[d]		1.66	2.09	
CO_2 tax[f]		0.32	0.29	
Natural gas	DKK/nm^3			
Energy tax[d]		0.01[g]	2.04	Tax introduced in 1996
CO_2 tax[f]		0.22	0.20	
Pit coal	DKK/kg			
Energy tax[d]		0.86	1.45	
CO_2 tax[f]		0.24	0.22	
All fuels				Applies to fuels with sulphur content > 500 ppm
SO_2 tax[h]	DKK/kg S	20	20	Tax introduced in 1996; 50% rebate for combustion plants with flue gas desulphurisation
AIR AND CLIMATE: TRANSPORT				
Registration tax	Threshold value (DKK/vehicle)			Since 1999 tax rebate to energy efficient cars
Passenger cars		34 400	62 700	Rate is 105% below and 180% above the threshold value
Freight vehicles	DKK/vehicle			
Below 2 tonnes		. .	15 100	Tax rate is 95% above the threshold value
Above 2 tonnes		. .	12 100	Tax rate is 60% above the threshold value

Table 5.9 **Economic instruments,**[a] 1996-2005 *(cont.)*

	Unit	1996	2005	Comments
Annual circulation tax	DKK/year			Until 1997 the tax was based on weight only
Gasoline vehicles				
Driving > 20 km/l		–	520	
Driving < 4.5 km/l		–	18 460	
Diesel vehicles				
Driving > 32.1 km/l		–	160	
Driving < 5.1 km/l		–	25 060	
Vehicles registered before 1997				
< 600 kg		. .	1 700	
1 500- 2 000 kg		. .	4 780	
Road user charges (Eurovignette)	DKK/year[i]	. .	. .	Applies to freight vehicles > 12 tonnes[j]. Shared with Belgium, Luxembourg, the Netherlands and Sweden
Maximum 3 axles				
EURO 0		7 800	7 154	
EURO I		7 800	6 334	
EURO II and less polluting		7 800	5 589	
4 axles or more				
EURO 0		12 896	11 550	
EURO I		12 896	10 432	
EURO II and less polluting		12 896	9 315	
OZONEDEPLETINGSUBSTANCES				
Tax on CFCs	DKK/kg product	30	30	
Tax on HCFCs		30	12-400	
Tax on halons		30	30	
Tax on HFCs		–	192-400	Tax introduced in 2001
Tax on PFCs		–	400	Tax introduced in 2001
Tax on SF_6		–	400	Tax introduced in 2001
WATER AND AGRICULTURE[k]				
Public water supply	DKK/m^3			Average prices
User charge		6.99	9.20	
Water tax		5.00	5.00	Refunded to industry. Agriculture is exempt
Sewerage and waste water treatment	DKK/m^3			Average prices
User charge		10.90	14.03	
Waste water tax[l]		1.24	0.57	Tax introduced in 1997. Agriculture is exempt
Pesticides	% retail value			
Tax on insecticides		27	54	Tax rate was doubled in 1998
Tax on fungicides[m]		13	25	Tax rate was doubled in 1998
Tax on wood preservatives		3	3	

Table 5.9 **Economic instruments,**[a] 1996-2005 *(cont.)*

	Unit	1996	2005	Comments
Phosphorus				Revenues are returned to the agriculture sector
Tax on mineral P added to feed	DKK/kg	–	4	Tax introduced in 2005
Nitrogen				
Tax on N in commercial fertilisers	DKK/kg	5	5	Introduced in 1998 Agriculture is exempt
Fine on N in excess	DKK/kg	up to 20	up to 20	Applies to the agricultural sector[n]
WASTE AND CHEMICALS				
Municipal waste collection	DKK/tonne			
User charge[o]		750-1 240	851-1 428	2001 survey of 181 (out of 275) municipalities
Waste tax				
Incineration		210	330	
Incineration connected to district heating		–	110	Introduced in 1999. Tax can be levied per GJ of heat
Landfill		335	375	
Packaging waste	DKK/kg			
User charge		. .	. .	Part of overall user charge
Packaging tax		. .	. .	Weight-based since 1999
Tax on beverage containers	DKK/unit			
Wines and spirits		0.25-3.20	0.25-3.20	Rate increases with container size
Beer and carbonated beverages		0.05-0.64	0.05-0.64	Rate increases with container size
Other waste streams				
Tax on tyres	DKK/unit	8-180	8-180	Rate increases with tyre size. Min. rate: DKK 4/unit retreaded tyres
Tax on Ni/Cd batteries	DKK/unit	6[p]	6[p]	Tax introduced in 1996
Charge on lead accumulators	DKK/unit			Tax introduced in 1996
Under 100 Ah		12	6	
Over 100 Ah		24	12	
Other types[q]		18	9	
Tax on disposable tableware	DKK/kg	50%	19.20	*Ad valorem* tax until 2001
Tax on carrier bags	DKK/kg			
Paper bags		9.00	10.00	
Plastic bags		20.00	22.00	
Tax on PVC films (food packaging)		–	20.35	Tax introduced in 2001
Deposit refund				
End-of-life vehicles	DKK/unit	–	1 750	Introduced in 2000
Beer and carbonated soft drinks	DKK/unit	–		
Glass-refillable				
< 0.5 litre		. .	1.00	
> 0.5 litre		. .	3.00	

Table 5.9 **Economic instruments,**[a] 1996-2005 *(cont.)*

	Unit	1996	2005	Comments
Plastic-refillable				
< 1 litre		. .	1.00	
< Exactly 0.5 litre		. .	1.50	
> 1 litre		. .	3.00	
Glass, plastic, cans-non-refillable				Introduced in 2002
< 1 litre		–	1.00	
Exactly 0.5 litre (plastic)		–	1.50	
> 1 litre		–	3.00	
Waste electrical and electronic equipment	DKK/unit	–	. .	Introduced in 2006
Chemicals	DKK/kg			
Tax on PVC		–	2	Tax introduced in 2000
Tax on phthalates		–	7	Tax introduced in 2000
Tax on chlorinated solvents		2	2	Tax introduced in 1996
NATURE				
Raw materials extraction tax	DKK/m^3	5	5	Tax rate unchanged since 1990

a) Excluding subsidies. See Table 5.3 for tax revenues. All tax rates unchanged since 2001 unless otherwise indicated.
b) Until 1st January 2009 when sulphur free road fuels will become mandatory in the EU.
c) 0.05% sulphur content.
d) Tax rate according to the energy content of fuels.
e) Lower rate on consumption exceeding 4 000 kWh for permanent residences heated with electricity.
f) Tax rate according to the carbon content of fuels. Since 1996 firms engaged in the agreement scheme on energy efficiency have been granted CO_2 tax rebates. In 2005 the basic rate of the CO_2 tax was lowered (Table 7.2).
g) Until 2001, before the EU open competition regulation, the tax rate was set so that the end-use price of natural gas did not exceed that of fuel oil.
h) Tax rate according to the sulphur content of fuels. Energy consumers can opt instead for taxation based on actual SO_2 emissions (DKK 10/kg SO_2).
i) Pursuant to EU Directive 99/62/EC as modified by Directive 2006/38/EC. Monthly and weekly charges are proportionate to the duration of the use of the infrastructure. There is a daily charge for all vehicle categories (EUR 8 in 1996; EUR 11 in 2005).
j) From 2012, Directive 2006/38/EC will apply to vehicles weighing between 3.5 and 12 tonnes.
k) Charge/tax rates refer to 1998 and 2003, respectively.
l) The tax rate (unchanged since 1998) varies according to the type of pollutants: DKK 11/kg for BOD, DKK 20/kg for N and DKK 100/kg for P.
m) The tax also applies to herbicides and growth regulators.
n) The fine applies to use on nitrogen beyond the amount allowed by the (farm level) fertiliser account.
o) Charge rates refer to 1997 and 2001 (1997 prices), respectively.
p) The rate is DKK 36/pack for round cells joined in a unit.
q) Not for use to start engines.
Source: Ministry of Taxation; MoE; Speck, *et al.*

centre of Copenhagen, a system that can be very expensive to society (Environmental Assessment Institute, 2006). Public transport is highly subsidised.

In 2001, Denmark extended the (1989) taxes on "traditional" *ozone depleting substances* (CFCs, HCFCs and halons) to (non-energy-related) greenhouse gases including perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and hydroflourocarbons (HFCs). The tax rate reflects the gases' global warming potential.

Water management and agriculture

User charges based on full cost recovery apply (since 1992) to households and industry for public water supply and sewerage and waste water treatment (combined bill). In addition, *taxes* are imposed on water consumers for both public water supply (1994) and waste water treatment (1997). The aim is to alleviate local water shortage problems and reduce pollutant discharges (Chapter 3).

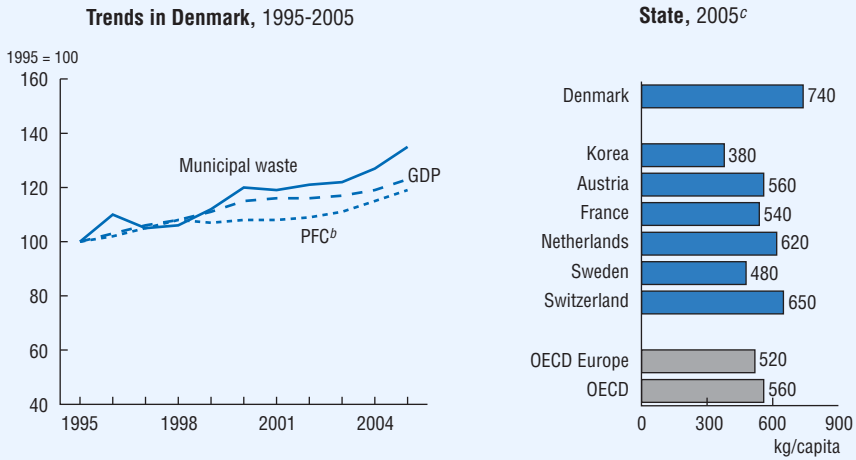
Agriculture is subject to taxes on pesticides (1996) and on phosphorus added to feedstuff (2005). Fines are levied on farms with nitrogen surplus (1994). These measures are intended to complement various support schemes to promote environmentally friendly farming (Box 3.3).

Waste and chemical management

Municipal waste generation has grown at a higher rate than GDP and private final consumption (Figure 5.4). Several municipalities differentiate *user charges for municipal waste collection* according to weight, volume or service frequency so as to promote minimisation. However, the latest national waste strategy (2005-08) highlights the need for greater transparency in the setting of user charges so that the differences among and within municipalities can be more fully explained, as well as the extent to which the equity and full cost recovery[18] principles are applied. The "equity principle" implies that the same charges should apply to the same services and that equal access to information on waste management should be guaranteed.

The tax rates *on waste sent to landfill or incineration* (1987) have remained unchanged since 2003. The tax is designed primarily to promote recycling, but also to promote incineration over landfill (higher rates have applied to landfill since 1993). The ban on landfilling of waste suitable for incineration (1997) is largely responsible for the 66% decrease in landfill over the last decade.[19] A tax on heat produced for district heating systems via waste incineration (Box 5.3) was introduced in 1999. The waste tax does not apply to hazardous waste, which must be disposed of at special treatment plants and the treatment of which is subject to full cost recovery.

Figure 5.4 **Municipal waste generation**[a]



a) In interpreting national figures, it should be borne in mind that survey methods and definitions of municipal waste may vary from one country to another. 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.
b) Private final consumption.
c) Or latest available year.
Source: OECD Environment Directorate.

Municipalities are responsible for the collection of *household packaging waste*, which is financed by user charges and packaging taxes (1978). A weight-based packaging tax introduced in 1999 was revised in 2001 to take account of the environmental impact of the different types of packaging. Since 2004 the volume-based tax on beverage containers (1999) has been differentiated, with lower rates for beer and carbonated drinks than for wines and spirits. In 2002 the *deposit-refund system for refillable beer and carbonated drink bottles* (established in 1922) was extended to beer and soft drinks in non-refillable bottles (as well as cans[20]) that are managed by a private operator. In 2005, the deposit-refund system was extended further to include cider, energy drinks and "ready-to-drink" beverage containers. Deposit-refund rates (set by the government) were recently lowered by around one-third to reduce the price difference between beverages purchased domestically and abroad. The return rate for refillable containers fulfils the legal requirement of 98%, but the return rate for non-refillable containers does not (required return rate was 95% by 1st January 2005).

Box 5.3 **From waste to energy**

Denmark has incinerated waste for a century. Although initially the purpose was to reduce the quantity of waste that had to be landfilled, the heat produced in the process has almost always been exploited for power and/or heat production.

In 1997, Denmark was the first country in the world to ban the landfilling of incinerable waste. This measure together with low waste taxes and a preferential right to sell the energy produced have been decisive in *promoting incineration with energy recovery*. Denmark currently incinerates two million tonnes of waste a year (i.e. around 400 kg per capita, which is the highest rate in the OECD) and exports incineration knowledge and technology. As the major part of the waste is CO_2-neutral biomass, incineration contributes to reducing Denmark's greenhouse gas emissions. Overall, the system is highly energy efficient, as Danish incineration plants are able to sell all of the heat produced almost all year round.

Some 1.5 million households in Denmark (60% of the population, 95% of flats in Copenhagen) are connected to collective district heating networks. The *Amagerforbrænding incineration plant* was the first plant in Denmark engaged in combined heat and power production. It treats waste from 535 000 inhabitants and 36 000 companies and institutions located in five municipalities of Greater Copenhagen (Copenhagen, Dragør, Frederiksberg, Hvidovre and Tårnby), and supplies heat and power to approximately 140 000 households in Greater Copenhagen. The excess electricity is exported to the rest of Zeland (sometimes to Sweden). Each year the Amagerforbrænding plant treats 390 000 tonnes of municipal waste and produces 2 930 TJ of heat and 211 000 MWh of power. Most of the residues from the incineration process are recycled (4 400 tonnes of scrap iron and 73 500 tonnes of slag). Only 17 800 tonnes of residues from flue gas cleaning are disposed of in landfills. The plant is owned by the five municipalities from which it collects waste. It also operates nine recycling stations.

Source: Kleis and Dalager (2004), I/C Amagerforbraending (2006).

Producer responsibility applies to *end-of-life vehicles* (ELVs), pursuant to the EU ELV Directive (2000/53/EC). ELVs returned to an authorised car breaker are eligible for a refund, from which the cost of dismantling the vehicle for recycling is deducted. The refund was slightly increased from DKK 1 500 in 2000 to DKK 1 750 in 2002.

Producer responsibility also applies to *waste electrical and electronic equipment* (WEEE), in response to the EU WEEE Directive (2002/96/EC). Waste treatment costs have been included in the price of electrical and electronic products since 2006, representing an increase estimated at between 0.2 and 3.0% of the consumer price.

Rates of the charges on *new, retreaded and used tyres* (1995) have remained unchanged. The revenues are used to cover the costs of collection and recycling of used tyres by the tyre and auto branch organisations, the recycling branch organisation (Genvindingsbrancherådet) and local authorities. In addition, since 2001 the Danish EPA has subsidised the collection and use of scrap tyres for production of rubber granules (or incineration with energy recovery[21]), at rates of DKK 1.20 to 1.60/kg according to tyre size. The subsidy scheme is administered by a private operator.

The tax on *nickel-cadmium batteries* (1996) applies to sealed batteries such as single cells, packs and inside products. Rates have remained unchanged. The Danish EPA subsidises the collection of nickel-cadmium batteries for recycling at a rate of DKK 150/kg. A system of charges applies to lead accumulators (1996). The revenues are used to cover the costs of collection and recovery of lead by a private operator, at an average rate of DKK 1.10/kg (depending on world lead prices).

The tax on *disposable tableware* (1982) was initially according to the value (50% of the wholesale price). Since 2001, it has been based on weight and the rate has remained unchanged. The tax on carrier bags (1994) has increased only very slightly over the past decade, remaining stable since 2001. The tax rate on PVC film used in food packaging (2001) has also remained unchanged.

Danish policy on *chemicals* relies on a comprehensive policy mix (Box 5.4). It includes a tax on PVC and phthalates (2000). Rates are calculated for a range of products, e.g. DKK 0.05 per plastic wallet containing soft PVC (reduced to DKK 0.02 if phthalates have not been used) or DKK 3.60/kg for gloves containing soft PVC (reduced to DKK 1.08) (Speck *et al.*, 2006). The tax rates have remained unchanged since they were introduced. In 2004 rigid PVC was removed from taxation (most PVC construction products are now recycled) and two new PVC products were added (plastisol-coated steel plate and mountings). Taxes are also charged on chlorinated organic solvents (1996), namely tetrachloroethylene, trichloroethylene and dichloromethane.

Nature conservation

Until 2006, Denmark's national government and counties (equally) financed most of the *public expenditure for nature protection* (Table 4.3). This included funds for land purchase, as provided for in the Nature Conservation Act. From 2007, public funding previously transferred to counties was granted to municipalities. Very few protected areas charge visitor entrance or parking fees (Chapter 4).

Since 1997, most support to the forestry sector has gone to private afforestation (Figure 4.3). The Environment and Agriculture Ministries support farmers who take

Box 5.4 **Policy on chemicals**

Denmark regulates chemicals under the *Act on Chemical Substances and Products*, which outlines procedures for their classification, labelling and restriction of use, as well as outlining the approval scheme for pesticides. Under this act, in 1998 the EPA promulgated a (non-binding) list of "undesirable" substances, which gave priority to 26 substances that the authorities wished to see restricted or completely banned. The list has been updated three times, most recently in 2004.

The *First Chemical Action Plan* (for 1999-2005) had four key priorities: first, to reduce consumption of problematic chemicals through instruments such as prohibition, taxes and voluntary agreements, and to speed up introduction of substitutes as part of integrated product policies; second, to better control chemicals, to increase the responsibility of manufacturers, and to improve consumers' access to information; third, to seek further regulation and wider use of risk assessment and of the precautionary principle at EU level; and fourth, to strengthen chemical regulation at the world level, and particularly in the countries of Eastern Europe.

Since 1999 initiatives have been implemented to *restrict the use of mercury and mercury-containing products, phthalates, lead, greenhouse F-gases (HFC, PFC and SF_6) and antifouling products*. This included, for instance, a general ban of phthalates in toys for children under three years of age, which has been in force since 1999. A ban of phthalates in bathing equipment for children that was due in 2003 has been postponed until alternatives are made available, for which an agreement was made with industry. A tax on PVC and phthalates (used as plasticisers in PVC) was introduced in 2000 (DKK 2/kg PVC; DKK 7/kg phthalates), and the government plans to adjust the tax rate according to the toxicity of individual phthalates. In 2002 the taxes on ozone-depleting substances were extended to greenhouse F-gases (DKK 10 to 400/kg of product). In 2003 Denmark set limits for copper concentrations in antifouling paints. A total ban of environmentally harmful ship painting entered into force in 2006.

Denmark has also contributed actively to the development of OECD test guidelines for chemicals, particularly *endocrine disrupters*. The use of oestrogen-like ancillary substances in pesticides was abolished in 2000. An earmarked fund was established in 2002 (DKK 15 million a year) to promote research on chemicals, environment and health, in particular endocrine disrupters, allergy and consumer products (Chapter 6).

Prior to that, taxes had been introduced in 1996 to reduce consumption of three *chlorinated solvents* (DKK 2/kg of product) and a charge was imposed that year on *pesticides*, which was doubled in 1998 (Chapter 3). An agreement to phase out the use of pesticides in publicly-owned areas of municipalities and counties was signed in 1998.

Since 1999 the resources of the *Chemical Inspection Service* have been reinforced and the Danish EPA has established a chemical information hotline for consumers. The EPA has also developed computer models, known as (Quantitative)

Box 5.4 **Policy on chemicals** *(cont.)*

Structure Activity Relationships (Q)SAR models, to identify chemical substances whose properties may cause toxic effects. This has led to issuance of an advisory list of 20 624 dangerous substances.

The *Second Chemical Action Plan* (for 2006-09) focuses on three key priorities: i) strengthened control of chemicals, ii) consumer products, and iii) better communication with firms. First, compliance with all legislation will be monitored within two years after its enactment. Random control of the entire production process will be carried out if control of a single sample reveals illegal chemical substances. Prosecution will be increased. The number of inspection visits to farmers and fruit and vegetable growers will be increased from 120 to 600 a year. Second, controls will be strengthened to ensure that toys, cosmetics, jewellery and other products do not contain chemicals that present a risk. Denmark will provide systematic information on problematic substances in consumer products to the EU, so as to improve EU legislation. A new information bank on chemicals will enable importers, buyers and retailers to avoid problematic substances. Third, every year at least four meetings will be organised with importers and manufacturers of toys, cosmetics, paint, impregnated wood and other products, and newsletters will be issued on selected subjects. A helpdesk will be set up, where companies can seek information on current rules, including the new EU chemicals legislation REACH, which entered into force in June 2007 (Regulation (EC) No. 1907/2006 and Directive 2006/121/EC).

Denmark's long-term goal is that by 2020, no products or goods that contain chemicals with particularly problematic effects on health and the environment should be on the market.

former wetlands out of agricultural production (Box 3.3). Most *financial incentives to expand wetlands and afforestation* derive from the Second and Third Action Plans for the Aquatic Environment (1998-2004 and 2005-15) (Tables 3.7 and 3.8).

A tax is levied on the extraction of *raw materials* (e.g. sand, gravel); its rate has not been revised since its introduction in 1990.

2.5 Other instruments

Environmental impact assessment

National provisions on environmental impact assessment are contained in Denmark's Planning Act. At the first stage of the procedure, the developer submits

plans to the authority (county), which decides whether an EIA is required. The result of this screening stage is published and communicated to the developer together with guidelines for appeal. If in a second stage the project is considered to require an EIA, the MoE initiates a first round of public consultation with a call for ideas and proposals, and after the EIA report (together with an addendum to the county land-use plan) has been drawn up, the county delivers an opinion on whether or not to support the project. If the project is not supported, in a third stage, the assessment report and proposal are made public for a second round of public consultation (of at least eight weeks).

The 1997 amendments to the EU EIA Directive (97/11/EC) were implemented in Denmark in 1999. Since 1999 the number of screenings has remained stable at 2 000 to 2 500 a year, with 90% relating to large livestock farms[22] (more than 100 livestock units). An EIA was deemed necessary for only 5% of screenings, and not all of them actually resulted in an EIA. Nevertheless, *the screening procedure* has to a significant extent enabled counties to bring about changes to projects. A survey carried out by MoE in 2001-03 revealed that changes to projects were made in 45% of cases, either before or after submission to the authority for screening, so that an EIA would not be required. For livestock farms, the most common changes relate to project size (number of animals) and the area on which the manure is to be spread.

However, *most changes to projects can be considered minor* (Christensen *et al.*, 2005). Since its introduction into Danish planning in 1989, EIA has been widely discussed. At the centre of the debate, the question has been whether EIA has actually offered anything new. There has been much scepticism about the efficacy of this instrument. EIAs do not seem to have led to measures covering more ground than traditional planning and environmental regulation. Since 1999 this can be explained by how the EIA procedure has been implemented in Denmark, where projects already covered by environmental permits or exemptions have not been subject to an EIA permit.[23] There are currently no examples of EIA permits in Denmark.

Following the *local government reform of January 2007*, most of the EIA administration was transferred from counties to municipalities and has become part of the municipal planning procedure. Major projects, notably industrial installations subjected to a national environmental license and infrastructure projects, are dealt with at the national level (Baaner *et al*., 2006).

Environmental reporting, voluntary approaches and eco-management by industry

Denmark is among the 16 OECD member countries[24] that have an operational *Pollutant Release and Transfer Register* (PRTR). Established in 1996, the Danish

PRTR is mandatory, covers discharges of all relevant substances[25] into air, water and land, and currently involves some 1 000 reporting facilities. Reporting is annual, raw data are publicly available (including in electronic form), and geographical data will be made available soon. Aggregated data sets are only partly available to the public.

The Danish PRTR is implemented pursuant to the Environmental Protection Act, which requires Danish firms to produce "*green accounts*". It was expected that the green accounts would create benchmarking effects, where firms from the same sector could compare their environmental performance (Holgaard *et al.*, 2005). In 2002 the legal requirements were strengthened, as expectations concerning content, form and reach were not met. Since then firms have been required to describe their environmental policy, goals and results.

The Green Tax Package launched in 1996 combined the introduction of SO_2 taxes and existing CO_2 taxes[26] with an *agreement scheme on industrial energy efficiency*. Firms that enter into the agreement with the Danish Energy Agency get a rebate on their CO_2 tax (Table 7.2). All firms with heavy processes may participate as well as some firms with light processes.[27] The agreement is conditioned on implementation of energy saving projects with a payback period of less than four years (heavy process) or six years (light process). Different price assumptions are used when calculating the payback periods: for firms with heavy processes, a (hypothetical) tax of EUR 3.33 per tonne CO_2 is added to the pre-tax energy price of the firm, while for firms with light processes, a (hypothetical) tax of EUR 12 per tonne CO_2 is added. The lower the (hypothetical) tax, the lower the likelihood that a given project will pass the test. Hence, some relatively low-cost energy-saving projects in firms with heavy processes could be left unrealised, which would tend to increase the overall abatement costs (OECD, 2003). Moreover, this approach involves considerable administrative costs (estimated at EUR 4 million a year), resulting from the complicated administration of tax rebates between the Central Customs and Tax Administration and the Danish Energy Agency.

Until 2001, individual agreements were based on an energy audit and collective agreements[28] on an analysis of energy consumption and production processes in the sector. Since then, these have no longer been required, but firms engaged in the agreement scheme must introduce energy management systems based on the structure of (and often integrated into) their environmental management system or *Eco-Management and Audit Scheme (EMAS)*.[29] The EMAS "environmental statement" is recognised as an equivalent of the green account. The supervision fee, which all firms must pay to the local or regional environmental authority, is reduced by 50% for EMAS organisations. The Environmental Competence Scheme provides financial support to small and medium-sized enterprises (SMEs) implementing an

environmental management system including EMAS. Some 118 Danish organisations have already voluntarily implemented EMAS, compared to 45 in 1999. Twenty-two are public authorities, waste water treatment facilities, or drinking water or hot water suppliers. The number of organisations with an *ISO 14001 certification* increased from 128 in 1999 to 837 in 2006. There are also examples of proactive environmental management in Danish municipalities.

Denmark implements *two voluntary eco-label schemes*, the EU Flower and the Nordic Swan. Products bearing them must fulfil environmental criteria that often go beyond requirements in national legislation. By end 2006, Denmark had 50 EU Flower and 465 Nordic Swan labels, covering approximately 3 000 product names.

The government is considering introducing a new type of binding "*partnerships for innovation*" between companies, research institutions and the state. The aim is to strengthen environmentally efficient technologies in which Danish companies have a strong position, such as: water, industrial biotechnology, wind energy from mega windmills,[30] biofuels and fuel cells (Andersen *et al.*, 2006). In this new type of consortium, companies would make a commitment to carry out the necessary technological development, whereas the state would provide the necessary framework conditions (e.g. finding the right partners for a consortium to develop a new type of mega windmill). An action plan for promoting environmental technology is under preparation.

Notes

1. At 2000 prices and purchasing power parities.
2. Denmark plans to introduce a NO_x tax on stationary sources that would apply from 2010 (at a rate of DKK 5/kg). Stationary sources account for 40% of total NO_x emissions in Denmark.
3. In March 2007 the committee recommended abolishing the CO_2 tax on emissions covered under the EU-ETS while introducing a CO_2 tax on all other emissions, at a rate that should reflect the CO_2-quota price. A new energy initiative under discussion proposes increasing the basic rate of the CO_2 tax to DKK 150 per tonne for all sectors not covered by CO_2 quotas.
4. Biofuels are CO_2 tax exempt (for both gasoline and diesel).
5. A request has been made to the EU to extend the derogation for buses, which expired at the end of 2006.
6. At a rate of 1.28 DKK/km/day for daily return trips of 25-100 km and 0.89 DKK/km/day beyond 100 km.
7. Prices excluding taxes.
8. Evaluations carried out by the Electricity Savings Trust and the Association of Danish Electricity Distribution Companies.
9. Implemented in 2003 (Chapter 6).
10. Cycling is still an important means of transportation in major cities, such as Copenhagen (Box 2.2) and Odense.
11. The "Infrastructure Commission" regroups representatives from the transport industry, the academic sector, trade unions and an environmental NGO (the Danish Society for Nature Conservation).
12. The municipalities of Copenhagen and Frederiksberg continue to exist, but without their dual functions and tasks as counties.
13. The funding that was previously allocated to counties is now shared between the municipalities, the state and the regions according to the tasks they took over from the counties.
14. The budget decrease of the Danish EPA mainly reflects the shift of responsibility for environmental development assistance to the Ministry of Foreign Affairs.
15. NGOs perform part of the monitoring of nature and biodiversity, particularly for birds, plants and butterflies, pursuant to a long tradition of collaboration with MoE.
16. The two highest instances for complaints concerning the environment (Environment Appeals Board) and concerning planning and nature (Nature Appeals Board) have been merged since 1st January 2007.
17. The survey included 133 cases related to the Environmental Protection Act and 112 cases related to the Nature Protection Act and Planning Act. Its findings should be interpreted with caution, as they might reflect a lack of reporting by the environmental authorities.
18. Danish municipalities must comply with the full cost recovery principle, pursuant to the 2001 Environmental Protection Act.

19. Recycling has remained the most important treatment method, currently accounting for approximately two-thirds of all waste treated. Following cost-benefit analysis, it was decided not to introduce a mandatory recycling system for organic household waste. It is up to the municipalities to decide whether such waste should be recycled or incinerated.
20. The sale of beverages in cans was permitted in Denmark for the first time in 2002, and the market share for cans rose to 16% in 2006.
21. Where recycling or re-use is not possible.
22. In 2003 a notification scheme was introduced for smaller livestock farms, under which the authority must inform applicants no later than ten working days following receipt of the notification (a very short questionnaire).
23. This is a particularity of Denmark's transposition of the EU Directive 97/11/EC.
24. According to the corresponding OECD Recommendation. All EU countries will have to establish a PRTR by 2009, pursuant to EC Regulation 166/2006.
25. Including releases in products, not from products.
26. All revenues from the taxes are recycled back to the industry in the form of reductions in the taxation of labour and, until 2001, through subsidies for energy efficiency measures.
27. Firms for which taxation of energy consumption accounts for at least 3% of value added.
28. Covering several firms within a sub-sector with similar production processes.
29. Voluntary scheme available at EU level since 1995 (Council Regulation (EEC) No 1836/93).
30. The next generation of wind turbines will have power ratings of 5-10 MW – compared to 2-3 MW for today's large turbines – and will be between 150 and 200 metres tall.

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6

ENVIRONMENTAL-SOCIAL INTERFACE*

Features

- Strategy on environment and health
- Environmental democracy
- Nature interpretation

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1999. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Denmark:

- set up additional *targets* concerning environmental factors related to health with related indicators; continue to understand better through research and studies the potential links between environmental pollution and chronic illness or child health issues; take action where there is knowledge (e.g. particulate pollution);
- continue to make use of *cost-benefit analysis* and economic valuation in environmental health policy making; and derive relevant priorities for action;
- include the public health benefits of *access to nature* and outdoor recreation as an integral part of national environment and health action plans;
- continue to promote *environmental democracy* through access to environmental information, public participation, and access to courts for citizens and associations (e.g. environmental NGOs);
- assess and reduce *disparities* in exposure to pollution.

Conclusions

Environmental health has received increased attention through the 2003 strategy and action plan on environment and health, as well as through targeted research (e.g. on allergenic substances, endocrine disrupters, impact of traffic on human health). To accelerate their replacement by less dangerous substances, all professional uses of hazardous substances must be registered in the national product register. Cost-benefit analysis and economic valuation methods have been used in several health-related studies and strategies (e.g. on noise, cycling, health effects of air pollution). Concerning *environmental democracy*, Denmark ratified the *Aarhus Convention* in 2000. Pursuant to the related EU directives on environmental information, it has harmonised its practices concerning provision of information, public access to information, public participation and access to courts. A wide range of environmental information (data, indicators, state of the environment reports, targeted information brochures) is publicly available and frequently updated. Most Danish municipalities have adopted a *Local Agenda 21*, and amendments to the Planning Act in 2000 require them to report on implementation every four years. A nationwide Local Agenda 21 network has been created, involving some 200 contact persons. *Environmental awareness* is enhanced through local and national campaigns, as well as through environmental education at all levels of the education system. In 2006, *environmental employment* accounted for some 2.2% of total civilian employment in Denmark.

Despite the high level of wealth and living standards in Denmark, several *health* indicators are of concern: for example, life expectancy is relatively low, the country has some of the OECD's highest rates of mortality from certain forms of cancer, and allergy and respiratory diseases affect about 20% of the population. Some of these problems might relate to environmental factors. Denmark has no explicit targets for fine particles ($PM_{2.5}$), which are known to be dangerous for human health. Little attention has been given to *disparities in pollution exposure*, and further attention should be given to promoting *access to nature* and outdoor recreation and the related health benefits. In 2003 the ambitious targets (set up in 1993) for reducing the number of people exposed to noise were postponed from 2010 to 2020 (as part of the 2003 Road Noise Strategy) due to benefits and costs distribution considerations. Despite the goal of issuing an updated set of sustainable development indicators every year, these indicators were not updated during the last two years. The 1999 OECD recommendation to collect data on *private pollution abatement and control expenditure* has not been followed up.

The *social context* of Denmark includes relatively high population densities, low unemployment, and a low level of inequality in a relatively rich country (Box 6.1, Figure 6.1). Social concerns in a sustainable development framework have a strong interface with environmental issues, particularly concerning environmental health, environmental democracy, environmental education and environmental employment.

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1. Environmental Health

Environmental health problems in Denmark today are considered to derive mainly from exposure to chemicals, urban air pollution and noise (Tables 6.1 and 6.2). The country has some of the OECD's highest rates of mortality from breast cancer and prostate cancer (OECD, 2005), and the incidence of testicular cancer is higher than in similar countries (MoE, 2005). Denmark's National Board of Health suggests that around 10% of all cancer cases are caused by environmental effects (MoE, 2005). Allergies and respiratory diseases have increased to affect about 20% of the population and to become the most common group of chronic diseases among young adults (EPA, 2006b).

Increased knowledge about the relationship between environmental factors and health resulted in the adoption of a *strategy and action plan on environment and health in 2003*. The strategy provides a general overview of effects of

Box 6.1 **Social context**

Population

In 2006 Denmark had a population of *5.4 million*, an increase of 3.7% since 1994. Some 6.3% of the population is foreign born (Figure 6.1). *Population density* is 126 habitants per km^2. About 85% of the population lives in urban areas. The capital city Copenhagen (incl. Fredriksberg) has a population of 593 000, Aarhus has 296 000, Odense 187 000, Aalborg 164 000 and Esbjerg 82 000. About 2 million people live in smaller towns.

Unemployment and employment

In 2005 the *unemployment rate was 4.8%*, thus well below the OECD and EU averages. The unemployment rate was high in the early 1990s but has remained quite stable since 1998. *Youth unemployment* is particularly low at 7.9%, the third lowest rate in the OECD. The total labour force has increased by 2.8% over the last ten years. Currently, 73% of the labour force is employed in the service sector, and 24% in industry.

Welfare and poverty

Denmark is a *rich country*: in 2005, GDP per capita was USD 34 400 (using current PPPs). Important *welfare* programmes have resulted in: 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% of the population is over 65 years old. Denmark's degree of inequality in household income distribution (as measured by the GINI index) is the second lowest in the OECD area (after Sweden) (Reference I.C). Measures on relative poverty have not been updated lately. Expenditure on education as a proportion of GDP is among the highest in the OECD (7.0% in 2003). Expenditure on health equalled 8.9% of GDP in 2004 (Table 6.2). *Life expectancy* is, however, below the OECD median for both men and women (Table 6.2).

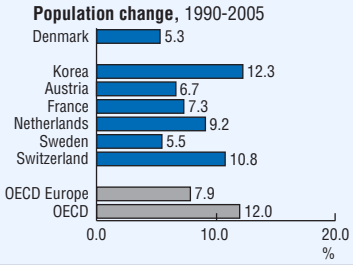
Gender issues

Denmark has the fourth highest rate of female participation in the workforce in the OECD (76.2% in 2005). Women occupy 37% of the seats in parliament, 4% of private sector senior executive jobs and 10% of professorships in universities.

Denmark has an active gender policy. The childbirth leave scheme was amended in 2002, introducing a year of paid leave. One of the objectives of the scheme is to be flexible. Hence it allows for 32 of the 52 weeks to be shared among the parents as they themselves wish.

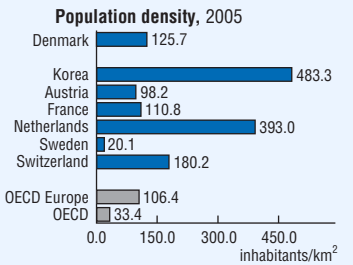
Figure 6.1 **Social indicators**

Population and ageing



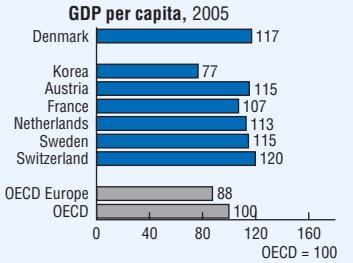
Population change		1998	2005
natural increase	‰	1.4	1.7
net migration	‰	2.1	1.2
		1998	2004
Foreign population	%	5.4	6.3
Ageing		1998	2005
over 64/under 15	ratios	0.82	0.80

Settlement and mobility



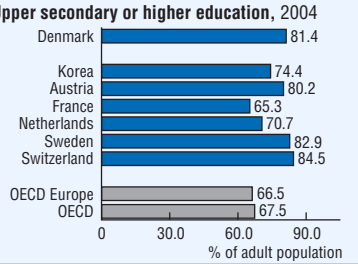
Population by type of region		Early 2000s		
		% population	% area	density
urban		29	1	2 543
intermediate		32	31	129
rural		39	68	72
Mobility			1998	2005
car ownership	veh./100 inh.		34	36
rail traffic	billion pass.-km		5.4	5.8

Income and employment



Labour force participation		1998	2005
total rate	%	80.2	80.3
female rate	%	75.2	76.2
Unemployment (standardised rates)		1998	2005
total rate	%	4.9	4.8
female rate	%	6.0	5.3

Health and education



Educational attainment		1998	2004
upper secondary	%	78.5	81.4
Life expectancy		1998	2004
at birth: total	years	76.4	77.6
female	years	78.8	79.9
at age 65: male	years	14.8	16.0
female	years	18.1	19.0

Source: OECD, Environment Directorate.

Table 6.1 **Health effects of selected environmental factors**

Environmental factor	Health effects	Impact on public health[a]	Trends in exposure
Air pollution	Respiratory and cardiovascular diseases	Particle pollution is estimated to cause: 3 400 premature deaths per year. Chronic bronchitis: 3 300 incidents per year. Acute bronchitis in children: 11 600 incidents per year	Urban levels of PM_{10}, NO, NO_2 and SO_2 are declining. PM_{10} and NO_x occasionally exceed the limit value in areas with heavy traffic
	Asthma	160 000 incidents per year	
	Lung cancer	300 cases per year	
Waterborn infections	Gastrointestinal infections	1992-97: approximately 6 400 cases caused by microbial pollution of drinking water	
Legionella	Pneumonia	100 cases per year	Stable
Environmental tobacco smoke	Lung cancer	30 cases of lung cancer per year among never smokers	Declining
	Cardiovascular diseases	Ischemic heart disease: 77 deaths in 1999. Cerebrovascular disease: 109 deaths in 1999	
	Respiratory diseases in children	1 900 hospital admissions (2003) for middle ear infections, upper airway infections and asthma in children aged 0-14 years	
Foodborn zoonoses	Gastrointestinal infections	In 2004: 5 657 cases[b]	Generally decreasing, though recently stable
Food mutagens	Cancer	7 cases of cancer per year	. .
Acrylamid in foods		35 cases of cancer per year	. .
PAH in foods		100-300 cases of cancer per year	. .
Traffic noise	Heart disease/ hypertension	800-2 200 cases per year of ischemic heart disease/ hypertension 200-500 premature deaths per year	Stable
Radon in houses	Lung cancer	250 cases per year of lung cancer when simultaneously smoking and exposed to radon	. .
Other natural radiation	Cancer	430 cases of cancer per year	Stable
Alternating electric and magnetic fields	Leukaemia	< 1 case of leukaemia in children per year	. .
Sunlight	Melanoma	1 150 cases of malignant melanoma per year and 5 500 cases of skin cancer per year	Increasing, but more sun protection is used
	Skin cancer		

a) Estimates.
b) Recorded cases.
Source: Statens Institut for Folkesundhed (National Institute of Public Health); Road Noise Committee.

Table 6.2 **Selected health data**

Health care expenditure			Health situation		
Total health expenditure as % of GDP	1971	8.0	Life expectancy (2004)	Women[a]	79.9
	2004	8.9		Men[b]	75.2
			Infant mortality (2004)	4.4 per 1 000	
Financed (in %) by:	General government	83	Annual deaths (2000)	Circulatory diseases	33.0 (falling)
	Public health insurance	0	of which (%):	Cancer	27.7 (rising)
	Private insurance	1		Respiratory diseases	9.0 (rising)
	Households	16		External causes	6.6 (falling)
				Other causes	23.7

a) 24th place in OECD ranking.
b) 20th place in OECD ranking.
Source: OECD, Health at a Glance; OECD Indicators; OECD in Figures 2006-2007.

environmental factors on health, sets out four principles, outlines the *goals and initiatives* for the coming years and identifies ten priority areas (Box 6.2). However, it does not set quantitative targets or time horizons. Instead, it focuses strongly on the need for more knowledge about the links between environmental factors and health effects.

1.1 Chemicals and health

While emissions of chemicals from industries and other point sources of pollution have declined considerably in the past decade, their release to the environment is still significant. About 20 000 chemical substances are currently used in Denmark in an even greater number of products and goods.

Hazardous substances

A first objective of the environment and health strategy is to reduce the negative impacts from chemicals and accelerate the substitution of *hazardous substances* by less hazardous ones. The long-term goal is that no products or goods should be on the market in 2020 that contain chemicals having particularly problematic effects on health and the environment. In this respect Denmark has worked intensively to strengthen the knowledge base and *regulation* of chemicals

Box 6.2 **Strategy and action plan on environment and health,** 2003

Denmark's *strategy* on environment and health is based on *four principles*: everyone must be ensured a high level of protection; the precautionary principle must be applied; the adverse effects of environmental factors on health must be prevented; and information and involvement must be ensured so that everyone can take responsibility for a healthy life.

To achieve the overall goals an action plan establishes ten priority areas:

1. negative impacts from chemicals are to be reduced, and the substitution of hazardous substances by less hazardous ones must be accelerated;
2. the total number of allergy and respiratory disorders is to be reduced;
3. measures directed at endocrine-disrupting substances are to be intensified;
4. noise nuisance is to be reduced;
5. the negative impacts on health from air pollution and from indoor conditions are to be reduced;
6. food is to be safe and free from pollution;
7. groundwater and drinking water must be protected;
8. research into the impact of environmental factors on health is to be enhanced;
9. co-operation between the authorities must be strengthened;
10. increased attention must be accorded to environmental factors and health in international co-operation.

Source: Danish Government, 2003, Strategy and Action Plan to Protect Public Health against Environmental Factors.

during the EU REACH Directive negotiations. Nationally, the regulation on working with chemical substances and materials has been amended (2004) to ensure the registration of all professional uses of dangerous substances in the *national product register*. This has lead to a steadily increasing number of chemicals being registered every year. Between 1994 and 2004 the number of registered chemicals rose from about 2 500 to 15 000. The national list of unwanted chemicals has been revised several times, and to promote the substitution of dangerous substances with less harmful or safe substances, a database that supports exchange of experience on substitution of dangerous substances has been established (Box 5.4).

Allergy and respiratory disorders

A second objective of the strategy is to reduce the total number of *allergy and respiratory disorders*. The measures focus on means to phase out the use of allergenic substances in consumer products, in the working environment, in food and in the indoor environment. The use of allergenic substances in cosmetics constitutes a considerable problem due to the direct contact with the skin and the duration of the exposure. Focus has been placed on a number of chemicals and substances, including nickel, preservatives, perfumes, pigments and rubber materials. EU rules on labelling were adopted in 2005 with regard to the perfume content of cosmetics, detergents and cleaning agents.

A National Allergy Research Centre for Consumer Products was established in 2001. The centre has provided *scientific documentation* which has contributed significantly to the EU policy process. A model for the assessment of allergenic effects has been developed and risk assessments have been carried out with regard to indoor dust, cleaning agents, surface active substances, volatile organic compounds, phthalates and quaternary ammonium compounds. A clinical database on contact allergy has been established, where incidents of contact allergy are registered. Denmark is one of the *leading countries in the development of computer models* for predicting the characteristics of chemical substances [(Q)SAR]. Considerable focus is placed on prevention through the provision of information and guidance to consumers and health staff. A number of web pages on allergy have been established.

Endocrine disruptors

A third objective of the strategy concerns *endocrine-disrupting substances*. Measures are mostly related to the development of methods to test the properties of endocrine disrupters. Denmark has in this respect contributed to the ongoing work of the OECD. The fertility of young men has been monitored nationally for the last ten years. During this period no changes in semen quality have been observed. However, the results indicate that more than one-third of young Danish men could suffer from lowered fertility at a later stage in their life. Four hundred substances have been analysed using (Q)SAR models to predict their ability to reduce testosterone. In addition, Denmark is contributing to an EU research project on combination effects and the effects of low doses of endocrine disrupters. The revised Danish list of unwanted substances contains all the endocrine disrupters from the EU list.

Food and drinking water

Food and drinking water are another important source for uptake of chemicals, especially residues of bio-accumulative chemicals such as heavy metals[1] and

persistent organic pollutants[2] (like dioxins, PCBs and some pesticides). The measures taken to ensure that Denmark's food supply is *safe and uncontaminated* focus on prevention of contamination at the source and regulation (limit values for unwanted chemical substances in food) as well as on dissemination of information on food quality and food safety. Measures to reduce environmentally-related contamination of food are carried out as part of media-specific environmental measures. Further, Denmark ratified the *Stockholm Convention* on Persistent Organic Pollutants (POPs) in 2003, and all POP-pesticides covered by the convention were banned by law in 2003.

Generally, the *dioxin content* in Danish food stuffs is under the level set by the statutory order.[3] For PCB, the focus has been on certain types of fish. Pregnant women are usually advised to be prudent with intake of fish and sea food. PCB in fish has been measured since 1983, when a monitoring programme on PCB in food was launched. Despite the general reduction in PCB found in fish, some types of fish from certain Danish waters will probably exceed the new limits set by the EU directive.

A special *monitoring programme for dioxins* started in 2000 (Bossi et al., 2006). Concentration in mothers' milk is a good indicator for human exposure to POPs. Time series show a decline of dioxins (48%) and dioxin-like PCBs (67%) in mothers' milk between 1993 and 2004 (EPA, 2006a). However, in other countries that do extensive monitoring of mothers' milk (e.g. Sweden), levels of polybrominated diphenyl ethers (PBDEs) seem to be on the rise. Time series data for PBDEs do not yet exist for Denmark.

All inhabitants of Denmark have access to a *water supply* of good drinking water quality, as defined by the EU drinking water directive. Danish drinking water generally comes from abstraction of clean groundwater. Only exceptionally is the water treated. If groundwater used for water supply is polluted, the well will normally be closed and the water supply will then come from other reservoirs. Several reservoirs have been closed in recent years due to contamination or risk of contamination by pesticides or nitrates. About 50 wells were closed in 1998, and the number rose to 550 by 2003. Although several measures have been taken lately to reduce the use of pesticides, it will take time before the results will be seen in the groundwater (Chapter 3).

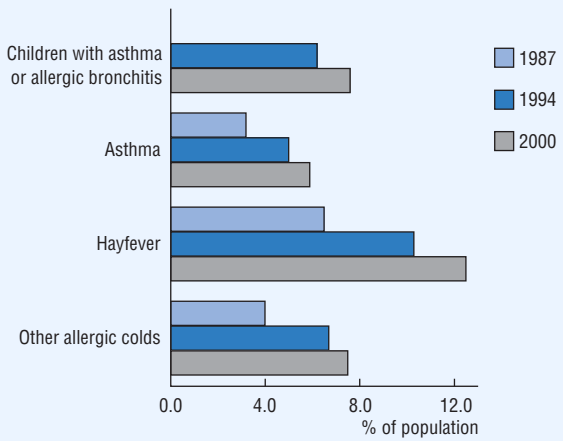
1.2 Outdoor and indoor air pollution

In recent decades, outdoor air quality has improved due to emission controls on industrial and energy facilities, incinerators and transport. Harmful outdoor exposure to

several air pollutants (lead, SO_2, NO_x) has thereby declined (Chapter 2). Nevertheless, the *incidence of respiratory health problems is rising* (Figure 6.2), probably largely due to chronic exposure to emissions from motor vehicle exhaust or wood burning. It is estimated that air pollution in Denmark is responsible for 3 400 premature deaths annually, and 300 excess cases of lung cancer per year (Table 6.1).

Indoor air quality is of prime importance to public health since people spend about 90% of their time indoors, whether at home or in offices. Diseases like asthma, allergy or other types of hypersensitivity are often related to *poor indoor conditions*. In Denmark, about 15-20% of all young people have seasonal hay fever due to pollen allergy. The Building Act treats several factors that are of importance to indoor conditions, for example regulation of *ventilation systems*. The authorities do not regularly monitor the level of *radon* in the indoor environment, but have defined recommended limit values. About 5% of Danish one-family houses have concentrations over the recommended value. A report done for the Ministry of the Environment (EPA, 2006b) concluded that the main health risks in the indoor environment today are *particles, radon, mould and mites, chemicals, tobacco smoke and noise*. Different risk factors in indoor conditions are treated in different regulations and strategies.

Figure 6.2 **Prevalence of asthma and allergy,** 1987-2000



Source: MoE (2005), Indicators for Sustainable Development.

1.3 Noise

Another objective of the strategy on health and environment is to *reduce noise nuisance*. According to the World Health Organisation (WHO), traffic noise can generate headache, increased blood pressure, increased risk of heart disease, stress and sleep disturbances. By contrast, absence of noise (quiet areas) seems to have positive effects on people's mental wellbeing. Many people in Denmark live in areas where noise is a nuisance, and road transport is the most important source.

Denmark set ambitious goals in 1993 to reduce the number of dwellings *severely affected by noise (more than 65 dB*[4]) from 150 000 to 50 000 by 2010 (Ministry of Traffic, 1993). Today, the number of dwellings severely affected remains at about 150 000. The number of dwellings exposed to road-traffic noise *above the recommended noise limit (55 dB*) has also remained quite stable despite the increase in traffic (EPA, 2003a). The number of dwellings exposed to a high level of *noise from airports and railways* has, however, been reduced to some extent. In 2003, 700 000 Danish dwellings were exposed to road-traffic noise above the recommended noise limit, while some 60 000 dwellings were exposed to a level of noise above the recommended limits from airports or railways.

In *Copenhagen*, 50% of dwellings are exposed to noise of more than 55 dB (Table 6.3). In a survey carried out in Copenhagen in 2003, 13.2% of the people interviewed said they considered traffic noise during the day to be a big problem. Only 3-4% of these considered traffic noise at night to be a considerable problem.

Table 6.3 **Population exposed to traffic noise,[a] Copenhagen**

	1995	1997	1999	2001	2003	2005
More than 70 dB(A)[b]	5 283	5 702	5 944	6 163	6 004	5 410
65-70 dB(A)	30 758	32 309	33 682	34 287	34 417	33 863
More than 65 dB(A)	36 041	38 010	39 626	40 450	40 421	39 273
Traffic work	100	107	110	114	116	117

a) Noise levels in facade of dwellings.
b) A-weighting of decibels is a standard for noise measure that takes into consideration the human ear's sensitivity to certain frequencies.
Source: MoE.

Initiatives taken

The *most important initiatives* to combat noise problems for existing dwellings over the past ten years concern the *state road* network. From 1992 to 2002, the Road Directorate carried out noise-abatement initiatives along the existing state road network, notably by establishing noise *screens* (EUR 27 million). Due in part to these initiatives, and due to new *EU regulations on noise from cars and urban traffic planning*, the number of dwellings severely affected by road noise nuisance in Denmark has not increased over the past ten years.

Measures have so far focused on noise from roads, noise-related improvements for buildings, noise in day-care facilities, and sectors where noise nuisance is affecting people's hearing. A *guideline* on acoustics in school buildings and day-care facilities has been developed. A *study* on noise from neighbours is currently being carried out, the results of which will feed into a new set of rules on apartment buildings. With the aim of targeting future measures at protecting young people, a *study* on the exposure of children and young people to noise has been carried out.

In connection with the *construction of new roads*, efforts are being made to keep to the noise limit of 55 dB when the road passes through large urban areas. This has been the practice on state roads for many years. In accordance with the Planning Act and the Building Act, no new housing has been built over the past 20 years that is exposed to traffic noise levels above 55 dB at facade and 30 dB inside. Since the early 1980s, about 300 000 dwellings have been built taking account of noise nuisance.

A road noise strategy

In 2003, the Road Noise Committee, set up by the government, submitted its proposal for a *road-noise strategy*. As 85% of the noise-affected homes are located alongside municipal roads, the ten main initiatives in the strategy aim to establish an improved framework for local action. One of these initiatives is the preparation of a "recipe book" for financial noise partnerships between municipalities and homeowners. The strategy also comprises the foundation for implementation of the EU Noise Directive.

The analysis in the road-noise strategy shows that the only way to achieve the 1993 goal for 2010 is through an extremely large investment (about EUR 0.9 billion). However, other scenario calculations show that it would be possible to reduce noise significantly with a smaller overall investment (EUR 0.3-0.4 billion), provided the measures aim at a goal for 2020. Among other things, this would involve: i) changing to less noisy road surfaces[5] when the roads are resurfaced during regular maintenance, and ii) benefiting from the improvement of the vehicle stock as it is

progressively replaced. For the time being, no *economic instruments* are being used to abate noise. However, the strategy considers a tax differentiation for the benefit of quieter tyres in 2010, if other means (like information to consumers) to promote quieter tyres do not prove effective.

Cost-benefit analyses and valuation of health costs and nuisance

In connection with the road-noise strategy, a preliminary survey of the extent to which traffic noise affects health in Denmark has led to estimates of 200 to 500 premature deaths annually and an additional 800 to 2 200 hospitalisations annually as a result of cardiovascular diseases or high blood pressure (Table 6.1). Based on these estimates, the strategy values the actual *health effects of road noise* at EUR 0.09 billion per year on the basis of a cost-based approach, or at EUR 0.5 billion per year on the basis of a willingness-to-pay approach. Further, the valuation of nuisance associated with road noise has been estimated through a study of variation in housing prices (EPA, 2003b). On this basis, the total annual social costs of the *nuisance from road noise* are estimated at EUR 0.7 billion in the road-noise strategy.

Overall, the benefits of higher house prices and less disease are estimated to exceed the costs of the initiatives to reduce noise (e.g. noise screens, noise-reducing asphalt, noise-reducing windows) in the road-noise strategy.

1.4 Access to nature and physical exercise

Access to nature

Access to nature and outdoor recreational activities are given increased attention in many official documents. The estimated health benefits from physical exercise and open-air activities are behind, for instance, open-air kindergarten activities, campsites, nature playgrounds and nature trails in state forests. Another initiative with recreation in nature as the main objective is the establishment of national parks (Box 4.2).

Denmark is a relatively forest-poor country with around 0.1 hectares of forest per capita. About 28% of the national forest area is publicly owned. The role of *state forests and state-owned land* is becoming central for recreational activities. Promotion of physical and mental wellbeing and opportunities for outdoor recreation are central objectives of the national forest programme (MoE, 2002). Recommendations to improve public access to nature (including private forests) were made by a commission set up by the Danish Forest and Nature Agency in 2001. About 75 million person-visits were made to a forest in 2005, and around 54 million

person-visits were made to beaches and coastal areas, which are nearly all publicly accessible in Denmark.

Despite the growing attention on the *positive health effects of being in nature and of physical exercise and recreation*, the topic is not included in Denmark's health or environmental health strategies or in any other national strategy.

Healthy cycling habits

Although Denmark is among the countries where people bike the most, cycling has decreased in recent years. However, the cities of Copenhagen (Box 2.2) and Odense have managed to break this trend. While obesity and lack of physical exercise are increasing in Denmark, studies have shown that people who cycle to work have a 28% lower mortality rate than the population average (Krag *et al*., 2005). An analysis of the socio-economic consequences of investing in cycling showed cost-benefit ratios much higher than normally expected from transport projects.

Concerning *children*, experience shows that when young people establish an inactive lifestyle, they have difficulty changing it later. At the same time, most children would like to bike to school and to be more active in general. Often parents drive their children to school because they believe it is too dangerous for them to go by bike. Several NGOs are carrying out campaigns to establish good cycling habits among school children, laying a foundation for a healthy and active life; the campaigns outline what different actors like parents, schools and the authorities can do to contribute (Nielsen, 2007).

Cycling is widely promoted in Denmark, both as a means of environmentally friendly transportation and as a way to exercise and improve health. The Danish Cyclists Federation has for many years run a "Bike to Work" campaign. A similar campaign called "Freewheeling" was launched in 2002, directed at schools and encouraging children to bike to school. Each class participates as a team, and prizes are awarded to the winners. In 2003, about one-tenth of Danish school children took part in the campaign (EPA, 2004).

2. Environmental Democracy

Environmental democracy in Denmark is among the most advanced in the OECD. Policy making has long been based on *wide access to information*, on a range of measures to ensure *public participation*, and on the *right to administrative and legal appeal*. And since 1998, Denmark has continued to further develop its environmental democracy.

The term "environmental democracy" can be defined on the basis of the 1998 Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, signed in Aarhus, Denmark (Aarhus Convention). Several principles in the convention were already part of the administrative laws in Denmark, but ratifying the convention did require adjustments in Danish legislation (e.g. to improve public access to information). The necessary changes were carried out in 2000, when the Access to Documents Act and the Act on Access to Environmental Information were amended according to the Act on Implementing the Aarhus Convention. Denmark was one of the first countries to ratify the convention.

2.1 Access to environmental information

Provision of information

Further to OECD's recommendation in 1999, Denmark publishes *a report on the state of the environment* at regular intervals. Danish legislation requires the report to be prepared every four years in consultation with relevant national businesses and consumer and environmental organisations. The National Environmental Research Institute (NERI) published the state of the environment report, called "Nature and Environment: Pressures and State", in 2001 and 2005.

In addition, the Ministry of the Environment has issued *annually a set of environmental indicators*, also called "Nature and Environment", since 1991. The core indicators have remained the same since the beginning, while the others have varied. The full indicator set now includes some 70 to 80 indicators. Since 2002, a new reporting concept has been introduced; it includes i) a thematic publication, presented in a popular form, and ii) the full indicator set provided electronically. The geographical levels covered are mostly national, but data are often presented at other geographical levels (e.g. regional point source, water wells, protected areas). Most major environmental themes are covered, although some standard environmental indicators are still missing, like private expenditure on environmental protection activities.

Denmark published its first *sustainable development strategy* in 2002 (Danish Government, 2002a). The strategy included a broad set of indicators (14 key indicators and about 100 thematic indicators). Indicator reports were also published in 2003 and 2004, but not in 2005 and 2006. Current work includes delivering short brochures on specific themes defined for the four annual meetings of the sustainable development council chaired by the Prime Minister.

The *legal basis* for producing the data or statistics that support the indicators is in the Environmental Protection Act, the National Planning Act and the NOVANA agreement. Reporting is covered in a number of acts and statutory orders, for example

those on soil contamination, water supply, waste and inspection. Further to a government decision, new publications by ministries and agencies have since 1997 been issued both electronically and in hard copy.

A major initiative related to the provision of environmental information is the establishment of the Environment Portal in 2007. Existing data and digitised geographical information *from the counties* is being archived for future use and large parts are available on the portal. The public also has access to a centre for information on environment and health, which opened in 2003.

Access to information

The website of the Danish Environmental Protection Agency (EPA) contains information on the *environmental rights* arising from the Aarhus Convention. According to Danish law, all natural or legal persons have the same rights of access to environmental information held by the public authorities, and they need not have a special interest or reason to obtain it. The reasons for refusal basically follow the line of the Aarhus Convention. Except for specific grounds,[6] the only formal reason to refuse requests is if they are too general. Some types of data, e.g. on emissions, must be made available even when disclosure is not in a firm's interest.

Replies to information requests must be supplied as soon as possible or at least within a month.[7] A fixed charge is set for requests about environmental information. In practice, however, most authorities do not charge.

2.2 Public participation

Denmark has a tradition of having an *open administration*. In general, all draft laws, programmes and plans are made public before being passed. Denmark has fully implemented the requirements of public participation in decision-making on specific activities listed in the Aarhus Convention. The legislation regarding the environment contains a number of regulations on planning, prior public participation and consultation in accordance with the convention. In addition, the public is to a large extent directly involved in a large amount of planning where participation is not required by law.

Denmark's environmental legislation contains a number of provisions on public participation in statutory *plans and programmes*. In the process of developing policies and strategies, preliminary meetings and workshops allow the public to have a say in the decision-making process. The proposal to establish national parks is an example of this (Box 4.2).

The Environment Ministry also offers citizens an opportunity to take part in the decision-making process by sending bills, proposed statutory orders, guidelines, plans

and programmes for hearing to a large cross-section of interested parties. Drafts of environmental acts and statutory orders are usually subject to four weeks of *hearings*. Further to a government decision, bills are made available on the Internet at the time they are sent for hearings. Public administrations are obliged to publish relevant hearing material in journals as well as on the Hearing Portal. Often, some 300 hearings may be in process on the portal simultaneously.

The major instrument for integration of social and environmental factors is the *regional and national physical plans* under the Planning Act. The planning process at all levels includes hearing procedures. As these plans are the background for administration and permissions for land use and a series of environmental issues, the hearing process is important. Local-level planning still encompasses direct seminars with citizens. However, the Hearing Portal is expected to be of increasing practical importance.

In 1999, Denmark implemented the *EU 1996 Council Directive* on Integrated Pollution, Prevention and Control (*IPCC Directive*). The integrated approach means that the permits must take into account the whole environmental performance of a plant. Permit conditions (including emission limit values) must be based on best available technology. The directive gives the public a right to participate in the decision-making process and to be informed of its consequences. The licensing system covers approximately 6 000 installations.

Monitoring by NGOs and the public

In the field of nature, a large part of monitoring is performed by scientists or volunteers from NGOs. The Danish government has a tradition of collaborating with, for example, the associations on birds, plants and butterflies. In the past, the monitoring focused mostly on spectacular or rare species, but in recent years NGO monitoring has given more importance to the broad nature concept and to common species. Interest in involving the public in monitoring has increased in recent years, especially boosted by modern reporting techniques using the Internet, digital phones and imageries.

2.3 Access to justice

Individuals and organisations have several options regarding access to justice. These include: i) a constitutional right to test cases in *court*, ii) extensive access to administrative procedures at special *administrative boards* for environmental issues, and iii) going to the *Ombudsman*. The general practice is that decisions are notified in writing. This is supplemented by the principle of good administrative practice under which significant decisions must be notified in writing. Moreover, the Public Administration Act allows the public to demand a written statement for a decision reported verbally.

Decisions on environmental issues made by courts and special administrative boards are *binding* and can be enforced. The decisions of the Ombudsman are not binding, but in practice the administration generally follows the recommendations of the Ombudsman. The Ombudsman's position on a case does not limit the possibility for courts to review the case subsequently.

Bringing a *case to court* involves a fee for instituting legal proceedings and usually costs for legal and expert assistance. The Danish Administration of Justice Act does however provide for the possibility of free trials. There is also a certain amount of public legal aid. Reviews by special *administrative boards* are essentially free in Denmark; however, in matters for the Nature Protection Board a charge has been set at DKK 500 per case.

There is no general *compensation* for the impacts of pollution or for nuisances from facilities, as all polluting facilities must undergo an environmental impact assessment and receive an environmental licence before they can be established. Older polluting facilities are also obliged to have an environmental licence, granted by either the municipality or the county. However, if a polluting facility exceeds the condition in the environmental license, citizens affected can go to civil court for economic compensation.

The *annual publication* "*Court Decisions and Judgements on Environmental Issues*" prints a selection of the decisions and judgements passed throughout the year. Between 1999 and 2005, the number of decisions and judgements was quite stable. However, the number of complaints to higher instances increased (e.g. cases to the Nature Appeals Board increased from around 1 500 in the mid-1990s to around 2 000 in recent years) (Chapter 5).

3. Environmental Awareness and Education

3.1 Awareness

Access to information and awareness raising are two sides of the same coin: better informed citizens and organisations will be more environmentally aware, and will thus modify their behaviour and their involvement in participatory social and decision-making processes. Information and partnership are twin objectives in present Danish environmental policy. Danes feel well-informed about the environment, more so than in the other countries in the EU-25 (European Commission, 2005a). Half of all Danes consider that people have a right to exploit nature for the sake of human well-being, while 96% of all Danes consider that we have a "duty to protect nature even when it means limiting human progress" (European Commission, 2005b).

3.2 Education

During the 1990s, environmental issues became more visible at all levels of the Danish education system, after the adoption of "the green perspective" in education policy, which aims to integrate environmental education into all topics and levels of the education system, from primary school to universities. In practice, teaching of basic environmental issues begins in pre-schools or kindergartens (e.g. open-air kindergartens) on an ad hoc basis. Environmental topics are taught during all nine years of compulsory schooling. Understanding the relationship between man and nature is a *central objective in the School Act* of 1999.

The Internet is now widely used in education. In 1999, an education portal (EMU) was set up as an "electronic meeting place for education", providing teaching resources for teachers, parents and pupils. The portal has a specific *site on* "*environment and nature*", developed in co-operation with the Ministry of the Environment. From time to time, specific campaigns are run on the site.

The *Green Flag schools* programme was started in the early 1990s. A Green Flag school is one that has carried out one or more Green Flag activities, which focus on themes like water, energy, waste, nature, environmental auditing and eco-labelling. Participating schools receive a flag for each theme completed, and are then allowed to fly the flag for a year. Once the year is over, the requirements associated with a new theme must be met. The number of schools with green flags rose from about 90 in 1998 to 210 in 2004. Recently, the Danish Outdoor Council launched a similar programme for kindergartens, called "Green Sprouts".

4. Environmental Employment

Unemployment decreased from 7.1% in 1995 to 5.0% in 2005 (OECD, 2006), and demand for labour is high at the moment in Denmark. The need to create new jobs is therefore not urgent. The Danish programme to promote environmentally friendly business (2004), and more generally Denmark's environmental policy overall, have not been assessed recently in terms of their employment effect. They are believed to have a positive effect on the international competitiveness of Danish industry.

In 2006, *60 000 people were employed in the environmental sector* (Rosted *et al.*, 2006). Overall, *2.2% of all jobs* in Denmark are in eco-industries or environmental service sectors.

The *action plan on eco-efficient technologies* (Chapter 5) focuses on economic growth and export, while at the same time helping to solve environmental and resource-

related problems. A side effect is thus growth in environmentally-related employment. Some environmental employment is generated by the "*nature interpretation*" programme largely financed by local governments (Table 6.4 and Box 6.3).

Table 6.4 **Nature interpretation,** 1987-2005

	1987 (start)	1995	2000	2005
Number of nature interpreters	13	145	249	315
Number of events arranged	1 408	7 000	21 000	28 000
of which for schools:	362	3 900	11 500	17 000
Number of participants in events	30 000	250 000	750 000	820 000

Source: MoE.

Box 6.3 **Nature interpretation**

The Danish Nature Guide Scheme started in 1986, with training courses for nature interpreters. Currently, there are *more than 300 nature interpreters* promoting knowledge and understanding of nature and the environment. The programme is managed by the Danish Forest and Nature Agency together with the Danish Outdoor Council.

"*Nature interpretation*" has evolved from being guided tours into a tool for *promoting sustainable development*. It promotes love of the countryside as well as understanding of local and global environmental conditions. In 2004, the objective of the nature interpretation service was extended to promote "direct involvement and influence of the public in nature and cultural management".

Children make up the most important target group: about 460 000 children (versus 360 000 adults) participated in one of the nature interpretation activities in 2005 (Table 6.4). The same year, nature interpreters gave 1 500 courses for 30 000 teachers to promote outdoor school activities in nature.

The nature interpreter system is largely anchored and financed at the local level. About DKK 74 million are spent per year for nature interpretation. About DKK 15 million come from state football and lottery pool funds. About DKK 59 million come from the employers of the nature interpreters: counties, municipalities, various institutions and associations.

Notes

1. Heavy metals have been shown to cause neurological disorders, birth defects, reproductive dysfunctions and various cancers.
2. POPs can cause various cancers and are suspected of causing birth defects, reproductive dysfunctions, immune response and nervous system disorders.
3. The average daily exposure to dioxins is however estimated to exceed the recommended limits set by the WHO.
4. All Danish noise limits, recommendations and statistics referred to in this chapter are given in L_{Aeq24h}.
5. Denmark is also carrying out research on noise-reducing asphalt.
6. E.g. national security, confidential international relations, protection of privacy, intellectual property rights.
7. Under special circumstances: up to two months.

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7

INTERNATIONAL CO-OPERATION*

Features

- Climate change
- Marine environment
- Marine resources
- Regional co-operation (Arctic, Nordic, North Sea, Baltic Sea, Eastern Europe)
- Trade and environment
- Environmental assistance

* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1999. It also reviews progress with respect to the objectives of the 2001 OECD Environmental Strategy.

Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Denmark:

- ensure that *cost-effective domestic measures* will contribute to meet the Kyoto Protocol's *greenhouse gas emission reduction target*, especially in sectors *not covered by the EU Emission Trading Scheme*; accelerate *afforestation*;
- place higher priority on *marine protection*, including marine ecosystem protection; take further steps to reduce the discharge of *toxic substances and nutrients*; ensure that Denmark's international commitments are achieved; continue efforts towards appropriate *dismantling* of Danish end-of-life *ships*;
- pursue efforts towards the sustainable management of *commercial fisheries and aquaculture*;
- continue to play an exemplary role in international environmental protection including through *development aid*; continue to contribute to sustainable development and capacity building in developing countries through environmental technology exports and other measures (e.g. support for environmental education and awareness programmes);
- continue efforts to ensure appropriate implementation of multilateral environmental agreements involving *trade* (ozone-depleting substances, hazardous substances, chemicals, endangered species);
- *accelerate the ratification* of international environmental agreements already signed.

Conclusions

Denmark's proactive stance on protecting the environment through international co-operation has played an influential role in a number of international negotiations, particularly in the EU context. Denmark has met or is well on the way to meeting many of its *international commitments* (e.g. reduced discharges of phosphorous and heavy metals into the Baltic and the North Seas, reduced atmospheric emissions of SO_2 and VOCs). Denmark has phased out or reduced its emissions of ozone-depleting substances ahead of internationally agreed deadlines. Denmark continues to provide a relatively high level of *official development assistance* (0.81% of GNI in 2005). Environmental management is mainstreamed into a substantial part of bilateral and multilateral regional assistance programmes. Danish export credits are well managed and the environmental risk assessment follows the rules agreed within the OECD. Concerning *marine issues*, Denmark (recently) ratified the 1978 UN Convention on the Law of the Sea and shows progress in implementing conventions such as MARPOL,

London and OSPAR. Illegal oil spills in the Baltic and the North Seas were reduced by half during the review period. Finally, the Greenland Dialogue on climate is welcome.

However, there is room for progress. Concerning *climate change*, in 2004, Denmark's greenhouse gas emissions had decreased by only 2% compared to 1990 (the base year). This is far from its challenging CO_2 emission reduction target (–21% for 2008-12) under the EU burden sharing agreement. The CO_2 reduction target of the 1990 Energy Plan was not met. Although good progress has been made in reducing greenhouse gas emissions from agriculture, households and the waste sector, much remains to be done and is in progress in the energy, transport and industrial sectors. This is despite the low energy intensity of the Danish economy. Review and revision of energy and transport prices and taxation should be considered. Denmark is one of the few OECD countries that have a carbon tax on energy products, but the CO_2 tax rate was reduced in 2005 to ensure a neutral overall energy tax burden. Further cost-effective domestic efforts will be necessary, given the anticipated allowances under the EU Emission Trading Scheme for the period 2008-12 and the limited scope for expanding the use of the Kyoto Protocol's *flexible mechanisms*. Afforestation projects are behind schedule with respect to the objective of doubling the forest area by 2040. Concerning *marine issues*, although Denmark has been active in many international and regional marine protection fora, fish kills (due mainly to oxygen depletion associated with nutrient discharges) have been reported annually for a long time in Danish coastal areas. The risk of oil spills and maritime accidents along the Danish coast, the Belt and the Øresund is high, with the heavy traffic from shipping and fishing activities. Inappropriate dismantling of Danish end-of-life ships in India became an issue in 2005. Concerning *transboundary air pollution*, while Denmark has met the 1998 Sofia Declaration target for NO_x emissions, achieving the Gothenburg target (55% reduction by 2010 from the 1990 level) will require further action.

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During the review period, Denmark *ratified a number of international environmental conventions and agreements, some of them old-standing*: these included the 1992 Helsinki Convention on the Transboundary Effects of Industrial Accidents, the protocols to the EU National Emission Ceilings Directive (2001/81/EC), and the 1982 Montego Bay Convention on the Law of the Sea (References II.A and II.B). However, Denmark has not ratified several other agreements. In the area of *marine pollution*, Denmark has signed but not ratified the 2000 Protocol (OPRC-HNS) for the 1990 London Convention on Oil Pollution Preparedness, Response and Co-operation

(OPRC). It has not signed the 2001 Convention on Civil Liability for Bunker Oil Pollution Damage, or the 2004 Convention for the Control and Management of Ships' Ballast Water and Sediments. Denmark has not ratified various other *agreements of regional scope*, including the 1993 Lugano Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment.

Denmark has made significant progress in *transposing EU environmental directives* into national law and has also played a *positive role* in developing new EU-wide environmental policy. A few EU directives have been difficult to implement. In 2006, the Commission's infringement procedures against 13 member states for violations of the Birds Directive and against 8 member states over the Habitats Directive included Denmark. Together with 11 other states, Denmark was sent reasoned opinions from the EC for failure to communicate transposition measures concerning the amended Seveso II Directive.

1. Climate Change

1.1 Objectives

Denmark has long taken a *vigorous international stance* on climate change, including through the *Greenland Dialogue initiated in 2005* (Box 7.1). Denmark has proposed to host the 2009 conference of parties of the United Nations Framework Convention on Climate Change (UNFCCC). Denmark made a commitment to take measures to reduce greenhouse gas emissions to 1990 levels under the UNFCCC and also undertook to work towards the EU target of stabilising greenhouse gases at 1990 levels. Concerning the 2008-12 target period, the *Kyoto Protocol* commits the EU region to reducing emissions of six greenhouse gases by 8%;[1] under the *1998 EU burden-sharing agreement*,[2] Denmark has *a stringent greenhouse gas emissions reduction target* (*21% reduction* from the base-year level) of all Annex I countries of the UNFCCC. This target reflects Denmark's ambition to contribute positively to the European effort and its relatively high emissions per unit GDP and per capita. Concerning the long-term future, an ambitious resolution by the Danish Parliament instructed the government to work towards a 50% reduction of emissions compared to the 1990 level of CO_2 emissions in all industrialised countries by 2030; it was, however, abandoned in 2000.

At *domestic level*, the target of a 20% reduction in energy-related CO_2 emissions by 2005 compared with 1988, set by the *1990 Energy Action Plan*, was not achieved. This target was broken down in the *1996 Energy 21 Plan* into a target of at least 28% reduction in emissions from stationary sources and stabilisation of transport emissions by 2005. The 1996 Energy 21 Plan sets a long-term target of reducing CO_2 emissions from the *transport sector* by 25% by 2030 compared to 1988 levels.

Box 7.1 **Greenland Dialogue on climate**

In August 2005 Denmark organised and hosted, with Greenland, the first of what may become a continuing dialogue on climate change, its devastating impacts, and ways to combat them. Denmark's purpose was to nurture a more *constructive and all-inclusive dialogue* among key countries from industrialised, transitional and developed country groupings, allowing for inclusion of the major economies that are not included in the Kyoto agreement. A set of simple "rules" for the dialogue included: first, that no decisions were to be taken; second, that only ministers and heads of delegation were to participate; and third, that the talks were to be coupled with excursions on site, in Greenland, to allow the ministers to witness the impacts of climate change in the Arctic environment.

Twenty-two countries participated, including China, India and the United States. The meeting succeeded in *allowing for support for some basic principles* and views such as: the need to end the "blaming game" among countries on climate issues, to improve knowledge of economic costs and benefits, and to raise the awareness of the general public and in the private sector; the need for urgent action to avoid the cost of inaction, and for application and transfer of technologies; the need to integrate climate change into sustainable development; and the need to develop an inclusive strategy after 2012 with options such as sectoral targets, voluntary commitments and further differentiation of parties within existing frameworks and types of commitments.

The initiative was replicated, under the title "*The Greenland Dialogue*", in a subsequent informal meeting of environment ministers in South Africa in 2006. A third meeting is planned in 2007. Denmark expects the meetings to provide for an open and informal discussion among political decision-makers, as background to the formal convention work.

In summer 2006, Denmark invited, and Greenland hosted, a visit by United States senators to enrich their impression of the climate change problems in the Arctic. In the same vein, Denmark, together with European countries and the European Commission, has taken the initiative of trying to secure a *congressional hearing* on European climate change policies with the purpose of demonstrating the viability of these policies.

With quantitative international targets set through 2012, the qualitative *domestic goal* for this period is to achieve the international targets in a *cost-efficient way*, in accordance with Denmark's *Climate Strategy 2003*. A significant element of this strategy is to combine cost-effective domestic measures with the flexible mechanisms of the Kyoto Protocol: emissions trading, joint implementation (JI) and the clean development mechanism (CDM). With the Climate Strategy 2003, Denmark's *focus shifted* from the previous domestic quantitative targets to a combined strategy to place

Danish domestic emission reductions within the context of the international quantitative targets and the international market for emission reductions.

1.2 Greenhouse gas emissions

Denmark's greenhouse gas emissions have only *slightly decreased* since 1990 (to reach 68.1 million tonnes CO_2 equivalent in 2004)[3] (Table 7.1).The *carbon intensity* of the Danish economy (i.e. CO_2 emissions per unit of GDP) is slightly below the OECD-Europe average. Per capita and per unit total primary energy supply (TPES) are higher than in many other European countries (Figure 7.1). Substantial efforts will be required to reduce the country's greenhouse gas emissions. Without the Climate Strategy, Denmark's excess emissions were expected to be 20-25 million tonnes CO_2 equivalent per year during the period 2008 to 2012.[4] This amounts to 25-30% of Denmark's recent total greenhouse gas emissions. Addressing this excess will be a *challenge*.

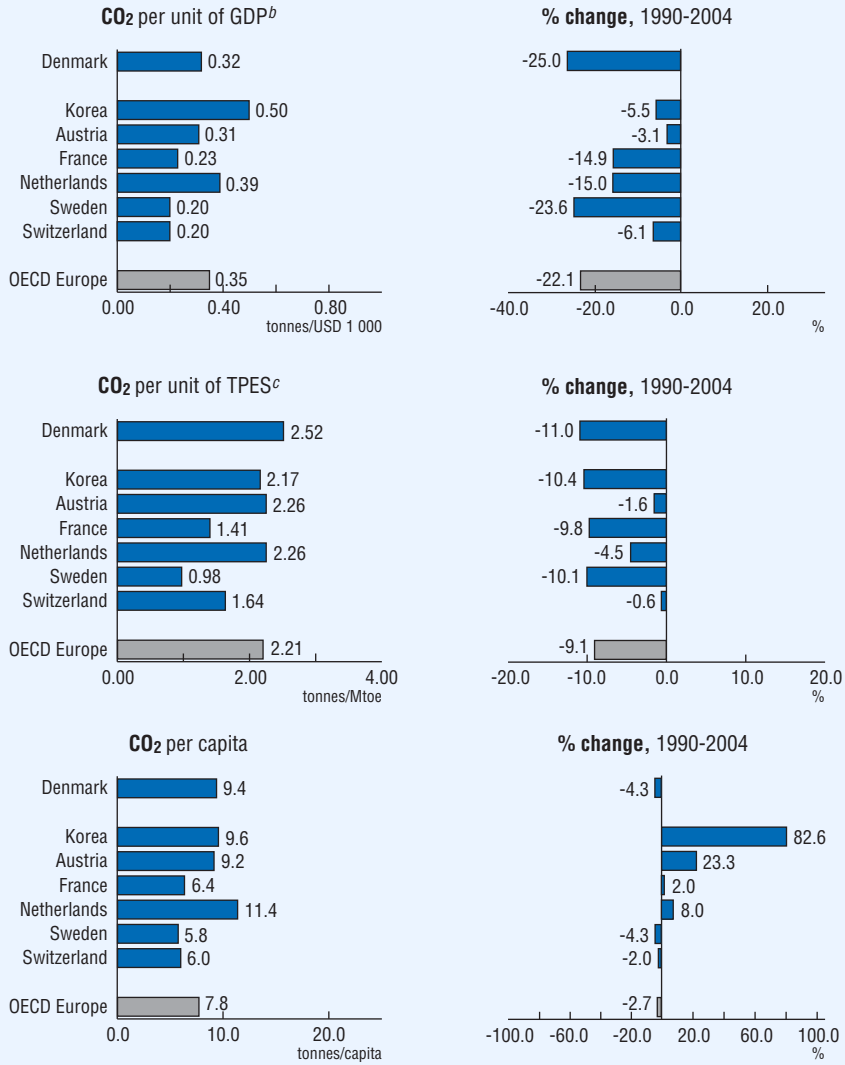
On the positive side, emissions from *agriculture* fell by 23% between 1990 and 2004, mainly due to implementation of the Action Plans for the Aquatic Environment; these plans have served to reduce nitrogen emissions, which leads to a reduction of nitrous oxide emissions. Emissions from *households* fell by 19% between 1990 and 2002 due mainly to more efficient energy consumption and the conversion of individual oil heating systems to natural gas or district heating. Methane emissions from the *waste sector* (i.e. from landfills) fell by around 10% between 1990 to 2003 due mainly to the 1997 ban on landfilling of combustible

Table 7.1 **Greenhouse gas emissions**

	Base year[a]	1998	1999	2000	2001	2002	2003	2004	2010[b, c]
Million tonnes of CO_2 eq.	69.3	76.0	72.9	68.2	69.6	68.9	73.9	68.1	72.3 (55)
Index (base year = 100)	100	109	105	98	100	99	106	98	104 (79)

a) In accordance with the Kyoto Protocol, the base year is composed of emissions of CO_2, methane and nitrous oxide in 1990 and emissions of so-called industrial greenhouse gases in 1995. The base year is shown here without correction for imports of electricity in 1990, as claimed by Denmark. The Kyoto Protocol target for Denmark under the EU burden sharing is 54.8 million tonnes of CO_2 equivalent as an annual mean during 2008-12.
b) 2010 stands for mean emissions during 2008-12.
c) Figures are National Environmental Research Institute (NERI) estimates. Figures in brackets are Denmark's Kyoto target.
Source: NERI.

Figure 7.1 **CO_2 emission intensities,**[a] 2004



a) CO_2 emissions from energy use only; sectoral approach excluding international marine and aviation bunkers.
b) At 2000 prices and purchasing power parities.
c) Total primary energy supply.
Source: OECD-IEA (2006), CO2 Emissions from Fuel Combustion; OECD (2006), OECD Economic Outlook No. 80; OECD-IEA (2007), Energy Balances of OECD Countries 2004-2005.

waste, as well as to the increasing collection of methane from landfills for energy purposes.

However, there is a particular need to reduce emissions from transport and industry. Emissions from the *transport* sector grew by 22% between 1990 and 2003. Although Denmark has introduced economic incentives to encourage the purchase and use of more energy-efficient cars (140 g CO_2 per kilometre), traffic volume, average car size and CO_2 emissions from the transport sector seem to continue to grow. Structural factors such as the high level of economic growth, the car buyer's increasing demand for performance and comfort, and the failure of voluntary agreements explain the current trend. Emissions from *industry* rose by 6% between 1990 and 2002, due partly to greater energy consumption and to the increasing use of HFCs as an alternative to ozone-depleting refrigerants. Denmark therefore needs to review its range of policy options concerning energy efficiency and substitution of greenhouse gas-intensive products, as well as energy and transport pricing and taxation (with an eye to internalising the costs of climate change for all end users).

Overall, Denmark has made *positive progress in decoupling* energy consumption from GDP growth (the latter rising at an annual rate of 2 to 3%). Indicators illustrate the progress in reducing emissions per unit GDP, per capita and per gross energy consumption.

OECD's previous Environmental Performance Review recommended that Denmark review its basis for adjusting *CO_2 emission data* to ensure compatibility with methodologies used internationally. Currently Denmark reports annual greenhouse gas inventories under the UNFCCC and the EU Council Decision, as well as adjusted national data in terms of temperature variations and, unlike other countries, trade in electricity.[5]

1.3 Measures to reduce emissions

CO_2 emissions

Denmark's current measures for reducing CO_2 emissions, set out in the *National Climate Strategy 2003*, include: establishment of an interdepartmental climate committee; implementation of the EU Emission Trading Scheme and establishment of a national allowance registry; initiation of a project to investigate possible additional cost-effective measures; agreement on the Action Plan for the Aquatic Environment III (nitrous oxide emissions from agriculture); and allocation of funds to JI and CDM projects and their implementation.

Since 2005, the *EU Emission Trading Scheme* has replaced Denmark's national allowance scheme. If the amount of quotas for activities under the EU scheme has been approved, the deficit will be estimated to be zero. The EU allowance scheme for 2005-07 will cover nearly half of Denmark's total greenhouse gas emissions. Under the national allocation plan, the present allowance regulation in Denmark includes individual emission limits during 2005 to 2007 for CO_2 emissions from 377 Danish production facilities. The anticipated reduction effect of 7.4% of the new allowance regulation corresponds to a reduction of 6 million tonnes of CO_2 annually during this period. Danish companies executed the first spot trading in 2005. A new plan for strengthened energy-saving efforts has been adopted.[6]

Economic instruments

Denmark is one of the few OECD countries that has introduced a *carbon tax* on energy products. Introduced in 1992 for households and space heating in industry, the tax has since been increased and extended to industrial processes, though with low rates for energy-intensive industries (Table 7.2). Revenues from the tax increased from DKK 4 140 million in 1998 to DKK 5 072 million in 2005, amounting to 8% of Denmark's environmentally-related tax revenue and 0.8% of its total tax revenue in 2005. In 2005, a revised CO_2 tax scheme entered into force and the basic tax rate was lowered to DKK 90/tonne CO_2 emissions from its 2004 rate of DKK 100/tonne CO_2. To ensure that the overall tax burden is neutral, the energy tax has been

Table 7.2 **CO_2 tax rates,** 1996-2005

(DKK/tonne CO_2)

	1996	1997	1998	1999	2000-04	2005
Households (basic rate)	100	100	100	100	100	90
Industry						
Heating (basic rate)	100	100	100	100	100	90
Light processes:						
– without voluntary agreement	50	60	70	80	90	90
– with voluntary agreement	50	50	50	58	68	68
Energy-intensive processes						
– without voluntary agreement	5	10	15	20	25	25
– with voluntary agreement	3	3	3	3	3	3

Source: IEA-OECD; Erik Rasmussen og Tina Knudsen, Klima Bidrag fra MST-Klima/ER + TIKNU.

correspondingly increased. Industries engaged in voluntary agreements to improve energy efficiency receive CO_2 tax concessions. The share of bio fuel in both gasoline and diesel is exempt from the CO_2 tax. A *tax on industrial greenhouse gases* (HFCs, PFCs, SF_6) was introduced in 2001. Different rates apply for different gases based on their global warning potential (Table 5.9).

In 1999, *the car registration tax* was reduced for particularly energy-efficient cars (Table 2.2). Electric vehicles up to two tonnes are exempt from this tax. From 1997, the vehicle excise duty was replaced by the *green owner tax*, which is based on fuel consumption, to promote energy-efficient cars. The tax increases with increased fuel consumption per kilometre.

A *review of the Danish tax system* has been launched to reduce its complexity. One of the objectives is to analyse the CO_2 taxes in relation to the CO_2 allowance scheme, which entered into force in 2005, as well as to analyse whether the energy taxation system can be better designed. The review is expected to be finished in 2007. Continuation of the green tax reform should contribute to Denmark's performance in meeting its climate change commitments.

Cost-effectiveness of measures

A Danish analysis of cost efficiency showed that only a few additional domestic measures (e.g. additional energy-saving activities, heat pumps and flare gas recovery) would be as cost efficient as additional reductions through JI and CDM projects under the Kyoto Protocol. *A benchmark* of DKK 120 (EUR 16) per tonne of CO_2, which was set as the upper limit for acceptable costs for additional domestic measures, was raised to *DKK 180* (EUR 24). The analysis showed that the costs of including these activities would be unlikely to exceed DKK 100 (EUR 13.5) per tonne CO2, with the most likely price being DKK 40-60 (EUR 5.4-8.1) per tonne CO_2. However, IEA reports that the actual price for EU allowances was more than DKK 194 (EUR 26) in January 2006 (IEA, 2006).[7]

Use of the Kyoto Protocol's *flexible mechanisms*, i.e. trading in the credits from CO_2 reduction projects in developing countries and in Central and Eastern Europe, as well as trading in CO_2 quotas, might help Denmark to meet its reduction commitments. The total costs of eliminating excess Danish emissions are estimated to range from DKK 1-2 billion (EUR 135-269 million) to DKK 4-5 billion (EUR 538-673 million) per year in the period 2008 to 2012, depending on the measures taken. Since the Climate Strategy 2003 was agreed, Denmark has allocated DKK 1 130 million (EUR 152 million) for the purchase of CO_2 credits from such projects, estimated to correspond to 4.5 million tonnes of CO_2 equivalent annually over the period 2008 to 2012 with an average cost of DKK 50 per tonne CO_2 (roughly

EUR 7/t CO_2) (Rasmussen *et al.*, 2005a). The most expensive initiative would be using domestic measures in the form of extending the use of renewable energy. The *Danish Carbon Fund* (DCF) was established in January 2005 with two public participants (the Danish Ministry of Foreign Affairs and the Danish Environmental Protection Agency) and two private sector participants. In the summer of 2005, three other private sector participants joined the DCF, increasing its capital to about EUR 58 million. The DCF purchases emission reductions from renewable energy projects, combined heat and power projects, and landfill projects that are implemented in developing countries and in countries with economies in transition.

Other greenhouse gas emissions

Methane emissions dropped steadily during the review period, though they were still 3% above their 1990 level in 2003 (5.9 million tonnes CO_2 equivalent in 2003). Emissions of methane from landfills are decreasing due mainly to the 1997 ban on landfilling of combustible waste, while emissions from the energy sector have been increasing due to an increased use of gas-driven engines. In 2003, total *nitrous oxide* emissions were 25% below the 1990 level due mainly to the 30% reduction in emissions from agriculture. The combined emissions of the potent greenhouse gases (HFCs, PFCs and SF_6) rose 28% between 1999 and 2003,[8] although the rate of increase decreased after 2001 due to taxes and regulations introduced for the use of new installations/products. Emissions of *HFCs* increased by 38% between 1999 and 2003 (to 695 000 tonnes CO_2 equivalent in 2003), emissions of *PFCs* rose 58% (to 19 000 tonnes CO_2 equivalent), and *SF_6* emissions dropped by half (to 31 000 tonnes CO_2 equivalent).

1.4 Policy integration: energy, transport and forestry

The *electricity generation* sector in Denmark accounts for a larger share of CO_2 emissions (44% in 2003) than in many other OECD countries, while the *transport sector* accounts for a relatively smaller share (22% in 2003). Electricity generation offers greater possibilities for cost-effective fuel substitution than the transport sector. To meet targets, behavioural and technological changes will be needed, in turn requiring that energy and transport pricing and taxation move further towards internalisation for all end users.

Although the 1996 Energy 21 Plan anticipated that improvements in energy efficiency (e.g. higher appliance and equipment efficiencies, expanded use of cogeneration) would result in a 12% reduction in total CO_2 emissions by 2005 relative to 1988, the CO_2 emissions reduction target of 28% from stationary sources by 2005 was not met. Several recent *measures in the energy sector* include: a scrapping scheme for old, badly located wind turbines; a national CO_2 allowance scheme for

electricity producers (2001-04); EU CO_2-allowances for electricity and district heating production and certain industrial processes; subsidies for electricity generation (wind turbines); savings activities by electricity grid, gas and district heating companies; a price supplement for environmentally-friendly electricity; and tenders for offshore wind turbines (Box 5.2).

Denmark has used a variety of economic instruments to reduce CO_2 emissions from the *transport sector*, but has not yet achieved its reduction target (Chapter 2). The *1996 Transport Action Plan* details the measures needed to stabilise transport emissions. The 1999 OECD Environmental Performance Review suggested that Denmark should envisage supplementary measures, since the Action Plan assumed fuel prices in 2005 would be 30% above 1988 prices. The plan estimated that the total effect of its measures would be to reduce CO_2 emissions by 15% below the business-as-usual emission level for 2005. In 2003, however, CO_2 emissions from the transport sector were about 22% above the 1990 level, accounting for 22% of Denmark's total CO_2 emissions. The Danish government recently set up a committee to examine ways to reduce greenhouse gas emissions, including from transport. The Ministry of Transport and Energy is in the process of working out a national policy plan for spring 2007 (Chapter 2).

Denmark's target for *afforestation* is to double the forest area in one tree generation (80-100 years) or to establish forest cover on approximately 25% of the country's territory (or about 10 500 km^2) (forest currently covers 13% of the country, or around 5 500 km^2). The average annual rate of afforestation, including private afforestation without subsidies, was 26 km^2 during the period 1999 to 2004, too low to reach the target. Denmark's fourth national communication on climate change projects an annual rate of afforestation of 19 km^2 through 2014 and 11 km^2 during the period 2015 to 2030, due to the cessation of subsidised afforestation in the private sector. Although it would seem difficult for Denmark to meet its target as scheduled, it would be advisable to ensure budget stability (Chapter 4).

1.5 Overall assessment

Official projections predict that Denmark's total greenhouse gas emissions will have increased by about 3.9% in 2010 compared to the base year, significantly *missing the Kyoto target* of 21% reduction (Rasmussen *et al.*, 2005a). CO_2 is likely to continue to represent some 80% of Denmark's total greenhouse gas emissions, with energy production and use remaining the largest source.

The Danish government's view is that *further commitments beyond 2012* should be guided by the UNFCCC's ultimate objective of stabilising greenhouse gas

concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. To meet this objective, the Danish government supports the EU view that the global average surface temperature increase should not exceed 2 °C above pre-industrial levels. The Danish government intends to achieve emission reductions after 2012 in *the most cost-effective way*, which makes it crucial to ensure the effective functioning of the global carbon market and flexible mechanisms.

2. Marine Environment

Denmark's *marine waters* are two and a half times as large as its land area and include fjords, bays, belts and the open sea. About 25% of the Danish land mass drains into the North Sea, 72% into inner marine waters (the Kattegat, the Great Belt, the Little Belt and the Belt Seas) and 3% into the Baltic Sea.

The Danish Environmental Protection Agency (EPA) is responsible for protecting the marine environment, i.e. water quality management and assessment of biological conditions, regulation of marine fish farms, regulation of dredging, regulation of ship-based pollution and off-shore activities, and administration of the *Marine Environment Act*. In October 2005 the European Commission issued a new Thematic Strategy for the Protection and Conservation of the Marine Environment. The Strategy's key element is a *Marine Framework Directive* whose objective is to achieve "good ecological status" in the European Seas. Work to achieve this objective will be organised in ecosystem-based regions. Denmark hosted a workshop in 2005 to consider the *Strategy* from the Nordic and Baltic perspective. Workshop participants recognised the urgent need for better management and protection of Europe's oceans.

2.1 Pollution from land-based sources

The effects of *eutrophication* have been documented in all Danish marine waters every year since the beginning of the 1980s. At present, quality criteria have been met in only a few Danish estuaries, coastal areas and open water areas[9] (Ærtebjerg *et al.*, 2003). The few coastal areas that meet the criteria are generally non-stratified shallow water areas with a relatively restricted load from land-based sources. The failure to meet the criteria is due primarily to nutrient loading and oxygen depletion (Chapter 3).

Land-based inputs of nitrogen into estuaries and coastal areas have been reduced, due mainly to the reduced loss from agricultural soils. Nitrogen discharges from sewage treatment plants have also been reduced. This has led, since 1997, to a

significant decrease in nitrogen concentrations in estuarine and coastal areas as well as in the open waters. The share of total nitrogen discharge from municipal waste treatment plants, industry and fish farms was 76%, 12% and 12%, respectively, in 2000. Atmospheric nitrogen deposition into Danish marine waters seems to have declined by about 15% since 1989.

Land-based *phosphorus* discharges into estuaries and coastal areas have been significantly reduced due to the extension of sewage treatment, which has stabilised phosphorus concentrations since 1990. The national target of an 80% reduction of phosphorus discharges from sewage plants and industry into fresh and marine waters had already been achieved by 1996. Water clarity increased and phytoplankton biomass and production decreased significantly in estuaries and coastal areas until the mid-1990s. The changes were less pronounced in open waters, although water clarity was higher and diatom biomass as well as phytoplankton production were lower in the 1990s than in the 1980s. The share of the total phosphorus discharge from municipal waste treatment plants, industry and fish farms was 86%, 5.5%, and 8.8% respectively in 2000.

The remaining unsolved problem is loss of nutrients from the *agricultural sector*.[10] The Danish government undertook initiatives to combat *eutrophication in 2002*, focusing on discharges and losses of nitrogen and phosphorus from agriculture. Recent studies indicate a greater loss of phosphorus from the agricultural sector, to which enough attention had not been paid. It has been estimated that the *Danish Action Plan on the Aquatic Environment (2003) will result in a change in agricultural practices*, which together with the reduction in discharges from industries and municipal waste water treatment plants, should reduce the combined discharges from these sources by nearly 50% (Grant, 2000).

Under the European Water Framework Directives, a *draft Water Management Plan* will be prepared for each catchment area in 2008. The strategies and measures to reach a healthy marine environment must focus on a reduction of discharges, emissions and losses from all relevant sources and on ecological quality objectives for the marine environment.

The *Baltic Sea* is shallow and almost fully enclosed.[11] This makes it particularly vulnerable to environmental pressures from municipal waste water discharges, shipping, aquaculture and fishing. Nitrogen and phosphorus inputs cause serious eutrophication, leading to large-scale, persistent algal blooms that destabilise coastal ecosystems. Persistent organic pollutants (POPs) and heavy metals pose particular problems because of the physical conditions of the Baltic Sea. Concentrations of *PCBs, dioxins and DDT* remain much higher in the Baltic than in the North Sea or the open Atlantic. The 1974 *Helsinki Convention* on the Protection of the Marine

Environment of the Baltic Sea Area, which was strengthened in 1992 and entered into force in 2000, takes into account all sources of marine pollution. The Helsinki Commission (HELCOM) set a target in 1988 to reduce *loading of nitrogen and phosphorus to the Baltic Sea* by at least 50% by 1995, a deadline that was later postponed to 2005. Land-based discharges from Denmark represented about 6% of total phosphorus inputs into the Baltic Sea and 5% of total nitrogen inputs in 2000, having decreased by half since 1995 (Table 7.3). Despite the achievements made in reducing nutrient inputs, the majority of the marine waters still do not meet the general quality objective of having no or only a slight impact on flora and fauna.

2.2 Pollution from ships

The *MARPOL 1973/78 Convention* for the Prevention of Pollution from Ships covers all technical aspects of preventing pollution from ships (except waste dumping, covered by the London Convention). A recent survey estimates that *illegal*

Table 7.3 **Denmark's point source discharges into the Baltic Sea,**[a] 1995-2000

	MWWTP[b]		Industry		Fish farm		Total		Whole Baltic Sea[c]	
	1995	2000	1995	2000	1995	2000	1995	2000	1995	2000
BOD (t)	5 843	4 959	13 749	5 042	. .	3 242	19 592	13 244	211 990 (9%)[d]	88 710 (15%)[c]
N total (t)	5 340	4 405	2 190	701	. .	705	7 530	5 811	75 410 (10%)[d]	117 500 (5%)[c]
P total (t)	815	613	223	39	. .	63	1 038	714	7 300 (14%)[d]	11 060 (6.5%)[c]
Cd (Kg)	409	101	. .	2.1	. .	–	. .	103	23 600	16 750
Hg (Kg)	324	93	. .	2.3	. .	–	. .	95	13 300	4 175
Cu (Kg)	1 597	4.7	. .	141.3	. .	–	. .	146	1 594 700	153 070
Pb (Kg)	464	1.6	. .	67.6	. .	–	. .	69	337 400	76 740
Zn (Kg)	18 417	80	. .	242.7	. .	–	. .	323	4 032 760	711 720
Cr (Kg)	1 027	1	. .	154.7	. .	–	. .	156	. .	66 355
Ni (Kg)	7 321	5	. .	134.2	. .	–	. .	140	. .	66 180

a) Including inland surface waters within the Baltic Sea catchment area.
b) Municipal waste water treatment plant.
c) Total load from nine countries (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden).
d) Figure in brackets shows Denmark's contribution to the total load.
Source: HELCOM.

spills in the Baltic and North Seas were reduced by half during the review period. Denmark charges lower port and pilot fees to double-hull tankers as well as to segregated ballast tankers and oil tankers of alternative design. Denmark has not signed the 2001 Convention on Civil Liability for Bunker Oil Pollution Damage or the 2004 Convention for the Control and Management of Ships' Ballast Water and Sediments.

The EPA and the Ministry of Defence are together responsible for *combating oil and chemical pollution* at sea. The responsibilities of Denmark's Navy are being expanded to include marine pollution surveillance and management. Admiral Danish Fleet HQ has been designated as the focal point for the newly established Maritime Assistance Service, the organisation introduced by the International Marine Organisation (IMO) for increasing maritime safety.

To reduce *air pollution from ships*, MARPOL Annex VI sets limits on SO_x and NO_x emissions from ship exhaust and prohibits deliberate emissions of ozone-depleting substances. The Annex establishes a global cap of 4.5% by mass on the sulphur content of fuel oil, whereas the sulphur content of fuel oil used onboard ships must not exceed 1.5% in an SO_x Emission Control Area (SECA). Ships must either install an exhaust gas cleaning system or use other methods to limit SO_x emissions. The Baltic and North Seas have been designated as a SECA under MARPOL Annex IV. The Helsinki Commission reported in 2003 that Denmark had implemented all but two HELCOM recommendations for the maritime environment, reduction of air pollutants and other pollution from ships (HELCOM, 2003a).

Port state control

Denmark participates in the *Paris Memorandum* of Understanding on Port State Control (1980). About 20% of ships calling at Danish ports, or around 600 foreign merchant ships out of more than 3 000 foreign ships, are inspected. This does not match the Paris MOU goal of inspecting at least 25% of foreign merchant ships entering a country's ports each year. Typically, about four hundred of the ships inspected in Danish ports show no deficiency, while around 30 are detained.

Denmark has also ratified the 1990 *London Convention* (Oil Pollution Preparedness, Response and Co-operation). The delivery of ship-generated waste and cargo residues, especially oil-containing waste, is mandatory in Danish ports. The fee for the receipt and handling of ship-generated waste is included in the normal port fee and does not depend on the amount or type of waste delivered. The fee might be reduced if the ship's environmental management system, design, equipment and operation are such that the ship master can document that the vessel produces limited amounts of ship-generated waste.

Other aspects of marine pollution

The *OSPAR Convention* for the Protection of the Marine Environment of the North-East Atlantic prohibits ocean dumping of waste or other matter with the exception of dredged material, waste from fish processing and natural inert material. In 2004, Denmark issued 15 permits for dredged material and dumped 4.6 million tonnes, which represents 4% of the total amount of dumped dredged material from the contracting parties.

Denmark has oil and gas reserves which are exported mainly to EU member countries. The OSPAR Commission reports that out of 678 *accidental oil spillages* in 2004, 70 (more than 10%) happened in Danish offshore oil and gas installations representing 56 tonnes of oil spillage (28% of the total).

Concerning the quantity of *chemicals discharged offshore*, Danish oil and gas installations discharged 35 266 tonnes in 2004, of which "PLONOR" substances, considered to pose little or no risk to the environment, constitute 87%. However, most of the discharged inorganic substances, which have pre-screening criteria of LC50 or EC50,[12] came from Danish installations. With regard to accidental chemical spillages, Denmark had only one accident (0.6% in number of accidents), which represented 0.3% in quantity, in 2004.

High-speed ferries, container ships, oil tankers and many other ocean-going vessels sail in and out of Danish waters daily, with all the noise and disturbance that they bring, such as the toxins released from their bottom paint, the waste they discharge, and the potential for oil spills at sea. The *risk of maritime accidents* along the Danish coast, the Belt and Øresund is high, due to the heavy shipping traffic and fishing activity.

2.3 Scrapping of ships

In 2006, Denmark possessed around 8 000 tonnes (GT) of merchant vessels, up from 5 560 tonnes (GT) in 1999, although the actual number of vessels decreased over this period from 589 to 515. Denmark is home to one of the world's largest container shipping companies. Liner trade represents 68% of the tonnage, while tanker trade and tramp represented 23% and 9% respectively in 2006.

International concern has risen in recent years about the *environmental impacts* and effects on worker health and safety associated with the *ship-breaking and vessel demolition industry*. Since the 1980s, ship-breaking has increasingly *moved to Asian countries*, driven by the demand for scrap steel, the low labour costs in some Asian countries (e.g. India, Bangladesh) and the tighter environmental regulations in Europe and North America (Table 7.4). In 2005, after the Danish government was unable to stop the sale of a Danish ferry which then sailed to India for recycling, Denmark proposed that the IMO establish a stronger enforcement system (Box 7.2).

Table 7.4 **Worldwide ship dismantling**, 1994-2002

Dismantling location[a]	Vessels (number)	Total tonnage[b] (Ldt)	Vessels (%)	Total tonnage (%)
India	2 245	16 135 949	*58*	*45*
Bangladesh	529	7 737 562	*14*	*22*
China	379	4 734 533	*10*	*13*
Unknown	241	1 255 762	*6*	*4*
Pakistan	192	3 521 888	*5*	*10*
Turkey	109	379 641	*2.8*	*1.1*
Indian Sub. Cont.	84	1 191 793	*2*	*3*
Vietnam	29	372 882	*1*	*1*
Spain	18	59 439	*0.46*	*0.17*
Mexico	18	75 746	*0.46*	*0.21*
Taiwan	5	31 272	–	–
Philippines	4	49 035	–	–
Brazil	4	20 041	–	–
Total[c]	3 877	35 681 405	*100*	*100*

a) Countries where more than two vessels were dismantled.
b) Expressed as light displacement tonnes (Ldt).
c) Total applies to all dismantling locations.
Source: Environmental Protection Agency.

3. Marine Resources

3.1 Management of fisheries

Denmark has the largest catch of any country from the North Sea; in 2004 its total catch amounted to 916 000 tonnes, of which, however, 545 000 tonnes were of species not for human consumption.[13] The EU is the most important market for Danish fishery products. Denmark exported 1.03 million tonnes of fish, valued at DKK 17.6 billion, in 2005. As the processing industry also depends on raw materials from abroad, imports amounted to 1 326 000 tonnes in 2005, valued at DKK 11.2 billion.

Legal and institutional framework

The fisheries sector in Denmark (i.e. excluding Greenland and the Faroe Islands) is managed within the framework of the *EU Common Fisheries Policy* (CFP). Since 2002, the CFP has focused on limiting fishing, inter alia, through a reduction in fishing capacity.[14] The European Council fixes annual total allowable catches and national fishing possibilities for most fish stocks. EU member states are required to adjust the

Box 7.2 **Recycling of ships**

In February 2005, the Danish government was informed that a 51-year-old *Danish ferry* (named Kong Frederik IX, later named Frederik and after that Ricky) was to be sold, *possibly for recycling in India*. It also learned that the ship contained asbestos. Both the former and the new owners of the ship claimed it was being sold to be put into service in the Middle East as a cargo ship. As declarations and documentation for this were produced, the Danish authority classified the ship as "non-waste", and it left the Danish port in March 2005. The ship then sailed directly for recycling in India. Denmark was not able to take action when the ship was anchored in the Danish port, because a sworn statement assured that the ship was going to carry trailers as cargo.

This incident convinced Denmark to propose to the IMO in 2005 that a legally-binding and enforceable system for the recycling of ships be established. The proposal invites all concerned to speed up the work both to create a *harmonised and enforceable international legal regime* for ship recycling and to make the IMO Guidelines on Ship Recycling mandatory. The proposal suggests that the regime should be based on: "prior informed consent"; environmentally sound management; and transparency, efficiency and uniformity.

The IMO is currently working towards a *binding international regime for clean ship dismantling*. A draft convention on the safe and environmentally sound recycling of ships is being negotiated in the organisation's Marine Environment Protection Committee, with the aim of its being adopted by a conference in 2008/2009 and entering into force a few years later (EMSA, 2007). The new legally-binding instrument will provide regulations for: the design, construction, operation and preparation of ships so as to facilitate safe and environmentally sound recycling without compromising safety and operational efficiency; the operation of ship recycling facilities in a safe and environmentally sound manner; and the establishment of an appropriate enforcement mechanism for ship recycling (certification/reporting).

In the meantime, the EU is drawing up a strategy for environmentally and socially responsible scrapping of end-of-life ships which could include requirements for a minimum level of ship recycling capacity in Europe.

fishing capacity of their fleets to achieve a balance between fishing capacity and their fishing possibilities. Most national support schemes for fisheries are part of EU schemes. The structural scheme is financed by the EU and national public funds, whereas aid in the framework of the market organisation is entirely financed by the EU.

The Danish *1999 Fisheries Act* covers protection of fish stocks, regulation of commercial and recreational fisheries, first-hand marketing and duties.[15] Amendments

to the legislation on structural adjustment were adopted in 2000 (implementation of the new financial instrument for fisheries guidance (FIFG) scheme) and in 2002 (simplification of advisory/partnership structure).The responsible authority for monitoring and enforcing EU and national conservation policies is the Danish Directorate of Fisheries in the Ministry of Food, Agriculture and Fisheries. The directorate also carries out inspection at sea and landings, as well as verification of EU marketing standards. Inspection of veterinary standards is the responsibility of the Danish Veterinary and Food Administration, which is also part of the Ministry of Food, Agriculture and Fisheries.

Initiatives in 2004, covered by the Initiative Package, include analysis, research and development to elaborate environmentally-friendly fishing methods. Renewal and rationalisation of the industrial fleet are part of the package, as well as the introduction of individual transferable quota (ITQ) schemes for mackerel and the industrial fishery. In the demersal fishery a committee has been looking into alternative management models, for example by pooling quotas and capacity. FIFG measures include a new scrapping scheme (budgeted at DKK 50 million), a new construction scheme (budgeted at DKK 16 million) and, partly as a follow-up to the Initiative Package, a support scheme targeted at the small scale coastal fisheries. The *National Strategy for Fisheries Research* has two main themes: i) to support sustainable, effective and quality-oriented utilisation of resources from fisheries and aquaculture; and ii) to develop improved management systems to safeguard resources.

Measures for commercial fisheries

Several key stocks exploited by Danish fishers are over-fished. The demersal stocks like cod, haddock and plaice have generally declined during the past two decades.[16] In particular, the International Council for the Exploration of the Sea (ICES) reported that the *North Sea cod* has been fished down to *the lowest level ever seen* and that the stock is in danger of collapse. Even if stringent recovery measures are implemented, the North Sea cod stock is not expected to recover within a decade or two. Concerning *Baltic cod*, the ICES has recommended a total ban or revised recovery plan (ICES, 2003). On the other hand, the pelagic stocks such as herring, blue whiting, shrimp and Norway lobster have increased. Due to a new international management regime in effect since 1996, the North Sea herring stock is again within safe biological limits

During the review period, Danish *fish catches* decreased significantly, from 1.9 million tonnes (DKK 3.2 billion in value) in 1995 to 864 000 tonnes (DKK 2.6 billion) in 2005, of which the North Sea catch represented 70% (54% in value) in 2005 (Table 7.5).

A wide *variety of management measures* has been introduced, including catch limits, closed seasons, vessel rations according to vessel size, tie-up schemes, demand for notification, and bonus quotas in the pelagic fisheries used for human consumption. In the Lime Fjord (in the northern part of Jutland), the largest fjord in Denmark, a *fishery management plan* is in force with the aim of restoring fish stocks and versatile fish life in the fjord. The plan places further restrictions on mussel dredging by reducing the allowed area and gradually reducing the size of the fleet as fishers leave the business.

Danish fishery management builds on overall catch restrictions (quotas) and *access regulation*, in combination with regulation of the total fleet capacity (i.e. tonnage and engine power). Access regulation requires that the fisher be an authorised full-time or part-time fisher and the vessel registered as a fishing vessel and granted a license. The *regulatory system* was expanded in 1989 to include catch quotas per vessel per month/week/trip for cod, haddock and saithe. This principle was also used for herring and mackerel. In 2003, the regulatory system introduced ITQs for herring in the North Sea, Skagerrak and Kattegat, which will provisionally apply until the end of 2007. The ITQs have been allocated to approximately 100 vessels based on their historical catches, the owners of which are entitled to transfer the rights to other registered vessels. Quotas for a number of the most significant species in the Danish fishery have been decreasing. Moreover, from 1st January 2007, fixed quota allocations (FQAs) were introduced in most of the remaining Danish fisheries,

Table 7.5 **Fish catch and aquaculture**

	1999	2000	2001	2002	2003	2004	2005
Marine catch							
Total catch (000 tonnes)	1 405	1 534	1 510	1 443	1 036	1 089	864
Value (DKK million)	3 163	3 140	3 406	3 513	2 628	2 558	2 620
Freshwater catch							
Total catch (000 tonnes)	0.2	0.2	0.1	0.1	0.13	0.25	. .
Aquaculture							
Freshwater (000 tonnes)	35.6	36.3	35.7	28.7	29.7	33.4	. .
Marine water (000 tonnes)	7.1	7.3	5.9	3.3	8.1	8.9	. .
Total							
Catch (000 tonnes)	1 447.7	1 577.7	1 522.3	1 474.4	1 074	1 132.2	. .

Source: FAO, Fisheries statistics; OECD.

including demersal species. These FQAs can be acquired together with the vessel to which the quotas are allocated. The *recreational fishery* is regulated by the amount and kind of gear used. Denmark forbids the sale of fish caught in the recreational fishery. Other national measures cover the release of fish and research financed by fees charged for fishing permits.

Economic incentives have been introduced to control the development of fleet capacity by granting financial support when vessels are decommissioned under the EU fleet management schemes. The number of Danish vessels was reduced 20% between 1995 and 2001. Between 1987 and 2001, 1 197 vessels were decommissioned with capacity reduction subsidies. However, total tonnage increased slightly from 1995 to 2001.

Aquaculture

Aquaculture in Denmark produces mainly freshwater rainbow trout and European eels. Other species include mussels, oysters, crayfish and turbot (in particular, fry for fattening). In 2003, production from Danish aquaculture amounted to DKK 641 million (OECD, 2005). Approximately 1 000 people are directly employed in Danish fish farming. Except for fully re-circulated eel farms, all Danish fish farms must be officially approved by the Environmental Protection Act, which has strict and fixed limits on feeding and specific requirements regarding feed conversion ratio, water use, rinsing and outlets, and removal of waste and offal. Local authorities assign the feed limits to each facility annually (Box 3.1).

Total annual *marine fish production* from the current 39 farms, roughly unchanged for many years, is about 8 000 tonnes. Annual eel production has stagnated at 2 000 tonnes since 2000. The number of eel farms has been reduced by half since 1999 to reach 15 farms. A ban on establishing and extending marine fish farms, issued in 1996 by the EPA, was lifted in 2001. The ad hoc advisory board for marine fish farming, established in 2001, recommended that off-shore cages be set with optimum conditions for diluting and spreading emissions from the cages. The environmental rules for marine fish farming are being readjusted to provide for *a flexible regulation system* based on documentation of environmental effects rather than strict production limits by fixed feed quota.

Danish *shellfish production* from aquaculture has been of limited size but is expected to increase. To optimise the total exploitation of the Danish shellfish resources (e.g. blue mussel, European oyster), certain areas of the Lime Fjord have been *assigned to shellfish production*. In 2004, an ad hoc advisory shellfish board recommended the establishment of a permanent advisory committee to integrate all relevant commercial and environmental aspects in the administration.

3.2 Protection of marine ecosystems

Fishing, dumping, maritime traffic, mineral exploitation and energy production in the seas around Denmark have altered the *marine ecosystem*. Since 1989, fish kills due mainly to *oxygen depletion* have been reported annually (Ministry of the Environment, 2003). *Toxins* used in marine paints are released into the ocean and are ultimately absorbed through the food chain. Five snail species display signs of *reproductive disruption*. The trend toward a reduction in excess *nutrient levels* is on the right track, due both to the reduction of discharges, emissions and losses of nutrients to marine waters, and to the quality of the marine environment (Table 3.4). However, the decrease in concentrations of nutrients, particularly nitrogen, in fjords and coastal waters over the review period has not yet led to improvement of the marine ecosystem (Chapter 3).

Denmark took *several steps* to protect marine ecosystems during the review period. In the context of Natura 2000, Denmark has designated 254 habitat areas, 113 bird sites and 27 Ramsar protection areas, which cover 12.3% of the country's marine areas. It also applied the EU Directives concerning Natura 2000 and pesticide and nutrient reductions. Another major accomplishment was the creation of the National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environments (NOVANA). However, the European Commission has shown that Denmark, along with many other member states, has not correctly implemented the EU Birds and Habitats Directives (Chapter 4).

Denmark ratified the Convention on the Conservation of Migratory Species of Wild Animals (*Bonn Convention*) in 1982 and is member to all its regional agreements that are relevant for Denmark, including the Wadden Sea Seals Agreement, ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic and the North Sea), and AEWA (Agreement on the Conservation of African-Eurasian Migratory Waterbirds). Under the Trilateral Co-operation on Protection of the Wadden Sea between Denmark, Germany and the Netherlands, *a seal agreement* has existed since 1991, which binds the countries on seal hunting and regulation. Under *ASCOBANS*, Denmark is actively participating in fulfilling the recovery plan for harbour porpoises in the Baltic Sea. The implementation of the *AEWA* has focused on supporting the EU with respect to a ban on lead shot by co-operating with Guinea-Bissau and preparing single species recovery plans (Chapter 4).

In view of the *critical situation* of the marine areas around Demark, it is recommended that Denmark continue to reduce the release of toxics and nutrients and, in co-operation with the surrounding EU countries, initiate development of a comprehensive plan of action to address the degradation of the marine ecosystem.

4. Bilateral and Regional Co-operation

Denmark is deeply involved in the follow-up to the Johannesburg World Summit on Sustainable Development, through its bilateral and multilateral development programmes, through EU development assistance, and through engagement in the international follow-up process. The Danish government established a Johannesburg Action Plan for follow-up to the summit (*Johannesburg-handlingsplanen*) in 2004 following a parliamentary debate in late 2002. The Action Plan focuses principally on developing countries and international organisations.

4.1 Arctic environment

Beyond the impact of climate change, several recent studies have shown that *large quantities of pollutants* are transferred through the atmosphere and by sea currents to the Arctic from the industrialised countries of the northern hemisphere. These pollutants accumulate in both birds and marine mammals and ultimately in the local population, the last link in the food chain.

The *main objective* of Danish environmental assistance for the Arctic is to help restore the global environment in accordance with the recommendations of the United Nations Conference on Environment and Development (UNCED) Agenda 21. In 1996, the Arctic nations established an intergovernmental regional forum called the Arctic Council. The environmental working groups of the Arctic Council are: the Arctic Monitoring and Assessment Programme (AMAP), the Arctic Contaminants Action Programme (ACAP), the Conservation of Arctic Flora and Fauna (CAFF), the Emergency Pollution Preparedness and Response (EPPR) and the Protection of the Arctic Marine Environment (PAME). Denmark contributes to the activities of the policy and action-oriented working group *PAME*, including its Regional Programme of Action for Protection of the Arctic Marine Environment from Land-Based activities.[17]

The Danish *Co-operation for Environment in the Arctic* (DANCEA) supports activities under the Arctic Council in close collaboration with the Home Rules of Greenland and the Faeroe Islands. Priorities are given to environmental health, climate change, biodiversity and sustainable use of natural resources and to local environmental issues. A number of institutions do research in environmental issues and the commercial use of natural resources. Greenland's Nature Institute, located in Nuuk, collects, analyses and evaluates data pertaining to a sustainable and environmentally sound use of Greenland's natural resources.

Denmark supports many Arctic projects with particular emphasis on Greenland. Assistance is granted to projects in Arctic Russia and to projects of Arctic relevance in the Faroe Islands. Activities fit into three sub-programmes: i) the Arctic Monitoring and Assessment Programme (AMAP), ii) AMP-V, and iii) AMP-K (Concrete Action). *AMAP* is an international environmental programme set up by Arctic countries' governments to implement the Arctic Environmental Protection Strategy (AEPS). It monitors the level of human-induced pollution (e.g. persistent organic pollutants, heavy metals) in the Arctic and assesses its widespread effects on the Arctic environment and on human health. *AMP-V* builds up and strengthens the knowledge base and information on the environment and nature protection. This work strengthens both Greenland's and the Faroe Islands' management of the environment and nature. *AMP-K* implements activities to enhance and restore the local environment and promote environmental awareness.

4.2 Nordic co-operation

Nordic environmental co-operation, which began in the 1960s, has led to a series of agreements on issues such as marine oil pollution, non-discrimination, emergency preparedness and mutual assistance, and nuclear power plants. Denmark participates in the Working Group on Sea and Air under the *Nordic Council of Ministers* (NCM). The group's objective is to give financial support to research programmes in Nordic countries related to marine and air pollution.

During the review period the Nordic ministers for the environment established the *Nordic Environmental Action Plan 2005-08*, replacing the previous action plan 2001-04. The Action Plans have formed the framework for the Nordic countries' environmental co-operation both within the Nordic area and in relation to neighbouring areas, the Arctic, the EU and other international forums. The plan for *2005-08* focuses on: the environment and health; the sea; nature, the cultural environment and outdoor life; and sustainable consumption and production. Much weight is placed on protecting the marine environment.

The *Nordic Environment Finance Corporation* (NEFCO), an international finance institution, was established in 1990 by the five Nordic countries: Denmark, Finland, Iceland, Norway and Sweden. Denmark contributed 21% of NEFCO's total capital (EUR 113.4 million in 2005). NEFCO has financed environmental projects in Central and Eastern European countries (Russia, Ukraine, Estonia, Latvia, Lithuania and Belarus). NEFCO's activities are focused on projects that achieve cost-effective environmental benefits across the region.[18] NEFCO's portfolio comprises more than 250 small and medium-sized projects spread across different sectors such as the

chemical industry, agriculture, water treatment, power utilities, waste management, environmental management, and environmental equipment manufacturing.

4.3 Baltic Sea

The 1974 *Helsinki Convention* on the Protection of the Marine Environment of the Baltic Sea Area was the first to include strong participation from Eastern European countries. Denmark has already met the objectives of the convention relating to phosphorus discharges (50% reduction between 1987 and 1995) and heavy metal loading (50% reduction between 1985 and 1995). It reduced mercury, cadmium and lead discharges by 70% between 1985 and 1995.

The 1992 *Baltic Sea Joint Comprehensive Environmental Programme* aims to clean up 132 "*hot spots*" by 2012. In 1999 it was estimated that a total funding of EUR 10 billion would be needed for the remaining spots. Of the four hot spots in Denmark, one caused by municipal waste water discharges from the Copenhagen area has been cleaned up. However, the other three hot spots, with high nitrogen loading from agriculture, remain to be dealt with (Chapter 3) (HELCOM, 2003b). Denmark is contributing to progress in other hot spots around the Baltic region.

Denmark is a member of *Baltic 21*, a regional multi-stakeholder process for sustainable development launched in 1996 by the environment ministers from the 11 member states of the Council of the Baltic Sea States. Its Action Programme consists of: joint actions, seven sector actions, and spatial planning actions. Denmark, together with Estonia, is a leading party of the energy sector action. Denmark also participates in the "*VASAB*" *initiative* (Vision and Strategies around the Baltic Sea 2010), which promotes co-operation among ministers responsible for spatial planning and development around the Baltic Sea. Denmark together with seven other Baltic Sea states succeeded in having the IMO classify the Baltic Sea as a "*particularly sensitive sea area*" in 2005, allowing coastal states to adopt additional protective measures to deal with risks from international shipping.

Denmark participates in the Baltic Sea Region Programme of EU Interreg III B, under which the "BALANCE" project aims at the development of informed marine management tools for the Baltic Sea based on spatial planning and cross-sectoral and trans-national co-operation. BALANCE consists of five work packages that include, for example, assessing the existing *Baltic Sea Marine Protected Areas Network* and developing a "*blue corridor*" concept, and developing Baltic marine zoning plans in two pilot areas. In total, Denmark has taken part in 69 projects.

4.4 North Sea

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. The number of Danish oil and gas installations with emissions and discharges covered by OSPAR measures remained almost stable during the review period, representing 2% of the 648 installations of all the contracting parties in 2004. Denmark is currently working on whether Natura 2000 sites are appropriate for nomination as OSPAR "*marine protection areas*". The North Sea has been designated as an SO_x "emission control area" (SECA) under the MARPOL Convention's Annex IV.

In the framework of the *North Sea Ministerial Conferences*, Denmark has undertaken the 1995 Esbjerg Declaration commitments to reduce discharges of phosphorous, nitrogen and heavy metals for 1995 relative to 1985. As in the case of discharges to the Baltic Sea, Denmark has met these objectives with respect to phosphorous and heavy metals but not for nitrogen discharges.

Denmark participates in both the Monitoring Committee and the Steering Committee of the *North Sea Region Programme* of EU Interreg III B. In total, Denmark has taken part in 47 projects.

4.5 Wadden Sea

The Wadden Sea extends along the south-western coast of Denmark and includes coastal areas of Germany and the Netherlands. It is protected under a *series of trilateral declarations and agreements*. 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 EC Bird Protection Area.

Monitoring done by the harbour Seal Management Plan showed that annual *seal population* growth rate continued to slow since the 2002 epizootic, from 18.5% between 2003 and 2004 to 8.1% between 2005 and 2006.[19] The overall results of the *breeding bird* surveys during the last decade showed significant increases in several species. However, declines were reported for nine species (including oystercatchers, common tern and herring gull) (Koffijberg *et al.*, 2006). Concerning *migratory waterbirds*, decreasing trends were detected over the period 1980-2000 for many species. Several reasons have been identified: climate change, the shellfish fishery (cockle, mussel), and the changing conditions of Arctic breeding grounds.

Trilateral co-operation has developed successfully. The 10th Trilateral Governmental Conference (2005) emphasised implementation of the agreements at

the Ninth Conference in Esbjerg (2001), which were: to start nomination of the Wadden Sea as a UNESCO World Heritage Site, to further develop the Wadden Sea Plan into a management plan in the sense of the Habitats Directive and other directives, to continue the work of the Wadden Sea Forum, and to underline the importance of the comprehensive Trilateral Monitoring and Assessment Program. Denmark takes part in the *Lancewadplan* project, one of the Interreg III B North Sea programmes, which focuses on the management and planning issues related to the region's unique cultural landscape and heritage.

4.6 Co-operation with Central and Eastern Europe

Denmark has been providing *environmental assistance* to Eastern Europe since 1991. The purpose of the assistance is: to help safeguard environmental and natural resources in Eastern Europe to the greatest extent possible and to reduce transboundary pollution; to help ensure an environmentally acceptable democratic and market development; and to promote the transfer of environmental knowledge and technology from Denmark to the countries of Central and Eastern Europe in the interest of both parties. Denmark also participates in assistance to Northwestern Russia through multilateral channels such as the Arctic Council and the Northern Dimension Environmental Partnership.

Environmental assistance is given primarily to installations that demonstrate the environmental and economic advantages of *new technologies*. Another principle is the requirement of *self-financing*. The principle ensures recipient countries' commitment and continuation of the projects. Environmental assistance to Eastern Europe is granted for two types of projects: technical assistance (e.g. for waste management, drinking water supply, nature management, waste water treatment, and air pollution control) and for projects that strengthen the institutional administrative system in the environmental sector.

The *Strategy for the Environmental Assistance to Eastern Europe 2001-06*, implemented by the Danish Environmental Protection Agency, replaces the previous 1993 Strategy. The areas of action have widened to include chemicals and the higher priority given to the interdisciplinary areas. The general *objectives* are to: make the greatest possible contribution to the protection of the environment in Eastern Europe by supporting countries that have applied for EU membership in their efforts to implement EU environmental requirements and those of international environmental conventions; help the CIS countries and other non-EU pre-accession countries in their approach to an enlarged EU, and help them to reduce domestic and transboundary pollution, protect nature and biodiversity, and implement international environmental conventions; help to ensure that political and economic developments move in the

direction of environmental sustainability by supporting market-based development and the promotion of democracy, including the encouragement of responsibility in the private sector and involving the public and NGOs in decision-making processes relating to the environment; and promote the use of Danish environmental expertise and technology for the benefit of the areas covered by this programme.

Environmental assistance projects in Eastern Europe amounted to DKK 1 billion at the beginning of 2002. Over 2002-03, as part of the Strategy, a further DKK 700 million was earmarked for environmental projects, respectively under the Danish Environmental Assistance Programme (64%), Joint Implementation (19%), the Northern Dimension Environmental Partnership (NDEP) Support Fund[20] (10%), and in the energy sector (7%).

Danish environmental assistance for Eastern Europe includes the following measures, which primarily concern the Baltic Region: *sector-integrated environmental programmes* within the energy, agriculture, transport and industry sectors, including the working environment; the *environmental investment facility* for Eastern European Countries (MIØ) under the Investment Fund for Eastern Europe, to improve the environment by co-financing joint venture projects in the private sector; and the *environmental credit programme* for Eastern Europe (MKØ), based on favourable export credit principles. The purpose is to promote investments in the Eastern European countries through long-term, subsidised environmental credit schemes.

5. International Trade and the Environment

5.1 Ozone-depleting substances

The *ozone column* over Denmark is declining by a mean of 0.4% per year, slightly more in the spring and slightly less in the autumn (NERI, 2001). Denmark has agreed to phase out or reduce the production and use of ozone-depleting substances (ODS) such as CFCs and halons (Vienna Convention, Montreal Protocol, London, Copenhagen and Beijing amendments). The deadlines adopted by Denmark for phasing out ODS are ahead of the schedule of the Montreal Protocol and its amendments. Denmark has two treatment facilities for *destruction of existing ODS*, Kommune Kemi and Århus Genindvinding. All ODS to be disposed are sent to one of these plants. Århus Genindvinding registers the annual quantity of individual substances disposed at the facility, but it is not possible to quantify the amounts collected at Kommune Kemi.

As a result of the 1998 *Action Plan for the Reduction of the Consumption of Ozone Depleting Substances*, the use of ODS has dropped dramatically. ODP-weighted[21]

consumption in 2004 (2.8 ODP tonnes) was one-sixth of consumption in 2003 (Table 7.6). Methyl bromide has only been used as feedstock for other chemical production. CFCs, tetrachloromethane and trichloroethane are used exclusively for laboratory purposes. HCFCs are used as refrigerants (regenerated HCFC-22) or for foam production (HCFC-141b). Consumption of HCFC-22 has increased, but HCFC-141b consumption has gone down. There has been no consumption of HCFC-142b.

Reports from importers show that *sales of new CFCs* decreased 90% between 2003 and 2004, to 0.01 tonnes.[22] Imports of CFC-11 and CFC-12 are prohibited. Imports and sales of *tetrachloromethane* also fell 90% between 2003 and 2004, to 33 kg. In 2004, 9 kg of *1,1,1-Trichlorethane* were imported. *Halons* have been phased out and there were no imports in 2004. *Methyl bromide* was only imported for feedstock in 2004. Six companies imported *HCFCs* in 2004; imports of HCFC-22 (regenerated) amounted to about 112.1 tonnes, and HFC mixtures to 10.3 tonnes (Table 7.6). Re-exports were about 180.7 tonnes. Imports of HCFC-141b decreased

Table 7.6 **ODS consumption**, 2002-04

(tonnes)

Substance	Net consumption			ODP-weighted consumption		
	2002	203	2004	2002	2003	2004
CFCs[a]	0.95	0.1	0.01	0.76	0.08	–
Tetrachloro-methane	0.87	0.36	0.033	0.96	0.39	0.036
1,1,1-Trichloroethane	0.02	0.02	0.009	–	–	–
Halons	0	0	0	0	0	0
Methyl bromide	(only feedstock)	(only feedstock)	–	–	–	–
HCFCs	390	204.65	142.68	41.25	16.88	2.79
HCFC-22 (new)	24.5	96.7	0	1.35	5.3	0
HCFC-22 (regenerated)	–	–	112.1	–	–	0
HCFC-22 (HFC mix)	–	–	10.3	–	–	0.56
HCFC-123	–	–	–	–	–	–
HCFC-141b	360	102.35	20.28	39.6	11.26	2.23
HCFC-142b	0	0	0	0	0	0
Total				42.97	17.36	2.83

a) The calculation of the ODP-weighted consumption of CFCs includes only CFC-113, the only substance that has been reported.
Source: Ministry of the Environment.

80% to 20.3 tonnes between 2003 and 2004. There were no imports of HCFC-142b in 2004 and Danish consumption of this substance has been phased out.

5.2 Hazardous waste

Denmark has banned the *export of hazardous waste to non-OECD countries* for final disposal and recovery (OECD amber and red lists) since 1998. 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. In 2000, Danish *exports of hazardous waste* totalled 225 000 tonnes, nearly two thirds of the produced and imported amount. During the review period, Danish exports of hazardous waste doubled (114 000 tonnes in 1997). *Hazardous waste imports* also doubled between 1997 and 2000.

Two developments in recent years (the *increasing number of notifications* of waste exports and imports, and the *development of new technologies* that make it difficult to decide if a waste-handling process is disposal or recovery) have made it difficult for Denmark to live up to the time limits in the Basel Convention and the Waste Shipment Regulation. The EPA has increased the number of people who handle the notifications, but it is a challenge to enforce the rules because exporters sometimes claim that the material is "used products" instead of waste. In Denmark, municipalities have the authority to decide if something is waste or not. There has recently been an increased focus on *illegal trade* (e.g. electronic waste). In 2006, the EPA learned from German authorities that old cars have been illegally exported through Germany in recent years; this is being further investigated by the Danish police.

5.3 Endangered species

Denmark ratified the Convention on International Trade in Endangered Species (CITES) in 1977. During the review period, the *violation of CITES* increased from 16 cases in 1999 to 70 cases in 2004, with a peak of 112 cases in 2002. The annual average fine varied from DKK 2 400 in 1999 to DKK 140 in 2004 (Statistics Denmark, 2005a). About 90% of the confiscations concern tourist effects (e.g. stony corals, queen conchs, giant clams and leather products from reptiles). In such cases the penalty is usually confiscation and warning. The remaining 10% concerns commercial imports, mainly parts and derivatives. Most violations occur because of negligence. The countries of export are also the main destinations for Danish tourists outside the EU, namely Southeast Asia (especially Thailand), the Caribbean and

Africa. A new challenge is the rapidly growing *Internet trade* and coping with the more *organised crime*, whose amount is unknown.

5.4 Chemicals

The *Rotterdam (PIC) Convention* allows export of "PIC chemicals" only if the receiving country has given prior informed consent. It is implemented in Denmark according to EU regulation 304/2003. Based on its *Chemical Action Plan 2006-09*, Denmark is taking strengthened control over chemicals, for example by establishing direct contact with importers and manufacturers of toys, cosmetics, paint and impregnated wood. Denmark has a very small exporting chemical industry, so the impact of the PIC Convention is limited. Since 2005, one Danish company has been exporting PIC chemicals with consent.

Denmark has fully implemented the *Stockholm (POPs) Convention* on persistent organic pollutants, including through a national implementation plan. The intentional use of POPs has long since ceased, and Denmark has no known stocks of POP pesticides. Implementation of the Convention is co-ordinated with implementation of the UN-ECE POPs Protocol and Danish waste policy. Denmark has experienced minor enforcement problems. The challenges that remain in implementing the POPs Convention pertain to unintentional production and release, especially of dioxins, but a substantial effort during the last decade under the Dioxin Action Plan has led to considerable improvement.

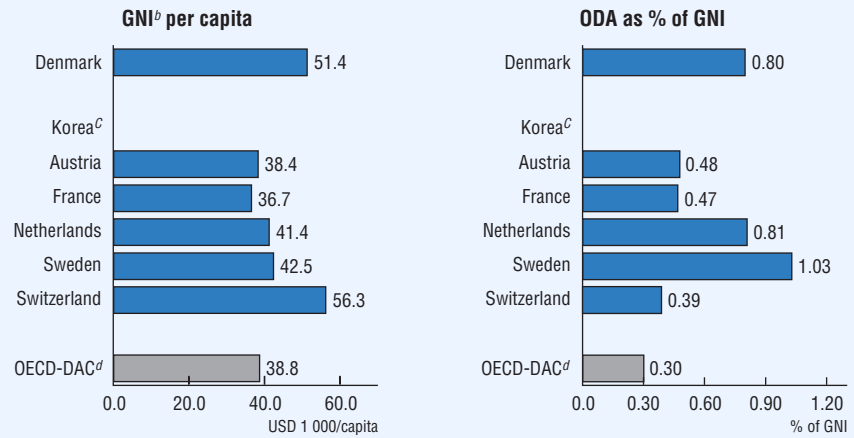
6. Aid

6.1 Overall development aid

Denmark's official development assistance (ODA), amounted to *0.80% of GNI*[23] in 2006 (USD 2.1 billion),[24] one of the highest rates in the OECD Development Assistance Committee (DAC) (Figure 7.2). During the period 1992 to 2002, Denmark's international assistance was approximately 1% of GNI every year. Denmark therefore meets the UN international development target of 0.7% of GNI and contributes to the objective of combating poverty globally. Denmark plans to continue to play an *exemplary role in development aid* by maintaining high levels of overseas development assistance.

The Danish International Development Agency (DANIDA) produces the *government's priorities* for Danish development assistance each year. In 2005, for example, the publication "Globalisation – Progress through Partnership Priorities of the Danish Government for Danish Development Assistance 2006-2010" prioritised

Figure 7.2 **Official development assistance**, 2006[a]



a) Provisional data.
b) Gross national income in USD at current exchange rates.
c) Korea is not a member of the OECD Development Assistance Committee.
d) Member countries of the OECD Development Assistance Committee.
Source: OECD-DAC.

the following areas: targeted efforts to promote the MDGs,[25] especially in Africa; increased focus on promoting economic growth as a way out of poverty; more targeted and focused development assistance; security and development; strengthened environmental efforts, a prerequisite for sustainable development; better climate, emphasis on global solutions; human rights and democracy; regions of origin, coherence home and abroad.

6.2 Environmental assistance

Denmark mainstreams environmental management into a substantial part of its bilateral and multilateral programmes. Danish *environment assistance* has been rising since 1998; in 2003 it amounted to about 0.07% of GNI. In 2005, environmental management (as classified by DAC) was the primary objective of 6.6% of Denmark's bilateral assistance and 3.9% of its multilateral assistance. Denmark made new commitments (bilateral and multilateral) related to implementing the conventions on biodiversity, climate change and desertification in the years 2001 to 2004.

Main priorities and operational targets for Denmark's international environmental assistance and co-operation with developing countries, as shown in the 2004 DANIDA *Environment Strategy*, include: to upgrade the environment as a cross-cutting issue in the bilateral and multilateral development co-operation; to upgrade and strengthen international environmental co-operation within multilateral assistance (i.e. water, energy, chemicals and climate); to work for a substantial replenishment of funds in the Global Environment Facility; to focus bilateral and special environmental assistance on the urban and industrial environment, sustainable energy and management of natural resources; and to continue special environmental assistance in Southern Africa and Southeast Asia.[26]

The *Environment Guide* is the operational part of the DANIDA Environmental Strategy and is applied to environmental assessment of bilateral programme co-operation and project assistance. The Environment Guide has a sequence of screening mechanisms (e.g. environmental impact assessment, strategic environmental assessment, environmental management plan, and country environmental analysis). As inadequate enforcement of existing guidelines has been pointed out, strengthened enforcement of the Environment Guide is expected[27] (DIIS, 2005).

Since 2001, the Danish Co-operation for Environment and Development (DANCED) of the Ministry of the Environment has been merged with DANIDA. The *2002 Review of Denmark's ODA and Environmental Assistance* emphasised the reciprocal responsibilities of the donor and recipient countries and stressed the need to promote greater efficiency in implementing aid. As of 2002, the funding for development assistance was reduced by DKK 1.5 billion, including a reduction of DKK 500 million for environmental activities. In 2005, Denmark decided to maintain ODA levels at a minimum of 0.8% of GNI.

6.3 Environmental funds

When the Danish Environment and Disaster Relief Facility (EDRF) was established in 1993, its target was to bring the funding of the facility to *0.5% of GNP* annually from 2002 over and above existing ODA, i.e. about DKK 1.34 billion. From 1999, the EDRF was changed to the Environment, Peace and Stability Facility (EPSF), and its environmental part supported projects in Eastern Europe, specific developing countries and the Arctic regions. Although it was on track to reach the target of 0.5% of GNI by 2005, the EPSF was closed in 2003.

At the same time the Danish Environmental Support Fund for Eastern Europe was changed to Danish Co-operation for Environment in Eastern Europe (DANCEE).

Environmental assistance has been an element of the government's Baltic Sea Initiative in the environment sector since 1998. The environmental assistance is supplemented with the *Environmental Credit Programme for Eastern Europe* (MKØ), administered by the Danish State Export Credit Agency (EKF).

Denmark makes efforts to maintain the *Global Environment Facility* as one of the most important mechanisms to promote sustainable development and the implementation of international environment agreements in developing countries. The qualitative goals set out for the period 2004 to 2005 were met. Concerning a quantitative target for the period 2006 to 2010, a replenishment of USD 3.1 billion was confirmed in 2006. Denmark's general aim for the multilateral *Montreal Protocol Fund* is to ensure that developing countries and countries in transition are assisted in implementing their obligations under the protocol. In 2005, Denmark contributed USD 1.9 million to the fund. Denmark met its obligations for contributions in the period 1999 to 2006.

Notes

1. Denmark's base year under the Kyoto Protocol comprises the 1990 emissions of CO_2, N_2O, and CH_4 and the 1995 emissions of HFCs, PFCs, and SF_6.
2. The EU agreement distributes the total EU target of 8% among the member states.
3. Notable fluctuations in total greenhouse gas emissions are due to variations in Denmark's electricity exchange with neighbouring countries, which in turn is weather dependent.
4. The latest "with measures" greenhouse gas projection shows an excess of 13 million tonnes of CO_2 equivalent annually over 2008-12, excluding the gap-closing effect of additional domestic measures, the full effects of the EU trading scheme and the projected amount of credits from JI and CDM projects.
5. There is international interconnection with Norway, Sweden and Germany. The total import capacity is 4 980 MW (i.e. about 80% of the peak electricity demand of Denmark in 2004).
6. The plan is predicted to reduce CO_2 emissions by an additional 2 million tonnes annually.
7. Carbon prices fluctuated widely in 2006-07.
8. Compared to the base year, total emissions of these three gases more than doubled, from 326 000 tonnes CO_2 equivalent in 1995 to 745 000 tonnes CO_2 equivalent in 2003.
9. Such as Karrebæksminde Bugt for coastal waters and Skagerrak for open sea areas.
10. However, almost all countries bordering the North Sea and the Baltic Sea have so far not been able to achieve the agreed reductions in losses from agriculture.
11. The average depth of the Baltic Sea is 50 meters. It takes 25 to 30 years for all the water in the Baltic Sea to be replaced.
12. LC50 means the lethal concentration of the chemical that kills 50% of the test animals in a given time. EC50 means the "effective concentration" of the chemical at which 50% of its maximal effect is observed.
13. Each year, the North Sea supplies a total of about 2 million tonnes of fish (ICES, 2003).
14. The European Commission calculated in 1995 that the EU fleet as a whole was 40% larger than required to fish the resources in a sustainable way.
15. There are basically three types of fisheries in Denmark: i) the industrial fishery for fishmeal and fish oil (e.g. sand eel, Norway pout, blue whiting and sprat), ii) the pelagic fishery for human consumption (e.g. herring and mackerel), and iii) the demersal fishery (also for human consumption) of white fish (cod, hake, haddock, whiting, saithe), flatfish (sole, plaice, flounder etc), lobster and deep water prawns.
16. An estimation done by the World Wide Fund for Nature shows that the loss of income from over-fishing of cod alone in the North Sea and Baltic Sea reached EUR 400 million in 2002.
17. For example, at the PAME Working Group in Iceland in 1999, Denmark/Greenland presented a Nordic Proposal on phasing out hazardous chemicals, based on the OSPAR strategy.
18. NEFCO estimates that to achieve the same environmental results on home soil, the estimated cost to the Nordic countries would have been seven to eight times as high.

19. The maximum number observed in the moulting period (August) in 2006 was 15 426 seals, of which 1 998 are in Denmark.
20. Established in 2001 and administered by the European Bank for Reconstruction and Development (EBRD), the NDEP Support Fund finances environmental and nuclear safety activities in Northwest Russia and Kaliningrad.
21. Namely, ozone depleting potential.
22. Due to new techniques, CFC-113 is no longer used for analysis purposes by the off-shore industry.
23. Gross national income.
24. Provisional data.
25. MDGs = UN Millennium Development Goals (adopted in 2000).
26. While development assistance is primarily given to the poorest countries, a large part of environmental assistance is given to medium-income countries (i.e. countries with a GNP per capita exceeding about USD 2 000).
27. Under existing guidelines, only 45% of the studied programmes conducted environmental screening and categorisation.

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REFERENCES

I.A Selected environmental data

I.B Selected economic data

I.C Selected social data

II.A Selected multilateral agreements (worldwide)

II.B Selected multilateral agreements (regional)

III. Abbreviations

IV. Physical context

V. Selected environmental websites

I.A: SELECTED ENVIRONMENTAL DATA (1)

		CAN	MEX	USA	JPN	KOR	AUS	NZL	AUT	BEL	CZE	**DNK**	FIN
LAND													
Total area (1000 km^2)		9971	1958	9629	378	100	7713	270	84	31	79	**43**	338
Major protected areas (% of total area)	*2*	8.7	9.2	25.1	17.0	9.6	18.5	32.4	28.0	3.4	15.8	**11.1**	9.1
Nitrogenous fertiliser use (t/km^2 of agricultural land)		2.5	1.2	2.7	9.0	20.1	0.2	2.6	2.9	10.7	6.9	**7.8**	5.9
Pesticide use (t/km^2 of agricultural land)		0.06	0.04	0.08	1.24	1.20	-	0.02	0.09	0.69	0.10	**0.11**	0.06
Livestock densities (head of sheep eq./km^2 of agr. land)		192	256	191	1011	1560	62	685	492	1790	287	**912**	290
FOREST													
Forest area (% of land area)		45.3	33.9	32.6	68.9	63.8	21.4	34.7	41.6	22.4	34.1	**12.7**	75.5
Use of forest resources (harvest/growth)		0.4	0.2	0.6	0.4	0.1	0.6	..	0.7	0.9	0.7	**0.7**	0.7
Tropical wood imports (USD/cap.)	*3*	1.6	0.2	2.1	10.7	6.1	4.0	3.4	0.4	24.2	0.3	**3.8**	1.4
THREATENED SPECIES													
Mammals (% of species known)		31.6	34.0	18.8	24.0	17.9	24.7	18.0	22.0	30.5	18.9	**22.0**	11.9
Birds (% of species known)		12.9	17.0	11.6	12.9	13.3	12.5	21.0	27.3	28.1	49.5	**13.2**	13.3
Fish (% of species known)		7.3	34.4	14.4	25.3	9.2	0.8	10.0	41.7	23.8	40.0	**15.8**	11.8
WATER													
Water withdrawal (% of gross annual availability)		1.5	15.9	19.2	20.4	36.2	4.8	1.7	5.0	32.5	12.7	**4.1**	2.1
Public waste water treatment (% of population served)		72	35	71	67	79	..	80	86	46	71	**88**	81
Fish catches (% of world catches)		1.2	1.4	5.3	4.7	1.7	0.2	0.6	-	-	-	**1.1**	0.1
AIR													
Emissions of sulphur oxides (kg/cap.)		76.3	12.2	49.4	6.7	10.4	123.6	18.6	4.4	14.5	22.2	**4.0**	16.4
(kg/1000 USD GDP)	*4*	2.6	1.4	1.4	0.3	0.6	4.2	0.8	0.2	0.5	1.4	**0.1**	0.6
% change (1990-2005)		-27	..	-31	-14	-46	58	39	-55	-58	-88	**-88**	-64
Emissions of nitrogen oxides (kg/cap.)		78.4	12.0	63.9	15.8	24.4	78.0	39.0	24.7	26.3	32.3	**34.3**	40.5
(kg/1000 USD GDP)	*4*	2.7	1.4	1.8	0.6	1.3	2.7	1.7	0.9	0.9	2.0	**1.1**	1.5
% change (1990-2005)		-6	18	-19	-2	47	25	16	-3	-24	-40	**-32**	-32
Emissions of carbon dioxide (t./cap.)	*5*	17.2	3.6	19.8	9.5	9.6	17.6	8.1	9.2	11.1	11.6	**9.4**	13.2
(t./1000 USD GDP)	*4*	0.57	0.39	0.54	0.36	0.50	0.61	0.36	0.31	0.40	0.69	**0.32**	0.47
% change (1990-2004)		29	27	20	15	105	36	49	31	7	-23	**1**	25
WASTE GENERATED													
Industrial waste (kg/1000 USD GDP)	*4, 6*	..	..	..	40	40	20	10	..	50	30	**10**	110
Municipal waste (kg/cap.)	*7*	420	340	750	400	380	690	400	560	460	290	**740**	470
Nuclear waste (t./Mtoe of TPES)	*8*	6.2	0.1	1.0	1.5	3.2	-	-	-	2.2	1.7	**-**	1.9

.. not available. - nil or negligible.

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) IUCN management categories I-VI and protected areas without IUCN category assignment; national classifications may differ.

3) Total imports of cork and wood from non-OECD tropical countries.

4) GDP at 2000 prices and purchasing power parities.

Source: OECD Environmental Data Compendium.

OECD EPR / SECOND CYCLE

FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD*	OECD*
549	357	132	93	103	70	301	3	42	324	313	92	49	506	450	41	779	245	35042
13.3	31.5	5.2	8.9	9.5	1.2	19.0	17.1	18.9	6.4	29.0	8.5	25.2	9.5	9.5	28.7	4.3	30.1	16.4
7.6	10.4	2.9	5.8	0.7	7.9	5.2	-	13.8	10.1	4.8	2.3	3.7	3.5	5.2	3.6	3.6	6.3	2.2
0.27	0.17	0.14	0.17	-	0.05	0.58	0.33	0.41	0.08	0.06	0.40	0.16	0.14	0.05	0.10	0.06	*0.21*	*0.07*
514	689	245	207	65	1139	488	4351	2142	845	315	498	226	339	409	794	290	*674*	208
31.6	30.2	22.8	19.5	1.3	9.4	23.3	34.5	9.5	39.2	30.0	36.9	41.6	33.3	73.5	30.8	27.0	11.6	34.4
0.6	0.5	0.6	0.5	-	0.7	0.5	0.5	0.6	0.5	0.6	0.8	0.5	0.5	0.7	0.8	0.5	0.6	0.6
6.8	1.8	2.7	0.1	2.8	11.2	7.2	-	15.6	3.6	0.3	17.6	0.1	6.2	2.2	0.6	0.5	2.7	4.0
19.0	41.8	37.8	71.1	-	1.8	40.7	51.6	18.6	3.4	14.1	17.7	22.2	26.3	22.4	32.9	22.2	*6.3*	..
19.2	27.3	1.9	18.8	44.0	5.4	18.4	50.0	21.5	7.7	8.6	13.7	14.4	25.5	19.1	36.4	30.8	*15.4*	..
31.9	68.2	26.2	32.1	-	23.1	29.0	27.9	48.9	-	7.0	22.9	24.1	52.9	16.4	38.9	9.9	*11.1*	..
17.5	18.9	12.1	4.7	0.1	2.3	44.0	3.3	10.0	0.9	18.3	12.0	1.3	33.3	1.5	4.7	17.0	*22.4*	*11.4*
79	93	56	57	50	70	69	95	99	76	59	60	52	55	85	97	35	*98*	*68*
0.7	0.3	0.1	-	1.9	0.3	0.3	-	0.6	2.7	0.2	0.2	-	0.9	0.3	-	0.5	0.7	26.2
9.0	7.4	46.3	24.5	35.0	24.5	11.6	6.7	5.3	4.9	38.1	28.4	19.0	37.3	6.5	2.3	25.2	16.9	27.5
0.3	0.3	2.6	1.7	1.2	0.8	0.4	0.1	0.2	0.1	3.5	1.5	1.6	1.7	0.2	0.1	3.4	0.6	1.1
-60	-89	4	-76	22	-48	-63	-80	-58	-58	-55	-9	-81	-29	-45	-60	18	-73	-41
22.6	17.2	28.9	17.9	90.4	31.0	22.2	38.1	26.6	46.9	20.8	27.8	19.0	34.7	27.1	11.4	13.1	26.8	34.2
0.8	0.7	1.6	1.2	3.1	1.0	0.8	0.7	0.9	1.3	1.9	1.5	1.6	1.6	1.0	0.4	1.8	1.0	1.4
-29	-48	11	-24	-2	5	-34	-27	-28	-5	-38	13	-53	14	-25	-46	35	-43	-18
6.4	10.3	8.5	5.6	7.7	10.2	7.9	24.9	11.4	7.9	7.8	5.7	7.0	7.7	5.8	6.0	2.9	9.0	11.1
0.23	0.40	0.43	0.38	0.24	0.31	0.30	0.45	0.39	0.21	0.65	0.31	0.55	0.34	0.20	0.20	0.40	0.32	0.44
9	-12	33	-19	19	37	16	7	18	26	-15	52	-34	59	1	8	63	-4	17
50	20	..	30	10	40	20	30	40	20	120	50	130	30	110	-	30	30	50
540	600	440	460	520	740	540	710	620	760	250	470	270	650	480	650	440	580	560
4.2	1.2	-	1.7	-	-	-	-	0.1	-	-	-	3.0	1.2	4.1	1.9	-	1.0	1.5

UKD: pesticides and threatened species: Great Britain; water withdrawal and public waste water treatment plants: England and Wales.

5) CO_2 from energy use only; sectoral approach; international marine and aviation bunkers are excluded.

6) Waste from manufacturing industries.

7) CAN, NZL: household waste only.

8) 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.

I.B: SELECTED ECONOMIC DATA (1)

		CAN	MEX	USA	JPN	KOR	AUS	NZL	AUT	BEL	CZE	**DNK**
GROSS DOMESTIC PRODUCT												
GDP, 2005 (billion USD at 2000 prices and PPPs)		990	983	11049	3477	958	596	94	246	294	182	**164**
% change (1990-2005)		51.3	53.8	55.3	21.6	125.0	64.5	58.2	38.2	33.2	22.7	**38.1**
per capita, 2005 (1000 USD/cap.)		30.6	9.3	37.3	27.2	19.9	29.3	22.9	29.9	28.2	17.8	**30.3**
Exports, 2005 (% of GDP)		37.9	29.9	10.5	14.3	42.5	19.1	27.9	54.4	86.3	71.6	**48.5**
INDUSTRY	*2*											
Value added in industry (% of GDP)		32	27	23	31	43	26	25	32	27	40	**27**
Industrial production: % change (1990-2005)		46.7	51.3	55.9	3.2	210.9	30.5	29.5	70.1	21.0	11.8	**38.3**
AGRICULTURE												
Value added in agriculture (% of GDP)	*3*	3	4	2	1	4	4	7	2	1	4	**3**
Agricultural production: % change (1990-2005)		25.6	41.5	27.6	-12.3	19.3	25.4	47.9	9.9	13.0	..	**0.7**
Livestock population, 2005 (million head of sheep eq.)		118	275	787	53	30	283	99	17	25	12	**24**
ENERGY												
Total supply, 2005 (Mtoe)		272	177	2340	530	214	122	17	34	57	45	**20**
% change (1990-2005)		29.9	42.0	21.4	19.3	128.9	39.3	22.9	37.1	15.2	-7.7	**9.6**
Energy intensity, 2005 (toe/1000 USD GDP)		0.27	0.18	0.21	0.15	0.22	0.20	0.18	0.14	0.19	0.25	**0.12**
% change (1990-2005)		-14.2	-7.7	-21.8	-1.8	1.7	-15.3	-22.3	-0.8	-13.5	-24.8	**-20.6**
Structure of energy supply, 2005 (%)	*4*											
Solid fuels		10.2	4.9	23.8	21.1	23.1	44.5	11.9	11.9	9.1	43.6	**19.1**
Oil		35.5	58.8	40.8	47.4	45.0	31.1	40.4	42.5	40.7	21.6	**42.1**
Gas		29.4	25.0	21.8	13.3	12.8	18.9	18.9	24.2	25.2	16.6	**22.6**
Nuclear		8.8	1.6	9.0	15.0	17.9	-	-	-	22.1	14.0	**-**
Hydro, etc.		16.1	9.7	4.7	3.2	1.2	5.5	28.9	21.4	2.9	4.2	**16.3**
ROAD TRANSPORT	*5*											
Road traffic volumes per capita, 2004 (1000 veh.-km/cap.)		9.8	0.7	16.2	6.5	3.2	9.8	12.3	9.3	9.0	4.6	**7.8**
Road vehicle stock, 2005 (10 000 vehicles)		1883	2205	24119	7404	1540	1348	271	502	559	439	**245**
% change (1990-2005)		13.8	129.3	27.8	31.1	353.5	37.9	47.0	36.0	31.2	69.4	**29.5**
per capita (veh./100 inh.)		58	21	81	58	32	66	66	61	54	43	**45**

.. not available. - nil or negligible.

1) Data may include provisional figures and Secretariat estimates. Partial totals are underlined.

2) Value added: includes mining and quarrying, manufacturing, gas, electricity and water and construction; production: excludes construction.

Source: OECD Environmental Data Compendium.

FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD	OECD
153	1693	2165	225	156	10	141	1521	26	478	180	475	194	73	995	269	231	568	1699	30283
37.4	29.5	26.6	56.3	33.3	57.2	156.5	20.9	90.8	40.4	59.6	68.2	37.2	35.9	54.5	35.2	17.1	75.6	43.3	44.3
29.1	27.8	26.2	20.3	15.4	33.8	34.2	26.0	56.8	29.3	39.0	12.4	18.4	13.6	22.9	29.7	31.0	7.9	28.3	25.9
41.8	26.0	40.7	20.8	66.4	32.0	81.2	26.3	159.3	69.9	45.3	37.2	28.6	77.3	25.5	48.6	47.9	27.4	26.4	24.3
32	25	30	23	31	27	42	29	20	26	38	30	29	32	30	28	27	31	26	29
75.6	18.2	16.9	19.5	92.2	..	312.8	10.5	57.6	20.8	35.5	113.0	15.1	19.5	27.0	55.3	27.6	78.3	8.6	34.6
4	3	1	7	4	9	3	3	1	3	2	3	4	5	3	2	1	12	1	3
-3.9	0.9	-4.7	10.1	-10.5	5.4	2.6	10.7	13	-9.2	-9.4	-15.8	1.1	..	7.4	-10.2	-4.3	18.2	-8.0	..
8	156	117	21	12	1	50	64	6	42	9	58	19	6	100	13	12	111	113	2639
35	276	345	31	28	4	15	185	5	82	32	93	27	19	145	52	27	85	234	5548
19.8	21.1	-3.2	39.7	-2.8	66.9	47.5	25.2	33.7	22.6	49.3	-6.9	53.1	-11.7	59.4	9.7	8.6	60.9	10.3	22.6
0.23	0.16	0.16	0.14	0.18	0.36	0.11	0.12	0.18	0.17	0.18	0.20	0.14	0.26	0.15	0.19	0.12	0.15	0.14	0.18
-12.8	-6.5	-23.6	-10.7	-27.1	6.2	-42.5	3.5	-29.9	-12.7	-6.4	-44.7	11.5	-35.0	3.2	-18.9	-7.2	-8.4	-23.1	-15.1
14.8	5.1	23.7	29.2	11.3	2.7	17.8	9.1	1.8	10.2	2.3	58.1	12.6	22.2	14.1	5.0	0.6	26.3	16.2	20.4
32.0	32.5	35.8	57.7	26.5	24.5	56.7	45.2	70.3	41.0	42.8	23.6	59.8	18.1	49.1	28.3	48.1	35.0	36.3	40.6
10.8	14.6	23.4	7.7	44.4	-	23.0	39.0	26.2	44.0	15.6	13.0	14.1	30.8	20.5	1.6	10.5	26.7	36.4	21.8
18.1	41.9	12.3	-	13.3	-	-	-	-	1.3	-	-	-	24.4	10.3	35.9	23.0	-	9.1	11.0
24.3	5.9	4.8	5.4	4.5	72.7	2.6	6.7	1.7	3.6	39.3	5.3	13.5	4.5	6.0	29.2	17.9	11.9	2.0	6.2
9.7	8.6	7.1	8.7	2.3	10.2	9.5	8.9	8.9	8.0	7.8	3.9	7.4	2.7	4.8	8.2	8.0	0.8	8.2	8.4
282	3617	4803	552	333	21	198	3894	34	806	252	1472	552	150	2516	463	419	843	3217	64939
26.2	27.1	28.8	118.7	49.4	59.8	108.5	30.2	68.0	40.7	29.9	126.8	151.3	44.4	74.2	17.9	28.9	257.1	35.0	38.7
54	59	58	50	33	72	48	66	74	49	55	39	52	28	58	51	56	12	54	56

3) Agriculture, forestry, hunting, fishery, etc.

4) Breakdown excludes electricity trade.

5) Refers to motor vehicles with four or more wheels, except for Italy, which include three-wheeled goods vehicles.

I.C: SELECTED SOCIAL DATA (1)

		CAN	MEX	USA	JPN	KOR	AUS	NZL	AUT	BEL	CZE	**DNK**
POPULATION												
Total population, 2005 (100 000 inh.)		323	1053	2965	1278	481	203	41	82	104	102	**54**
% change (1990-2005)		16.6	25.4	18.8	3.5	12.3	19.2	21.9	6.7	4.7	-1.4	**5.3**
Population density, 2005 (inh./km^2)		3.2	53.8	30.8	338.2	483.3	2.6	15.2	98.2	341.9	129.6	**125.7**
Ageing index, 2004 (over 64/under 15)		72.3	18.6	59.7	140.3	44.4	65.4	54.9	97.1	97.2	91.6	**79.5**
HEALTH												
Women life expectancy at birth, 2004 (years)		82.4	77.6	80.1	85.6	80.8	83.0	81.3	82.1	82.4	79.0	**79.9**
Infant mortality, 2004 (deaths /1 000 live births)		5.3	19.7	6.9	2.8	5.3	4.7	6.2	4.5	4.3	3.7	**4.4**
Expenditure, 2004 (% of GDP)		9.9	6.5	15.3	8.0	5.6	9.6	8.4	9.6	10.1	7.3	**8.9**
INCOME AND POVERTY												
GDP per capita, 2005 (1000 USD/cap.)		30.6	9.3	37.3	27.2	19.9	29.3	22.9	29.9	28.2	17.8	**30.3**
Poverty (% pop. < 50% median income)		10.3	20.3	17.0	15.3	..	11.2	10.4	9.3	7.8	4.4	**4.3**
Inequality (Gini levels)	*2*	30.1	48.0	35.7	31.4	..	30.5	33.7	26.0	26.0	25.0	**24.0**
Minimum to median wages, 2000	*3*	42.5	21.1	36.4	32.7	25.2	57.7	46.3	x	49.2	32.3	**x**
EMPLOYMENT												
Unemployment rate, 2005 (% of civilian labour force)	*4*	6.8	3.5	5.1	4.4	3.7	5.1	3.7	5.2	8.4	7.9	**4.8**
Labour force participation rate, 2005 (% 15-64 years)		79.2	58.6	66.0	78.0	68.5	77.1	67.8	78.4	67.7	71.1	**81.0**
Employment in agriculture, 2004 (%)	*5*	2.6	15.9	1.6	4.5	8.1	3.7	7.5	5.0	2.0	4.3	**3.1**
EDUCATION												
Education, 2004 (% 25-64 years)	*6*	84.3	22.6	87.9	84.0	74.4	64.1	77.6	80.2	63.6	89.1	**81.4**
Expenditure, 2003 (% of GDP)	*7*	6.1	6.8	7.5	4.8	7.5	5.8	6.8	5.5	6.1	4.7	**7.0**
OFFICIAL DEVELOPMENT ASSISTANCE	*8*											
ODA, 2006 (% of GNI)		0.30	..	0.17	0.25	..	0.30	0.27	0.48	0.50	..	**0.80**
ODA, 2006 (USD/cap.)		114	..	76	91	..	103	62	183	187	..	**411**

.. not available. - nil or negligible. x not applicable.

1) Data may include provisional figures and Secretariat estimates. Partial totals are underlined.

2) Ranging from 0 (equal) to 100 (inequal) income distribution; figures relate to total disposable income (including all incomes, taxes and benefits) for the entire population.

3) Minimum wage as a percentage of median earnings including overtime pay and bonuses.

Source: OECD.

OECD EPR / SECOND CYCLE

FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD	OECD
52	609	825	111	101	3	41	586	5	163	46	382	106	54	434	90	74	721	600	11690
5.2	7.3	3.9	10.0	-2.8	16.1	17.9	3.3	18.5	9.2	9.0	0.3	7.0	1.7	11.7	5.5	10.8	28.3	4.8	12.0
15.5	110.8	231.0	84.1	108.4	2.9	58.8	194.5	175.9	393.0	14.3	122.0	114.8	109.9	85.8	20.1	180.2	92.5	245.0	33.4
89.6	88.5	134.5	121.5	98.7	52.2	53.5	133.1	75.3	74.2	74.3	76.9	107.8	66.8	116.0	97.3	100.8	19.4	87.1	70.2
82.3	83.8	81.4	81.4	76.9	82.7	80.7	82.5	81.0	81.4	82.3	79.4	80.5	77.8	83.8	82.7	83.7	73.8	80.7	..
3.3	3.9	4.1	4.1	6.6	2.8	4.9	4.1	3.9	4.1	3.2	6.8	4.0	6.8	3.5	3.1	4.2	23.6	5.1	..
7.5	10.5	10.6	10.0	8.0	10.2	7.1	8.8	8.0	9.2	9.2	6.5	10.1	5.9	8.1	9.1	11.6	7.7	8.4	..
29.1	27.8	26.2	20.3	15.4	33.8	34.2	26.0	56.8	29.3	39.0	12.4	18.4	13.6	22.9	29.7	31.0	7.9	28.3	25.9
6.4	7.0	9.8	13.5	8.2	..	15.4	12.9	5.5	6.0	6.3	9.8	13.7	..	11.5	5.3	6.7	15.9	11.4	10.2
25.0	28.0	28.0	33.0	27.0	35.0	32.0	33.0	26.0	27.0	25.0	31.0	38.0	33.0	31.0	23.0	26.7	45.0	34.0	30.7
x	60.8	x	51.3	37.2	x	55.8	x	48.9	47.1	x	35.5	38.2	..	31.8	x	x	..	41.7	..
8.4	9.9	9.6	9.8	7.2	2.6	4.4	7.7	4.5	4.7	4.6	17.7	7.6	16.3	9.2	6.4	4.5	10.0	4.8	6.6
74.6	69.3	78.2	64.9	60.0	84.6	72.5	62.6	69.1	77.9	79.1	63.9	77.5	68.7	71.3	78.3	86.3	53.0	76.0	68.7
4.9	3.5	2.4	12.6	5.3	6.3	6.4	4.5	1.3	3.0	3.5	18.0	12.1	5.1	5.5	2.1	3.7	34.0	1.3	6.1
77.6	65.3	83.9	56.2	75.4	60.0	62.9	48.2	62.3	70.7	88.3	50.1	25.2	84.7	45.0	82.9	84.5	26.1	65.1	67.5
6.1	6.3	5.3	4.2	6.1	8.0	4.4	5.1	3.6	5.0	6.6	6.4	5.9	4.7	4.7	6.7	6.5	3.7	6.1	5.8
0.39	0.47	0.36	0.16	..	..	0.53	0.20	0.89	0.81	0.89	..	0.21	..	0.32	1.03	0.39	..	0.52	0.30
157	171	126	35	..	..	235	62	633	334	631	..	37	..	86	437	220	..	209	63

4) Standardised unemployment rates; MEX, ISL, TUR: commonly used definitions.

5) Civil employment in agriculture, forestry and fishing.

6) Upper secondary or higher education; OECD: average of rates.

7) Public and private expenditure on educational institutions; OECD: average of rates.

8) Official Development Assistance by Member countries of the OECD Development Assistance Committee.

II.A: SELECTED MULTILATERAL AGREEMENTS (WORLDWIDE)

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

			CAN	MEX	USA
1946	Washington	Conv. - Regulation of whaling	Y D	R	R
1956	Washington	Protocol	Y D	R	R
1949	Geneva	Conv. - Road traffic	Y R		R
1957	Brussels	Conv. - Limitation of the liability of owners of sea-going ships	Y S		
1979	Brussels	Protocol	Y		
1958	Geneva	Conv. - Fishing and conservation of the living resources of the high seas	Y S	R	R
1959	Washington	Treaty - Antarctic	Y R		R
1991	Madrid	Protocol to the Antarctic treaty (environmental protection)	Y R		R
1960	Geneva	Conv. - Protection of workers against ionising radiations (ILO 115)	Y	R	
1962	Brussels	Conv. - Liability of operators of nuclear ships			
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		
1997	Vienna	Protocol to amend the Vienna convention	Y		
1963	Moscow	Treaty - Banning nuclear weapon tests in the atmosphere, in outer space and under water	Y R	R	R
1964	Copenhagen	Conv. - International council for the exploration of the sea	Y R		R
1970	Copenhagen	Protocol	Y R		R
1969	Brussels	Conv. - Intervention on the high seas in cases of oil pollution casualties (INTERVENTION)	Y	R	R
1973	London	Protocol (pollution by substances other than oil)	Y	R	R
1969	Brussels	Conv. - Civil liability for oil pollution damage (CLC)	Y D	D	S
1976	London	Protocol	Y R	R	
1992	London	Protocol	Y 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 D	D	S
1976	London	Protocol	Y R	R	
1992	London	Protocol (replaces the 1971 Convention)	Y R	R	
2000	London	Amendment to protocol (limits of compensation)	Y R	R	
2003	London	Protocol (supplementary fund)			
1971	Brussels	Conv. - Civil liability in maritime carriage of nuclear material	Y		
1971	London, Moscow, Washington	Conv. - Prohib. emplacement of nuclear and mass destruct. weapons on sea-bed, ocean floor and subsoil	Y R	R	R
1971	Ramsar	Conv. - Wetlands of international importance especially as waterfowl habitat	Y R	R	R
1982	Paris	Protocol	Y R	R	R
1987	Regina	Regina amendment	Y 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
1996	London	Protocol to the Conv. - Prevention of marine poll. by dumping of wastes and other matter	R		S
1972	Geneva	Conv. - Protection of new varieties of plants (revised)	Y R	R	R

OECD EPR / SECOND CYCLE

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

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

II.A: SELECTED MULTILATERAL AGREEMENTS (WORLDWIDE) (cont.)

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

		CAN	MEX	USA
1978 Geneva	Amendments	Y R	R	R
1991 Geneva	Amendments	Y		R
1972 Geneva	Conv. - Safe container (CSC)	Y R	R	R
1972 London, Moscow, Washington	Conv. - International liability for damage caused by space objects	Y R	R	R
1972 Paris	Conv. - Protection of the world cultural and natural heritage	Y R	R	R
1973 Washington	Conv. - International trade in endangered species of wild fauna and flora (CITES)	Y R	R	R
1974 Geneva	Conv. - Prev. and control of occup. hazards caused by carcinog. subst. and agents (ILO 139)	Y		
1976 London	Conv. - Limitation of liability for maritime claims (LLMC)	Y	R	
1996 London	Amendment to convention	Y S		
1977 Geneva	Conv. - Protection of workers against occupational hazards in the working environment due to air pollution, noise and vibration (ILO 148)	Y		
1978 London	Protocol - Prevention of pollution from ships (MARPOL PROT)	Y R	R	R
1978 London	Annex III	Y R		R
1978 London	Annex IV	Y		
1978 London	Annex V	Y	R	R
1997 London	Annex VI	Y		S
1979 Bonn	Conv. - Conservation of migratory species of wild animals	Y		
1991 London	Agreem. - Conservation of bats in Europe	Y		
1992 New York	Agreem. - Conservation of small cetaceans of the Baltic and the North Seas (ASCOBANS)	Y		
1996 Monaco	Agreem. - Conservation of cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area	Y		
1996 The Hague	Agreem. - Conservation of African-Eurasian migratory waterbirds	Y		
2001 Canberra	Agreem. - Conservation of albatrosses and petrels (ACAP)	Y		
1982 Montego Bay	Conv. - Law of the sea	Y R	R	
1994 New York	Agreem. - relating to the implementation of part XI of the convention	Y R	R	S
1995 New York	Agreem. - Implementation of the provisions of the convention relating to the conservation and management of straddling fish stocks and highly migratory fish stocks	Y R		R
1983 Geneva	Agreem. - Tropical timber	Y R		R
1994 New York	Revised agreem. - Tropical timber	Y R	R	R
1985 Vienna	Conv. - Protection of the ozone layer	Y R	R	R
1987 Montreal	Protocol (substances that deplete the ozone layer)	Y R	R	R
1990 London	Amendment to protocol	Y R	R	R
1992 Copenhagen	Amendment to protocol	Y R	R	R
1997 Montreal	Amendment to protocol	Y R		R
1999 Beijing	Amendment to protocol	Y R		R
1986 Vienna	Conv. - Early notification of a nuclear accident	Y R	R	R
1986 Vienna	Conv. - Assistance in the case of a nuclear accident or radiological emergency	Y R	R	R
1989 Basel	Conv. - Control of transboundary movements of hazardous wastes and their disposal	Y R	R	S

OECD EPR / SECOND CYCLE

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

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

II.A: SELECTED MULTILATERAL AGREEMENTS (WORLDWIDE) (cont.)

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

		CAN	MEX	USA
1995 Geneva	Amendment			
1999 Basel	Prot. - Liability and compensation for damage			
1989 London	Conv. - Salvage	Y R	R	R
1990 Geneva	Conv. - Safety in the use of chemicals at work (ILO 170)	Y	R	
1990 London	Conv. - Oil pollution preparedness, response and co-operation (OPRC)	Y R	R	R
2000 London	Protocol - Pollution incidents by hazardous and noxious substances (OPRC-HNS)			
1992 Rio de Janeiro	Conv. - Biological diversity	Y R	R	S
2000 Montreal	Prot. - Biosafety (Cartagena)	Y S	R	
1992 New York	Conv. - Framework convention on climate change	Y R	R	R
1997 Kyoto	Protocol	Y R	R	S
1993 Paris	Conv. - Prohibition of the development, production, stockpiling and use of chemical weapons and their destruction	Y R	R	R
1993 Geneva	Conv. - Prevention of major industrial accidents (ILO 174)	Y		
1993	Agreem. - Promote compliance with international conservation and management measures by fishing vessels on the high seas	Y R	R	R
1994 Vienna	Conv. - Nuclear safety	Y R	R	R
1994 Paris	Conv. - Combat desertification in those countries experiencing serious drought and/or desertification, particularly in Africa	Y R	R	R
1996 London	Conv. - Liability and compensation for damage in connection with the carriage of hazardous and noxious substances by sea (HNS)	S		
1997 Vienna	Conv. - Supplementary compensation for nuclear damage			S
1997 Vienna	Conv. - Joint convention on the safety of spent fuel management and on the safety of radioactive waste management	Y R		R
1997 New York	Conv. - Law of the non-navigational uses of international watercourses			
1998 Rotterdam	Conv. - Prior informed consent procedure for hazardous chemicals and pesticides (PIC)	Y R	R	S
2001 London	Conv. - Civil liability for bunker oil pollution damage			
2001 London	Conv. - Control of harmful anti-fouling systems on ships			S
2001 Stockholm	Conv. - Persistent organic pollutants	Y R	R	S

Source: IUCN; OECD.

OECD EPR / SECOND CYCLE

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

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

II.B: SELECTED MULTILATERAL AGREEMENTS (REGIONAL)

			CAN	MEX	USA
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
1958 Dublin	Amendments	Y			
1960 London	Amendments	Y			
1961 Copenhagen	Amendments	Y			
1962 Hamburg	Amendments	Y			
1963 London	Amendments	Y			
1950 Brussels	Agreem. - Prior consultation concerning setting up near the border of permanent storage of	Y			
1950 Paris	Conv. - Protection of birds	Y			
1956 Rome	Agreem. - Plant protection for the Asia and Pacific region	Y			
1957 Geneva	Agreem. - International carriage of dangerous goods by road (ADR)	Y			
1975 New York	Protocol	Y			
1958 Geneva	Agreem. - Adoption of uniform conditions of approval and reciprocal recognition of approval for motor vehicle equipments and parts	Y			
1960 Paris	Conv. - Third party liability in the field of nuclear energy	Y			
1963 Brussels	Supplementary convention	Y			
1964 Paris	Additional protocol to the convention	Y			
1964 Paris	Additional protocol to the 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 Brussels	Agreem. - Measures for the conservation of Antarctic Fauna and Flora	Y			R
1964 London	Conv. - Fisheries	Y			
1966 Rio de Janeiro	Conv. - International convention for the conservation of Atlantic tunas (ICCAT)	Y	R	R	R
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			
1969 Rome	Conv. - Conservation of the living resources of the Southeast Atlantic	Y			
1972 London	Conv. - Conservation of Antarctic seals	Y	R		R
1973 Oslo	Agreem. - Conservation of polar bears	Y	R		R
1973 Gdansk	Conv. - Fishing and conservation of the living resources in the Baltic Sea and the Belts	Y			
1982 Warsaw	Amendments	Y			

OECD EPR / SECOND CYCLE

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

II.B: SELECTED MULTILATERAL AGREEMENTS (REGIONAL) (cont.)

			CAN	MEX	USA
1974 Stockholm	Conv. - Nordic environmental protection	Y			
1992 Helsinki	Conv. - Protection of the marine environment of the Baltic Sea area	Y			
1978 Ottawa	Conv. - Future multilateral co-operation in the Northwest Atlantic fisheries (NAFO)	Y	R		R
1979 Bern	Conv. - Conservation of European wildlife and natural habitats	Y			
1979 Lima	Conv. - Conservation and management of the Vicuña	Y			
1979 Geneva	Conv. - Long-range transboundary air pollution (CLRTAP)	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 (further reduction of sulphur emissions)	Y	R		
1998 Aarhus	Protocol (heavy metals)	Y	R		R
1998 Aarhus	Protocol (persistent organic pollutants)	Y	R		R
1999 Gothenburg	Protocol (abate acidification, eutrophication and ground-level ozone)	Y	S		R
1979 Honiara	Conv. - South Pacific Forum Fisheries Agency	Y			
1980 Madrid	Conv. - Transfrontier co-operation between territorial communities or authorities	Y			
1995 Strasbourg	Additional protocol	Y			
1998 Strasbourg	Second protocol	Y			
1980 Canberra	Conv. - Conservation of Antarctic marine living resources	Y	R		R
1980 Bern	Conv. - International carriage of dangerous goods by train (COTIF)	Y			
1980 London	Conv. - Future multilateral co-operation in North-East Atlantic fisheries	Y			
1982 Paris	Memorandum of understanding on port state control	Y	R		
1982 Reykjavik	Conv. - Conservation of salmon in the North Atlantic Ocean	Y	R		R
1983 Bonn	Agreem. - Co-operation in dealing with poll. of the North Sea by oil and other harmful subst.	Y			
1989 Bonn	Amendment	Y			
1985 Nairobi	Conv. - Protection, management and development of the marine and coastal environment of the Eastern African region	Y			
1985 Nairobi	Protocol (protected areas and wild fauna and flora in the Eastern African region)	Y			
1985 Nairobi	Protocol (co-operation in combating marine pollution in cases of emergency in the Eastern African region)	Y			
1988	Agreem. - Conservation of wetlands and their migratory birds		R	R	R
1989 Stockholm	Agreem. - Transboundary co-operation with a view to preventing or limiting harmful effects for human beings, property or the environment in the event of accidents	Y			
1989	Agreem. - Co-operation in environmental protection				
1989 Geneva	Conv. - Civil liab. for damage caused during carriage of dang. goods by road, rail, and inland navig. (CRTD)				
1989 Wellington	Conv. - Prohibition of fishing with long driftnets in the South Pacific	Y			R
1990 Noumea	Protocol	Y			R
1990 Noumea	Protocol	Y	S		

OECD EPR / SECOND CYCLE

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

II.B: SELECTED MULTILATERAL AGREEMENTS (REGIONAL) (cont.)

		CAN	MEX	USA
1990 Lisbon	Agreem. - Co-op. for the protection of the coasts and waters of the North-East Atlantic			
1990 Magdeburg	Agreem.-International commission for the protection of the Elbe river			
1991 Espoo	Conv. - Environmental impact assessment in a transboundary context	Y	R	S
2001 Sofia	Amendment			
2003 Kiev	Prot.- Strategic environmental assessment			
1992 Helsinki	Conv. - Transboundary effects of industrial accidents	Y	S	S
2003 Kiev	Prot. - Civil liability and compensation for damage caused by the transboundary effects of industrial accidents on transboundary waters			
1992 Nuuk	Agreem. - Co-op. on research, conservation and managt of marine mammals in the N. Atlantic	Y		
1992 Helsinki	Conv. - Protection and use of transboundary water courses and international lakes	Y		
1999 London	Prot. - Water and health	Y		
2003 Kiev	Prot. - Civil liability and compensation for damage caused by the transboundary effects of industrial accidents on transboundary waters			
1992 La Valette	European Conv. - Protection of the archaeological heritage (revised)	Y		
1992 Vienna	Agreem. - Forecast, prevention and mitigation of natural and technological disasters			
1992 Moscow	Conv. - Conservation of anadromous stocks (North Pacific Ocean)	Y	R	R
1993 Lugano	Conv. - Civil liability for damage resulting from activities dangerous to the environment			
1993	North American agreement on environmental co-operation	Y	R	R R
1993 Copenhagen	Agreem. - Co-op. in the prevention of marine poll. from oil and other dangerous chemicals	Y		
1993 Rome	Agreem. - Establishment of the Indian Ocean Tuna Commission	Y		
1994 Lisbon	Treaty - Energy Charter	Y		
1994 Lisbon	Protocol (energy efficiency and related environmental aspects)	Y		
1994 Washington	Conv. - Conservation and management of pollock resources in the Central Bering Sea			S
1995 Port Moresby	Conv. - Regional convention on hazardous and radioactive wastes (Waigani Convention)	Y		
1996 Wroclaw	Agreem.-International commission for the protection of the Oder river against pollution			
1998 Aarhus	Conv. - Access to env. information and public participation in env. decision-making	Y		
2003 Kiev	Prot. - Pollutant Release and Transfer Registers (PRTR)			
1998 Strasbourg	Conv. - Protection of the environment through criminal law			
2000 Florence	Conv. - European landscape convention	Y		
2000 Geneva	Agreem. - International carriage of dangerous goods by inland waterways (AND)			
2003 Kiev	Conv. - Framework Convention on the Protection and Sustainable Development of the Carpathians	Y		

Source: IUCN; OECD.

OECD EPR / SECOND CYCLE

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

Reference III

ABBREVIATIONS

AMAP	Arctic Monitoring and Assessment Programme
BOD	Biochemical oxygen demand
CAP	EU Common Agricultural Policy
CDM	Clean Development Mechanism (Kyoto Protocol)
CFCs	Chlorofluorocarbons
CLRTAP	United Nations Convention on Long-range Transboundary Air Pollution
DANIDA	Danish International Development Agency
DANVA	Danish Water and Waste Water Association
DSFI	Danish Stream Fauna Index
EIA	Environmental impact assessment
EMAS	European Eco-management Audit Scheme
EMEP	Environmental Monitoring and Evaluation Programme
EPA	Environmental Protection Agency
GDP	Gross domestic product
Ha	hectare
IMO	International Maritime Organisation
IPPC	Integrated Pollution Prevention and Control
JI	Joint Implementation (Kyoto Protocol mechanism)
MoE	Ministry of the Environment
Mtoe	Million tonnes of oil equivalent
NEC	National Emissions Ceiling (EU Directive)
NERI	National Environmental Research Institute
NGO	Non-governmental organisation
NOVANA	Denmark's nationwide monitoring and assessment programme for the aquatic and terrestrial environments
ODA	Official development assistance
ODS	Ozone depleting substances
PAH	Polycyclic aromatic hydrocarbon
PAP	Pesticide Action Plan
PCBs	Polychlorinated biphenyls
PM	Particulate matter
POP	Persistent organic pollutant

PPPs	Purchasing power parities
PVC	Polyvinyl chloride
PWS	Public water supply
QSAR	Quantitative structure-activity relationship
REACH	EU Directive concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals
TFC	Total final consumption
TPES	Total primary energy supply
TSP	Total suspended particulate matter
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile organic compound
VMP (I, II, III)	Denmark's Action Plans for the Aquatic Environment
WHO	World Health Organization
WWTP	Waste water treatment plant

Reference IV
PHYSICAL CONTEXT

Denmark covers 43 000 km^2 on the *peninsula of Jutland and an archipelago of 406 islands*, of which 81 are inhabited. The largest islands are Zealand, Funen, Lolland, Falster and Bornholm. Denmark is surrounded by the North Sea and the 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 proportion of total surface area (62%) than in other OECD countries. Open-land habitats such as meadows, dry grasslands, dunes, coastal meadows, heaths, marshes and lakes cover 10% of total area. Forest is being established on former arable land, which represents 13% of Denmark.

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 a *net exporter of food and energy* and enjoys a comfortable balance of payments surplus. In addition to petroleum and natural gas resources, the country also has fish, salt, limestone, chalk and gravel. There is an average wind speed of 7 to 8 metres per second, which is being exploited to generate *wind power*.

Reference V
SELECTED ENVIRONMENTAL WEBSITES

Website	Host institution
Government	
www.denmark.dk	Denmark's official website
www.mim.dk	Danish Ministry of the Environment
glwww.mst.dk	Danish Environmental Protection Agency
www.skovognatur.dk	Danish Forest and Nature Agency
www.trm.dk	Danish Ministry of Transport and Energy
www.ens.dk	Danish Energy Authority
www.fvm.dk	Danish Ministry of Food, Agriculture and Fisheries
www.dfu.dtu.dk	Danish Institute for Fisheries Research
www.oem.dk	Danish Ministry of Economic and Business Affairs
www.fm.dk	Danish Ministry of Finance
www.skm.dk	Danish Ministry of Taxation
www.um.dk	Danish Ministry of Foreign Affairs
www.danidadevforum.um.dk	Danish International Development Agency (DANIDA)
www.dst.dk	Statistics Denmark
www.ft.dk	Danish Parliament
www.dmu.dk	National Environmental Research Institute (NERI)
Other	
www.sum.uio.no/susnordic/denmark/	SusNordic Gateway, Governance for Sustainable Development in the Nordic Region

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