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Denmark's
Fifth National Communication on Climate Change

Under the United Nations Framework Convention on Climate Change

Denmark’s Fifth National Communication on Climate Change

Under

the United Nations Framework Convention on Climate Change

and the Kyoto Protocol

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Foreword

I am pleased to present Denmark's Fifth National Communication under the United Nations Framework Convention on Climate Change. For the second time the National Communication also contains information required under the Kyoto Protocol.

This Fifth National Communication contains information on the action taken by Denmark, Greenland, and the Faroe Islands on the commitments under the UN Framework Convention on Climate Change. For Denmark and Greenland it also contains information on the action taken on the commitments under the Kyoto Protocol.

The ultimate objective of the UN Framework Convention on Climate Change is to achieve "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".

In 2007, the Fourth Assessment Report from the UN Intergovernmental Panel on Climate Change (IPCC) showed that there is now stronger evidence for human influence on the global climate than previously assumed, and that most of the observed warming at the earth's surface over the last 50 years is very likely to have been due to human activities. More recent research results suggest that there is strong evidence, that climate change due to anthropogenic emissions of greenhouse gases is already occurring and that it will result in changes in frequency, intensity and duration of extreme weather and climate events.

The exact extent of future climate change is not known. However, the risk that climate change will affect humans and the environment in both the developed and the less developed parts of the world is of great concern to the Danish government. The Danish government will continue its efforts to reduce greenhouse gas emissions both at national and at global level. This task involves fulfilling the commitments under the Kyoto Protocol and the agreement on joint fulfilment of the EU's target under the Protocol, and it involves further implementation of the UN Framework Convention on Climate Change.

Adressing the climate challenge requires substantial targeted and long-term action both at international and national level with a view to reduce global emissions so as to hold the increase in global temperature below 2 degrees Celsius. It will also reqire cooperation in achieving the peaking of global and national emissions as soon as possible. Negotiations on a legally binding agreement on further action after 2012 will continue to be a major global challenge.

Taking the Copenhagen Accord into account the industrialised countries will continue to have to lead the way, with ambitious emission reductions, and by providing support to developing countries through finance, technology and capacity-building to promote sustainable development.

There are many technological opportunities to promote economic development while at the same time contributing to reductions in emissions of greenhouse gases. In a Danish context renewable energy is a good example that could give inspiration to other countries.

Copenhagen, December 2009

Lykke Friis

Minister for Climate and Energy

Introduction

At the United Nations Conference on Environment and Development in Rio de Janeiro in June 1992, more than 150 countries signed the UN Framework Convention on Climate Change (the Climate Convention). As of 16 October 2009, the Convention has received 194 instruments of ratification.

On 21 December 1993 the Climate Convention was ratified by a sufficient number of countries, including Denmark, for it to enter into force on 21 March 1994.

This report is Denmark’s Fifth National Communication under the Climate Convention and the second under the Kyoto Protocol. Since Denmark’s ratification of the Climate Convention covers the entire Realm, the report also includes information on Greenland and the Faroe Islands. The Kyoto Protocol however, only covers Denmark and Greenland due to a ratification with a territorial exclusion to the Faroe Islands. The report is organised in accordance with the guidelines for national communications adopted by the parties to the Climate Convention and follows to the extent possible the Annotated Outline suggested by the Climate Secretariat in June 2009.

In addition to efforts described in this report, Denmark also contributes to the European Union's common efforts under the Climate Convention and the Kyoto Protocol. Such efforts have – and will in the future – be transposed by implementation of common and coordinated policies and measures to reduce greenhouse gas emissions, including under the European Climate Change Programme (ECCP). Further information on the EU's climate policy etc. is available in the EU’s Fifth National Communication submitted to the UNFCCC in December 2009.

The Danish Ministry of Climate and Energy has been in charge of coordinating the work relating to Denmark’s Fifth National Communication. Contributions have been made by the following institutions:

Danish Building Research Institute at Aalborg University;

Danish Energy Agency, Danish Meteorological Institute and Geological Survey of Denmark and Greenland under the Ministry of Climate and Energy;

Danish Environmental Protection Agency and Danish Forest and Nature Agency under the Ministry of the Environment;

Danish Institute of Agricultural Sciences, National Environmental Research Institute and Climate Secretariat at Aarhus University;

Department of Agriculture and Ecology, Institute of Food and Resource Economics and Forest & Landscape Denmark under Faculty of Life Sciences at the University of Copenhagen;

Department of Environmental, Social and Spatial Change at the Roskilde University;

Faroe Islands Home Rule's Ministry of the Interior;

Greenland Government's Infrastructure Agency under the Ministry of Housing, Infrastructure and Transport;

Ministry of Economic and Business Affairs and Statistics Denmark there under;

Ministry of Food, Agriculture and Fisheries and the Danish Plant Directorate there under;

Ministry of Foreign Affairs;

Ministry of Taxation;

Ministry of Transport and the Danish Coastal Authority there under;

National IT and Telecom Agency under the Ministry of Science, Technology and Innovation; and

Risø DTU - National Laboratory for Sustainable Energy at the Technical University of Denmark.

1
Executive Summary

1 Executive Summary

1.1 National circumstances relevant to greenhouse gas emissions and removals

1.1.1 General

The Kingdom of Denmark – the Realm - comprises Denmark, Greenland and the Faroe Islands. The UN Framework Convention on Climate Changes has been ratified on behalf of all three parts of the Realm.

Today, Denmark has a population of 5.5 mill. and a total area of 43,000 km^2. More than 66% of the area is used for agricultural purposes, while 14% is forested and 10% is towns, roads and scattered housing, while the rest consists of natural areas, including lakes, watercourses, heath, etc.

The Danish climate is temperate with precipitation evenly distributed over the year. The mean annual temperature is 7.7ºC and mean annual precipitation is 712 mm.

Since 1993 economic growth in Denmark has been considerable, with GDP (Gross Domestic Product) rising at an average of 2.3% per year. In 2008, GDP amounted to DKK 1,735 billion, corresponding to DKK 315,600 per capita.

1.1.2 Energy, transport, and the domestic sector

Denmark is self-sufficient in energy, due primarily to the production of oil and gas in the North Sea, but renewable energy is also increasingly contributing to the energy supply. Denmark's total own production of energy has almost tripled since 1990.

Despite the economic growth, total energy consumption has remained largely unchanged at approximately 800 PJ since 1980. Denmark's dependence on oil and coal has fallen, and particularly within electricity and heat production, Denmark has succeeded in substituting with other fuels. Renewable energy accounts for about 15% of Denmark's actual energy consumption.

The actual (non-adjusted) energy consumption in 2007 was 863 PJ and was distributed over the following energy sources: oil 346 PJ (40%), natural gas 171 PJ (20%), coal 195 PJ (23%), and renewable energy 154 PJ (18%). The net export of electricity was insignificant in 2007, corresponding to 3 PJ (0.3%).

The distribution of gross energy consumption (energy consumption adjusted for foreign electricity trade) in 2007 was as follows: industry and agriculture accounted for 25%, domestic sector for 27%, transport for 26% and commerce and service for 15%. Refining and non-energy purposes accounted for the remaining 7%. More than 2/3 of the electricity supply comes from large primary power stations or CHP plants, while the district heat supply covers almost half of the need for heating. Energy production and supply alone account for 39% of Denmark's total emissions of greenhouse gases.

The domestic sector accounted for 5% of Denmark's total greenhouse gas emissions in 2007.

Transport activity, energy consumption and CO_2 emissions within the transport sector have developed largely in step with economic growth. In 2003, passenger and goods transport performances were 14% and 44% above the 1990 levels respectively. In 2007, CO_2 emissions by the transport sector were about 35% over the 1990 level and accounted for 22% of Denmark's total greenhouse gas emissions.

1.1.3 Business sector and waste

Industry's production value accounts for about 30% of total production. The largest sectors of industry are food and beverages, engineering, electronics and the chemical industry. The total business sector (industry, building and construction, together with public and private services) accounts for about 14% of Denmark's total emissions of greenhouse gases. This does not include emissions connected to the sector’s consumption of electricity and district heating, since these emissions from power and heat plants are included in the emission calculations for energy. By far the largest part of these emissions, is CO_2 from energy consumption, but the sector is also a source of emissions of industrial greenhouse gases.

The waste sector's methane emissions account for 2% of the total greenhouse gas emissions in 2007. Methane emissions from the waste sector are expected to fall in the future due to the obligation the municipalities have had since 1997 to send combustible waste for incineration. In addition, gas from a number of landfill sites is used in energy production, which helps to reduce both CO_2 and methane emissions.

1.1.4 Agriculture and forestry

Over the last 40 years, the agricultural area in Denmark has fallen from 72% (30,900 km^2) of the total area in 1960 to 63% (27,105 km^2) in 2006. The number of farms has fallen by more than 50%, from 119,155 in 1980 to 47,385 in 2006, while the average size of farms has increased by more than 100% in the same period, from 24 ha to 54 ha. At approximately 10%, agricultural exports still account for a considerable proportion of all Danish export. Agriculture accounted for approximately 18% of Denmark's total emissions of greenhouse gases in 2007.

Approximately 14% of Denmark is forested, and the Forestry Act protects a very large part of the existing forest from other land use. The ambition is to have about 20-25% of Denmark's area forested by the end of the 21st century.

1.1.5 Greenland and the Faroe Islands

Greenland is the world's largest island, with an area of 2.2 mill. km^2, 85% of which is covered by the ice sheet. From north to south, Greenland extends over 2,600 km. Greenland has a population of around 56,500, and fishing is the main occupation.

Greenland's climate is Arctic, and forests do not grow in Greenland. The warmest recorded temperature since 1958 is 25.5ºC, while temperatures can go down below -70ºC on the inland ice sheet.

The Faroe Islands consist of 18 islands with a total area of 1,399 km^2 and have a population of just over 48,000. The climate is characterised by mild winters and cool summers and the weather is often moist and rainy. The mean annual temperature is 6.5ºC.

Fish and fisheries account for about 95% of the Faroe Islands' total export earnings, apart from exports of ships, which vary greatly over the years. Agriculture was the main occupation until the end of the 19th century but now only accounts for 0.3% of gross national product at factor cost. There are about 1,000 head of cattle and about 78,000 sheep on the Faroe Islands.

1.2 GREENHOUSE GAS INVENTORY INFORMATION

Denmark's greenhouse gas inventories are prepared in accordance with the guidelines from the Intergovernmental Panel on Climate Change (IPCC) and are based on the methods developed under the European CORINAIR programme.

Table 1.1 shows Denmark's, Greenland's and Faroe Islands' total emissions of the greenhouse gases CO_2, CH_4 and N_2O and the industrial gases HFCs, PFCs and SF_6 from 1990 to 2007, calculated in CO_2 equivalents in accordance with the general rules for inventories under the Climate Convention. Inventory based on the rules under the Kyoto Protocol will involve some changes with respect to base year and removals in connection with land use change and forestry (LULUCF).

Table 1.2 shows Denmark's total emissions of the greenhouse gases CO_2, CH_4 and N_2O and the industrial gases HFCs, PFCs and SF_6 from 1990 to 2007, calculated in CO_2 equivalents.

TABLE 1.1 DENMARK'S, GREENLAND'S AND THE FAROE ISLANDS' TOTAL EMISSIONS OF GREENHOUSE GASES, 1990 – 2007

Source: The National Environmental Research Institute (NERI)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007
	CO_2 equivalent (Gg)					
CO_2 emissions including net CO_2 from LULUCF	54 631	59 969	55 867	51 732	58 567	53 467
CO_2 emissions excluding net CO_2 from LULUCF	54 079	61 638	54 236	51 571	59 442	54 594
CH_4 emissions including CH_4 from LULUCF	5 730	6 024	5 923	5 711	5 658	5 781
CH_4 emissions excluding CH_4 from LULUCF	5 731	6 024	5 923	5 712	5 658	5 781
N_2O emissions including N_2O from LULUCF	10 559	9 388	8 320	6 772	6 515	6 813
N_2O emissions excluding N_2O from LULUCF	10 559	9 388	8 320	6 772	6 515	6 813
HFCs	NA,NE,NO	218	611	812	832	858
PFCs	NA,NE,NO	1	18	14	16	15
SF_6	44	108	59	22	36	30
Total (including LULUCF)	**70 965**	**75 706**	**70 797**	**65 063**	**71 624**	**66 965**
Total (excluding LULUCF)	**70 414**	**77 376**	**69 167**	**64 902**	**72 500**	**68 092**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2005	2006	2007
	CO_2 equivalent (Gg)					
1. Energy	52 083	59 912	52 186	49 611	57 431	52 546
2. Industrial Processes	2 240	2 724	3 387	2 435	2 516	2 533
3. Solvent and Other Product Use	179	141	127	113	130	124
4. Agriculture	13 010	11 906	10 582	9 929	9 586	10 072
5. Land-Use, Land-Use Change and Forestry	551	-1 670	1 630	161	-875	-1 128
6. Waste	1 548	1 563	1 498	1 389	1 379	1 366
7. Other	1 354	1 130	1 389	1 425	1 457	1 451
Total (including LULUCF)	**70 965**	**75 706**	**70 797**	**65 063**	**71 624**	**66 965**

TABLE 1.2 DENMARK'S TOTAL EMISSIONS OF GREENHOUSE GASES, 1990 – 2007

Source: The National Environmental Research Institute (NERI)

GREENHOUSE GAS EMISSIONS	1990	1995	2000	2005	2006	2007
	CO_2 equivalent (Gg)					
CO_2 emissions including net CO_2 from LULUCF	53 345	58 905	54 721	50 390	57 194	52 101
CO_2 emissions excluding net CO_2 from LULUCF	52 793	60 574	53 090	50 229	58 069	53 228
CH_4 emissions including CH_4 from LULUCF	5 695	5 988	5 889	5 678	5 625	5 748
CH_4 emissions excluding CH_4 from LULUCF	5 695	5 989	5 890	5 678	5 625	5 748
N_2O emissions including N_2O from LULUCF	10 527	9 358	8 288	6 739	6 482	6 780
N_2O emissions excluding N_2O from LULUCF	10 527	9 358	8 288	6 739	6 482	6 780
HFCs	NA,NE,NO	218	605	795	815	840
PFCs	NA,NE,NO	1	18	14	16	15
SF_6	44	107	59	22	36	30
Total (including LULUCF)	**69 611**	**74 577**	**69 580**	**63 638**	**70 167**	**65 514**
Total (excluding LULUCF)	**69 060**	**76 246**	**67 950**	**63 477**	**71 043**	**66 641**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2005	2006	2007
	CO_2 equivalent (Gg)					
1. Energy	52 083	59 912	52 358	49 611	57 431	52 546
2. Industrial Processes	2 240	2 724	3 387	2 435	2 516	2 533
3. Solvent and Other Product Use	179	141	127	113	130	124
4. Agriculture	13 010	11 906	10 582	9 929	9 586	10 072
5. Land-Use, Land-Use Change and Forestry	551	-1 670	1 630	161	-875	-1 128
6. Waste	1 548	1 563	1 498	1 389	1 379	1 366
7. Other	0	0	0	0	0	0
Total (including LULUCF)	**69 611**	**74 577**	**69 408**	**63 638**	**70 167**	**65 514**

1.2.1 Carbon dioxide, CO_2

Almost all CO_2 emissions come from combustion of coal, oil and natural gas for energy production, although road transport also contributes a considerable proportion - about 20% in 2007. The relatively large fluctuations in the emissions from year to year are due to trade in electricity with other countries - primarily the Nordic countries.

In 2007, total actual CO_2 emissions inventoried under the Climate Convention, excluding land-use, land-use change and forestry (LULUCF), were about 1% higher than in 1990. If LULUCF is included, net emissions were 2% lower.

The reduction since 1990 is due, in particular, to a significant change in the use of fuels in energy production from coal to natural gas and renewable energy, more widespread use of CHP and improved energy efficiency.

1.2.2 Methane, CH_4

The biggest source of man-made methane emissions is agriculture, followed by landfill sites and energy production. The emissions from agriculture are due to enteric fermentation in farm animals and the handling of manure.

Emissions of methane from landfills are decreasing, because the production of methane has fallen year by year since the abrupt fall in landfilling in 1997.

The emissions from energy production have been rising with increasing use of gas engines. However in later years new legislation establishing emission limits for existing gas-driven engines have resulted in lower emissions.

In 2007, total methane emissions were 1 % above the 1990 level.

1.2.3 Nitrous oxide, N_2O

Agriculture is by far the main source of emissions of nitrous oxide because this forms in soil through bacterial conversion of nitrogen in fertiliser and manure. Bacterial conversion of nitrogen also occurs in drain water and coastal water. It will be seen that there has been a 31% fall in nitrous oxide emissions from agriculture since 1990. That is due to less and better use of fertiliser. A small proportion of the nitrous oxide emissions comes from the exhaust of cars fitted with a catalytic converter.

In 2007, total nitrous oxide emissions were 36% below the 1990 level.

1.2.4 The industrial gases HFCs, PFCs and SF_6

The contribution of industrial greenhouse gases (HFCs, PFCs and SF_6) to Denmark's total emissions of greenhouse gases is relatively modest, but in percentage terms, the emissions of these gases showed the biggest rise during the 1990s. The HFCs, which are primarily used in the refrigeration industry, are the biggest contributor to emissions of industrial greenhouse gases. In 2007 industrial gases accounted for a little over 1% of total emissions of greenhouse gases, corresponding to approximately 840,000 tonnes of CO_2 equivalents. In 2001 and 2002 new regulatory instruments, including both taxes and bans, were adopted. This has meant that the increase rate in emissions of industrial gases has fallen.

From 1995 to 2007 annual emissions of HFCs increased from 217,700 to 840,000 tonnes of CO_2 equivalents. Emissions of PFCs increased in the same period from 500 to 15,400 tonnes CO_2 equivalents, with a peak at 22,200 tonnes CO_2 equivalents in 2002. The emissions of SF_6 decreased from 107,300 in 1995 to 30,400 tonnes of CO_2 equivalents in 2007.

Total F-gas emissions rose by 172% from 1995 to 2007.

1.2.5 Total Danish emissions and removals of greenhouse gases

In 2007 the total emissions were estimated to 66.6 mill. tonnes of CO_2 equivalents,

Of the total Danish greenhouse gas emissions in 2007, CO_2 made up 80%, methane 9%, nitrous oxide 10%, and F-gasses 1%. If net contributions of CO_2 emissions by sources and removals by sinks from forests and soil are included (i.e. with LULUCF), then net total Danish greenhouse gas emissions corresponded to 65.5 mill. tonnes of CO_2 equivalents in 2007.

1.2.6 The national system for the estimation of greenhouse gas emissions

In pursuance of Article 5, Section 1 of the Kyoto Protocol, the Parties to the Protocol shall establish national systems for the estimation of greenhouse gas emissions.

The Danish National Environmental Research Institute (NERI) is responsible for producing the Danish greenhouse gas emission inventories and the annual reporting to the UNFCCC. NERI is therefore the contact point for Denmark's national system for greenhouse gas inventories under the Kyoto Protocol.

The work on the annual inventories is carried out in cooperation with other Danish ministries, research institutes, organisations and private enterprises.

The Danish emissions inventory is based on the IPCC guidelines for calculation of greenhouse gas emissions (the Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories and the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and the European CORINAIR program for calculation of national emissions. Generally, emissions are calculated by multiplying the activity data (e.g. fuel consumption, number of animals or vehicles) by an emission factor (e.g. the mass of material emitted per unit of energy, per animal or per vehicle).

Uncertainty in the greenhouse gas inventories is calculated as recommended in the IPCC guidelines and covers more than 99 % of total Danish greenhouse gas (GHG) emissions. The result of the calculations shows that total GHG emissions were calculated to have an uncertainty of 5.8 % and the increase in GHG emissions since 1990 was calculated to be -6.3 % ± 2.5 %. Uncertainty is greatest for N_2O emissions from stationary combustion and agricultural land, whilst the uncertainty for CO_2 emissions from the energy sector is only 5.9 % and the uncertainty for the development is 1.8%.

As part of the national system, NERI is drawing up a manual to use in quality assurance and quality control of the emission inventories.

NERI produces an annual report (National Inventory Report) for the Climate Convention in which the results of the calculations are presented and the background data, calculation methods, plan for quality assurance and control, uncertainty and recalculations are described and documented.

A number of improvements of the emission inventories have been made. In the near future focus will be on improving procedures for quality assurance and control and on improving documentation of the national emission factors.

1.2.7 The National Registry for accounting of assigned amounts and credits from sinks and JI- and CDM-projects

Denmark's national allowances registry and other EU Memberstates national allowances registers are part of the EU emissions trading scheme, which entered into force on 1 January 2005. The 16th of October 2008 the EU ETS was included in the international emissions trading system under the Kyoto Protocol after successful connection to the International Transaction Log. Danmark's national registry is therefore set up so it works and a fullfills all requirements of both the international emissions trading system under the Kyoto Protocol as well as the EU emissions trading system (EU ETS).

A secretariat has been established in the Danish Energy Agency to manage operation and administration of the registry. Users can contact the secretariat directly by phone or email for help in using the registry.

Enterprises and users of the registry are kept informed about regulations, news etc. through regular updates from the Danish Energy Agency website, the news on the registry website and a newsletter from the allowances registry.

1.2.8 Denmark's and Greenland's base year emissions, assigned amount and greenhouse gas inventories under the Kyoto Protocol

As mentioned above the GHG inventory of the Kingdom of Denmark under the Kyoto Protocol covers Denmark and Greenland. Denmark is part of the European Union while Greenland is not.

As Denmark is part of the European Union, of which 15 Member States will meet their reduction commitment jointly in accordance with Article 4 of the Kyoto Protocol, Denmark's quantified emission limitation for the 1st commitment period 2008-2012 under the protocol is 79 percent. The quantified emission limitation for Greenland is 92 percent because Greenland is not part of the European Union. Denmark's assigned amount is calculated based on the Article 4 commitment. Greenland's assigned amount is based on 92 per cent.

According to the initial report under the Kyoto Protocol submitted in 2006 and the initial review report published by the UNFCCC secretariat in 2007 the total assigned amount for Denmark and Greenland for the period 2008-2012 is 276,838,955 tonnes CO_2 equivalent. This is shown in table 1.3 together with base year figures and the calculated minimum holding of 249,155,060 tonnes CO_2 equivalent in the national registry – the so-called commitment period reserve.

The full annual inventory reporting under the Kyoto Protocol will start in 2010 for emissions and removals in 2008, which is the first year of the commitment period.

TABLE 1.3 DENMARK'S AND GREENLAND'S BASE YEAR EMISSIONS AND ASSIGNED AMOUNT FOR 2008-2012 UNDER THE KYOTO PROTOCOL

Source: The Kingdom of Denmark's initial report on assigned amount, 2006 and the UNFCCC's report of the review of the initial report of Denmark, 2007.

Tonnes CO_2 equivalents	**Denmark under the EU**	**Greenland**	**Denmark and Greenland**
CO_2 (1990)*	52,712,457	629,996	53,342,453
CH_4 (1990)	5,692,000	16,155	5,708,155
N_2O (1990)*	10,593,311	8,523	10,601,834
HFCs (1995)	217,728	25	217,753
PFCs (1995)	502	0	502
SF_6 (1995)	107,338	36	107,374
Base year	**69,323,336**	**654,734**	**69,978,070**
Annual Assigned Amount in %	79%	92%	DK79%+GR92%
Annual Assigned Amount in tonnes	54,765,435	602,356	55,367,791
Total Assigned Amount 2008-12	**273,827,177**	**3,011,778**	**276,838,955**
a. 90% of AA	246,444,459	2,710,600	249,155,060
Most recently reviewed inventory (2003)*	74,007,808	634,000	74,641,808
b. Times 5 (100%)	370,039,040	3,170,000	373,209,040
*Most recently inventory (2004)**	*68,092,442*	*697,904*	*68,790,345*
c. Times 5 (100%)	*340,462,209*	*3,489,518*	*343,951,727*
CPR (lowest of a and b *or c*)	**246,444,459**	**2,710,600**	**249,155,060**

* without LULUCF

1.2.9 Trends in Danish greenhouse gas emissions from the base year under the Kyoto Protocol

The developments in Danish emissions and removals of greenhouse gases from the base year under the Kyoto Protocol to 2007 (the most recent inventory year), as they are to be inventoried under the Kyoto Protocol, are shown in Figure 1.1 together with a preliminary estimate for 2008.

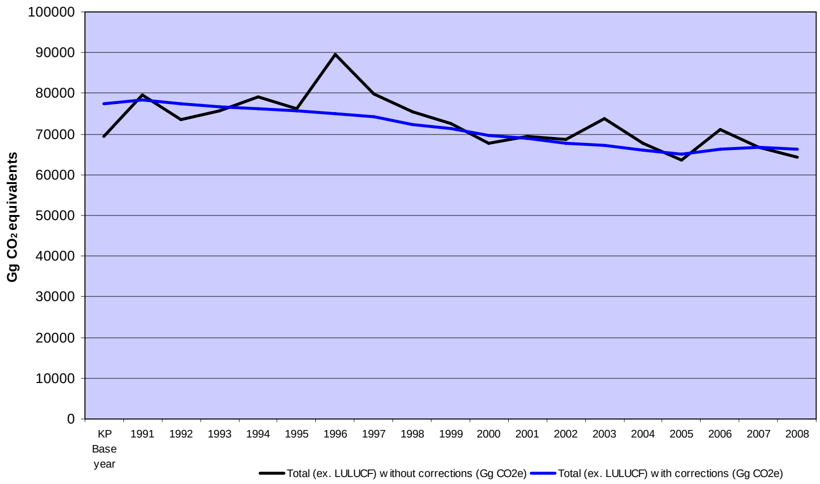
The relatively great variations in previous total emissions and removals of greenhouse gases are especially due to variations in Denmark's exchange of electricity with neighbouring countries. Furthermore, emissions of CO_2 from energy consumption vary considerably from year to year, depending on winter temperatures.

In order to facilitate the assessment of developments in CO_2 emissions associated with Denmark's own energy consumption in normal winters, estimates with corrections made for exchange of electricity and variations in temperature are also calculated in the annual energy statistics. The development in emissions with these correction is also shown in Figure 1.1.

As it can be seen from this Figure there has been a 14% drop from the base year to 2007. The preliminary estimate for 2008 suggests almost the same level as in 2007 and 2006.

FIGURE 1.1: DENMARK'S GREENHOUSE GAS EMISSIONS AND REMOVALS 1990-2008 WITHOUT AND WITH CORRECTIONS FOR INTER-ANNUAL VARIATIONS IN TEMPERATURES AND EXCHANGE OF ELECTRICITY

Source: The UNFCCC's Report of the review of the initial report of Denmark, 2007 (base year), National Environmental Research Institute (1991-2007), Danish Energy Agency (corrections of CO_2 emissions for degree days and net electricity imports and the preliminary estimate for 2008).



1.3 POLICIES AND MEASURES

1.3.1 Denmarks climate policy

Since the end of the 1980s and during the 1990s a considerable number of measures have been implemented that have reduced the emissions of greenhouse gases.

In February 2003 the government published Denmark's new Climate Strategy. Cost effectiveness is a vital planning consideration in order to achieve cost-effective solutions in environment efforts. The basis of the strategy is that Denmark must fulfil its international climate obligations under the Kyoto Protocol and according to the subsequent burden-sharing agreement in the EU.

The Kyoto Protocol offers the possibility of planning climate action that is flexible as regards the use of both domestic and international measures and that, globally, gives more cost-effective solutions in environment efforts. The Climate Strategy combines cost-effective domestic measures with use of the Kyoto Protocol's flexible mechanisms.

Follow-up on the Climate Strategy

In order to ensure cost-effectiveness in climate policy the government follow up regularly on the basis of greenhouse gas projections etc.

In 2006 the results of the Policies and Measures Project showed that there remain only relatively few domestic cost-effective actions with a significant potential compared to the use of the flexible mechanisms. This must be seen in the light of the fact that Denmark has already made a massive national effort up through the 1990s as documented in the Effort Analysis from 2005.

The governments new platform from 2007 was follow-up in 2008 with a political agreement on Danish energy policy for the years 2008-2011. The elements from the platform and the agreement are concreate initiatives based on the governments:

Visionary Danish climate and energy policy:

- The Government's long-term target is for Denmark to be independent of fossil fuels.
- The Government will double the share of renewable energy, so that it reaches a minimum of 30 per cent of total energy consumption by 2020.
- The Government will ensure an even more efficient utilisation of energy, so that Denmark reduces gross energy consumption by 4% by 2020 relative to 2006.
- The Government will double the public funding for research into energy technologies, so that it reaches DKK 1 billion per year by 2010.

The targets mean that Denmark will become less dependent on fossil fuels up to 2020, and reduce the present level of energy consumption without stifling economic growth.

The visionary Danish climate and energy policy contains the following concrete initiatives:

- *More renewable energy*
- *New integrated legislative package on renewable energy*
- *More biomass and waste and less fossil fuel in central heat and power generation*
- *Wind turbines on land*
- *Offshore wind turbines*
- *Bio gas*
- *Heat pumps for replacing individual oil burners:*
- *Small renewable energy technologies:*
- *Secure energy supply*
- *More efficient utilisation of energy*
- *Low-energy housing*
- *Rationalisation of the energy tax system*
- *Transformation of the transport sector*
- *Climate Research Centre*
- *New and more efficient energy technologies*
- *Second generation of climate policy instruments – Climate Commission*
- *Assistance to climate adaptation efforts in developing countries*

Although many important initiatives have already been implemented in order to achieve the 2008-2012 reduction target under the Kyoto Protocol and the EU Burden Sharing Agreement, new knowledge included in a preliminary update of Denmark's energy and CO_2 emission projection (April 2009) suggested that additional initiatives had to be taken to ensure, that Denmark can live up to its very ambitious target in the sectors not covered by the ETS. Additional initiatives were therefore adopted by the Government in November and December 2009.

1.3.2 Legislative arrangements and enforcement and administrative procedures

The legal basis for the division of powers into the legislative, executive, and judicial power is the Danish Constitution, Danmarks Riges Grundlov .

The Constitution includes the legal basis for how the Regent acts on behalf of the Realm in international affairs, and he cannot act without the consent of the Folketing in any way that increases or restricts the area of the Realm, or enter into obligations requiring cooperation of the Folketing or which in some other way are of great significance to the Realm. Neither can the Regent, without the consent of the Folketing, cancel an international agreement entered into with the consent of the Folketing.

On the motion of the government, the Folketing thus gave its consent in 2002, allowing Her Majesty Queen Margrethe the Second, on behalf of the Realm and with territorial reservations for the Faroe Islands, to ratify the Kyoto Protocol. This was on 31 May 2002.

Denmark's implementation of the Kyoto Protocol is on-going and is being effectuated by following up on the national Climate Strategy, sector-policy strategies with climate considerations, and concrete initiatives, which will contribute to limiting or reducing greenhouse gas emissions, and implementation of the other parts of the Kyoto Protocol. The legislation necessary to do this has been adopted in pursuance of the Constitution regulations concerning legislative powers.

1.3.3 Policies and measures and their effects

Allowance regulation

For many of the energy producers and a large part of the energy-intensive industry, the Danish implementation of the EU Directive establishing a scheme for greenhouse gas emission allowance trading within the Community form the framework for Danish efforts. The companies that are covered by the scheme, and whose activity thus is limited by a quota, can plan their climate action themselves. They can choose to reduce their own emissions when this is most appropriate, or they can buy allowances or credits from project-based emission reductions when this is considered most appropriate. The companies covered by the scheme will thus have the possibility of ongoing adjustment of their action so that it is always as effective as possible.

In 2007 the European Commission approved the Danish National Allocation Plan (NAP2) for the period 2008-2012. This allowances regulation covers a little less than half of Denmark's total greenhose gas emissions. This gives certainty about the activites covered regarding these activities' effect on Denmark's greenhouse gas accounting under the Kyoto Protocol and the allocation plan documents how Denmark will achieve its reduction target 2008-2012 under the Kyoto Protocol.

The Kyoto Protocol mechanisms

The starting point in the Government Climate Strategy is that efforts aimed at fulfilling the international climate commitment under the Kyoto Protocol and the subsequent EU Burden Sharing Agreement are organised cost-effectively.

The flexible Kyoto Protocol mechanisms are, therefore, important elements of the Government Climate Strategy, supplementing domestic reduction measures. The purchasing of CO_2 credits is primarily a task for the private businesses under the regulations of the EU allowance directive. By involvement in project development, the government has contributed to "start up" the market for CO_2 credits earlier than would otherwise have been the case. The buying of credits will also contribute to the fulfilment of Denmark's international climate commitment, just as the climate projects will entail a number of additional environmental benefits such as reduced pollution of air and water.

On this basis the government has allocated approximately DKK 1.7 billion for the development of JI and CDM projects and purchase of credits in 2003-2009. The allocated funds should correspond to 3.7 million tonnes of CO_2 annually from 2008-2012.

Taxes and duties

The levels of taxes and duties are also having an effect on several greenhouse gas emitting activities across sectors. Denmark has special taxes on motor vehicles, energy products, alcohol, tobacco, and a number of other products. During the 1990s a number of new environmental taxes were introduced. These taxes were placed on consumer goods that caused pollution or were scarce (water, energy products such as such as oil, petrol, electricity, etc.) or on discharges of polluting substances (CO_2, HFCs, PVC, SF_6, SO_2, and sewage). Taxes are imposed on mineral oil, tobacco, and alcohol in accordance with EU legislation.

The energy sector

Energy production and energy-consuming activities in the different sectors are the main contributors to the total emissions of CO_2 due to use of large quantities of coal, oil and natural gas. This is due to use of large quantities of coal, oil and natural gas. The energy sector is therefore pivotal in the efforts to reduce the emissions of CO_2.

The goal of the energy policy today is to create well-functioning energy markets within frameworks that secure cost-effective solutions, security of supply, environmental concerns and efficient use of energy.

The goal of the 1970s energy policy was to prevent supply crises using a multiple energy supply, which reduced dependency on oil. In the 1980s, the main focus was to protect against large and external increases in energy prices through increased focus on self-sufficiency, co-production and macroeconomic considerations. In the 1990s the goal was the development of a sustainable energy sector.

Energy-policy key considerations have thus been both multi-faceted and changing as the goals were met and new challenges appeared. Over a number of years, many initiatives have been taken that have yielded positive results for society. At the same time, CO_2 emissions have been reduced in a number of sectors.

First, this success is due to significant efforts in the transformation sector. Particularly in the production of electricity and heat there has been a substantial increase in co-production and substitution with other fuels. Thus, natural gas, waste and biomass are increasingly being used in small-scale and industrial CHP plants, natural gas and renewable energy is increasingly being used in large scale electricity production, and natural gas is increasingly being used for individual heating of buildings.

A vast range of measures have been applied over the years to achieve the various energy policy objectives mentioned above.

Taxes have been used for a number of years as measures which also lead to a reduction of the CO_2 emissions from the energy sector - partly with a view to a general reduction and partly to promote the use of fuels with lower CO_2 emissions, mainly biomass. This includes lower CO_2 emissions, e.g. natural gas and biomass. Such taxes are still being used.

Increased use of CHP and enlarging the areas receiving district heat have been main elements of the Danish strategy to promote efficient use of energy resources ever since the end of the 1970s.

Renewable energy sources have been promoted with economic measures, including the tax system and through production grants.

From 2005 energy producers and parts of the energy-intensive industry are covered by the EU's CO_2 allowance scheme. From 2008 the allowance scheme has become the most important measure in Denmark's fulfilment of its climate obligations under the Kyoto Protocol. The allowance scheme permits significant improvements to the cost-effectiveness of Denmark's climate policies and measures and forms a main element of the Danish Government Climate Strategy.

When the EU's CO_2 allowance scheme started in 2005, it was replacing the national CO_2 allowance regulation for electricity producers which was in force from 15 June 2000 to 31 December 2004.

The transport sector

Efforts to turn the upward trend in emissions of greenhouse gases in the transport sector have so far failed, in part because it is extremely difficult to reduce the CO_2 emissions in this sector in Denmark without international initiatives.

The transport sector's possibility, with national measures, of contributing to reduction of Denmark's CO_2 emissions shows that the cost-effectiveness of the measures depends entirely on the side effects. Taxes have also been used for a number of years as measures to reduce the CO_2 emissions from the energy sector - partly with a view to a general reduction and partly to promote the use of fuels with lower CO_2 emissions, mainly biomass.

Since 2000, registration taxes for private car have been differentiated according to their fuel efficiency. In 2007, the difference in tax rates was increased with an estimated additional annual emissions reduction effect of 0,05 mill. tonnes CO_2.

The most recent reference prognosis from 2008 predicts continued growth in the sector's CO_2 emissions.

However in the beginning of 2009 the Danish Government made an agreement with most parties in the parliament to change Danish transport policy into a new greener direction. This change will have important impact on future CO_2-emissions from transport. With the introduction of number of new measures the Danish Government expects CO_2-emissions from transport to peak around 2010.

The business sector

In addition to the key instrument - allowance regulation - the ongoing initiatives to reduce the emissions from the business sector include promotion of energy savings and energy efficiency improvements, conversion of energy production to cleaner fuels and initiatives to reduce the emissions of industrial gases. As an extension of the political agreement of 10 June 2005 to significantly strengthen energy-saving efforts, new initiatives have been taken with the objective to save energy in the business sector:

- Efficiency consultancy and information efforts, including more focus on realising the savings assigned.
- Promotion of sales of energy services. Efforts for business and industry is organised so that energy services are promoted. Information campaigns are still running to give the market a push.
- Promotion of energy management, energy-conscious planning, energy-correct procurement and bench-marking of energy consumption.
- Promotion of exploitation of surplus heat.

The action plan was evaluated in December 2008. New political measures will be adopted during 2010 in order to organise the energy saving effort more effectively and to implement new energy saving measures. December 15th 2010 a broad majority of the Danish parliament passed a bill on the establishment of an energy saving program with ten year duration (2010 to 2020). The aim of the program is to strengthen the energy saving efforts as a total in order to achieve a more coherent and efficient approach.

When the only nitric acid production facility in Denmark stopped in 2004, nitrous oxide emissions decreased with by approx. 0,9 mill. tonnes of CO_2 equivalents.

The regulation of emissions of the industrial greenhouse gases (HFCs, PFCs and SF_6) is 2-phased, consisting partly in a tax and partly in a statutory order on discontinuation of the use of the gases in new installations. The tax is imposed on the substances on importation because none of them is produced in Denmark.

In July 2002 a statutory order on regulation of the industrial greenhouse gases entered into force. It includes a general ban on use of the industrial greenhouse gases in a wide range of new installations/products from 1 January 2006, including, for example, domestic refrigerators and freezers, PUR foam, etc.

Agriculture, forestry and fisheries

Within the agricultural sector the following measures have reduced, or will reduce, emissions: ban on burning straw on fields, Action Plans for the Aquatic Environment I and II and the Action Plan for Sustainable Agriculture, Action Plan for the Aquatic Environment III and the CAP reform, the Ammonia Action Plan and an amended

Statutory Order on Manure, action plan for joint biogas installations) and support for planting of windbreaks.

The Action Plans for the Aquatic Environment and the Action Plan for Sustainable Agriculture have, in particular, reduced the emissions of nitrous oxide, and most of the changes in emissions of nitrous oxide from the agriculture sector that have taken place since 1990 can be attributed to these action plans.

2001 brought the adoption of an Ammonia Action Plan which, together with Action Plans for the Aquatic Environment I (1987), II (1998) and III (2004), will reduce ammonia evaporation.

The purpose of banning burning of straw has been to reduce air pollution from this activity. The ban has resulted in greater return of carbon to the soil and increased use of straw as a fuel.

Conversion of manure from biogas and other organic waste in biogas plants provides the opportunity to reduce methane emissions from manure management at the same time as producing energy.

Planting of windbreaks contributes to reducing wind erosion and also leads to greater biodiversity in the landscape. Moreover, removal of CO_2 takes place in the woody biomass of the windbreaks.

The national forest programme includes evaluation of the possibilities offered by the Kyoto Protocol for economically viable CO_2 sequestration in forests. The political goal with the most direct influence on increased carbon sequestration is the declaration of intent from 1989 to double the forested area in Denmark within 100 years. Various measures have been taken towards achieving this goal. For instance, a government grant scheme has been establish that supports private afforestation on agricultural land and the state itself establishes new forests. In addition, some private individuals choose to establish forests on agricultural land without a government grant.

Due to a change in the methodology for estimating removals by sinks in forests in August 2009, new data suggests that the forest cover in Denmark is bigger (14%) than previously estimated (11%). But at the same time it has been revealed that the forests are older than previously estimated. This could change the Danish forests from being a net sink to be a net source in 2008-2012.

The domestic sector

With a view to reducing both direct and indirect CO_2 emissions from the domestic sector, a wide range of initiatives have been launched. The initiatives promote electricity savings, savings in energy consumption for space heating and fuel conversion (from electric heat and oil to district heat, natural gas and renewable energy).

As a follow-up to the Report on Energy Savings of May 2003, a number of new initiatives have been commenced, including promoting particularly energy-efficient refrigerators and freezers, phasing-out traditional double glazing (voluntary agreement), initiatives in relation to boilers and circulation pumps, reducing energy consumption for standby and strengthening of research and development activities.

On 10 June 2005 the government made a broad political agreement to significantly strengthen energy-saving efforts. The agreement is ambitious, and sets the framework for efficient and increased energy-saving efforts in the coming years. The parties to the agreement agree that overall energy consumption (excluding transport) are to be reduced. Strengthened efforts will be made to attain specific and verifiable energy savings corresponding to 7.5 PJ per year on average in the period 2006-2013.

The initiatives will be based on economically justifiable investments, environmental consideration and advancement of Danish energy and building technology. Measures aimed at reducing energy consumption include more stringent energy provisions in building regulations, new improved energy labelling, better inspection of boilers and ventilation systems, special initiative in the public sector, and reorganisation of the energy savings initiatives of energy companies. Overall, the government’s action plan and the political agreement entail a significant strengthening of overall energy-saving efforts.

To this end, market analyses and campaigns focusing on the price and efficiency of energy appliances will – as from 1 March 2010 – be one of the tasks of the new Centre for Energy Savings, which will replace The Electricity Saving Fund.

Furthermore, in November/December 2009, the Parliament decided to allocate DKK 400 mill. to support the substitution of individual oil based furnaces for modern, low-emitting heating solutions, including systems based on renewable energy such as heat pumps and solar heating. Implementation of a program of subsidies is projected to start 1 March 2010.

The waste sector

The waste sector's contribution to reduction of greenhouse gas emissions consists mainly in: reducing landfilling of organic waste, utilising gas from discontinued/existing landfill sites and the waste as an energy source.

The Statutory Order on Waste was amended from 1 January 1997, to introduce a municipal obligation to assign combustible waste to incineration (corresponding to a ban on landfilling combustible waste). As a result of this, large quantities of combustible waste that used to go to landfill sites are now either recycled or used as fuel in Denmark's incineration plants. Future action will consist mainly in a continued ban on landfilling of combustible waste and implementation of Waste Strategy 2005-2008.

1.3.4 Policies and measures in accordance with Article 2, of the Kyoto Protocol

Denmark’s climate efforts – a step on the way to sustainable development

The government's National Strategy for Sustainable Development in Denmark, A SHARED FUTURE - balanced development, was adopted by the Folketing in June 2002.

In March 2009, the government adopted its new strategy for sustainable development “Growth with consideration”. The new strategy collects objectives and concrete actions within the following 9 areas:

- Globalisation for the benefit of all people on Earth
- Climate Change – a major challenge

- Nature for the future
- Green innovation in production and consumption
- Active, healthy and well-functioning urban areas
- Better health for all
- Knowledge, research and education in an innovative society
- Human as a resource
- Responsible, long-term and sustainable economic policy

This new strategy forms the framework for the Danish government's sector specific action plans such as "The Green Transport Vision", "The Tax Reform" ("Forårspakke 2.0" and "The Green Growth Plan" and for the support and development of green technologies based on The Action Plan on Environment Efficient Technology 2007-2009".

Efforts for international air transport and shipping

Denmark recognises that the international aviation and maritime transport sectors are large and rapidly growing sources of greenhouse gas emissions and have to be dealt with at international level. Given the global nature of the two sectors Denmark believes that the international organisations for civil aviation and maritime transport – ICAO and IMO – should decide and implement appropriate global measures to control greenhouse gas emissions from international aviation and maritime transport with levels of keeping EU's 2 degrees Celsius objective within reach.

Efforts to limit adverse effects in other countries

In connection with Denmark's contribution to international climate efforts, in accordance with the Kyoto Protocol Denmark will endeavour to implement policies and measures under article 3 of the Protocol in such a way that adverse effects in other countries are minimised. However, Denmark does not consider that its contributions to international climate efforts have adverse effects in other countries as, on the contrary, the reduction of emissions of greenhouse gases in Danish commitments under the Protocol will in fact contribute to limiting dangerous climate change in all countries.

If nothing is done to limit emissions of greenhouse gases, climate scenarios from the IPCC indicate that developing countries in particular will experience the greatest changes in climate.

In its international efforts, Denmark will therefore continue to take the greatest possible account of special needs and concerns of developing countries and especially least developed countries. This also applies to adverse effects which can already be ascertained from changes in the climate. The existing strong Danish focus on the special vulnerability of developing countries to climate change underlines this.

1.3.5 Greenland

Greenland is faced by a series of challenges in energy supply and demand. Due to climatic and infrastructural conditions as well as future developments in the industry, Greenland's consumption of energy is not likely to decrease. But Greenland is also witnessing the effects of climate change in the Arctic.

Greenland has therefore initiated policies and a series of political measures for the energy areas, supporting the objectives of the Climate Convention and the Kyoto Protocol on the reduction of emissions of greenhouse gasses. Initiatives are made to further the use of renewable and environmentally sustainable energy, i.e. hydropower, wind energy, solar energy and hydrogen.

1.3.6 Faroe Islands

The Climate Convention was ratified by the Realm, and therefore it also applies for the Faroe Islands. When ratifying the Kyoto Protocol the Danish government followed a request from the Faroese Government took a territorial reservation for the Faroe Islands.

In the spring 2008 the Faroese Government started a process formulating a Climate Strategy, and in the autumn 2008 a catalogue of potential options to reduce emissions of greenhouse gases was published.

In December 2009 the Faroese Climate Policy has been adopted by the Faroese Parliament. The policy is adopted by all the political parties in the Parliament. The national target is to reduce the domestic emissions of greenhouse gases by at least 20% in the period 2010 to 2020 compared with the level of emissions in 2005.

1.4 Projections and the total effect of policies and measures

An up-dated projection of Denmark's emissions and removals of greenhouse gases in 2007-2025 was prepared in February 2009.

This comprehensive projection from February 2009 includes the period 2007-2025 and the main result is included in Table 1.4. The projection is a "with measures" projection, which includes measures that have been or are expected to be implemented. The projections are based on a number of sector-specific projections of the domestic emissions for this period. These emissions depend on the extent of economic activity in all sectors of society, energy prices, technological development, and legislation regulating individual activities in relation to the environment, energy efficiency, etc. Among the most important preconditions are the Ministry of Finances' estimate of economic development and the IEA's expectations regarding future energy prices.

The previously projected deficit has in the February 2009 projections changed to a minor over delivery when the projected effects of the credits from sinks and Kyoto Mechanisms are taken into account.

As an element in the implementation of Denmark’s National Allocation Plan 2008-12, a political energy agreement on further specific policies and measures with greenhouse gas emission reduction as one of the key objectives was reached on 21 February 2008. On the basis of the adoption of these new measures, the “with measures” greenhouse gas emission projection from January 2007 has been updated with this and other changes in assumptions and projected parameters showing a decrease in annual greenhouse gas emissions 2008-2012 of 1,6 million tonnes of CO_2 equivalent from 67.8 to 66.2 million tonnes of CO_2 equivalents in the February 2009 projection, as shown in Table 1.4 and Figure 1.2.

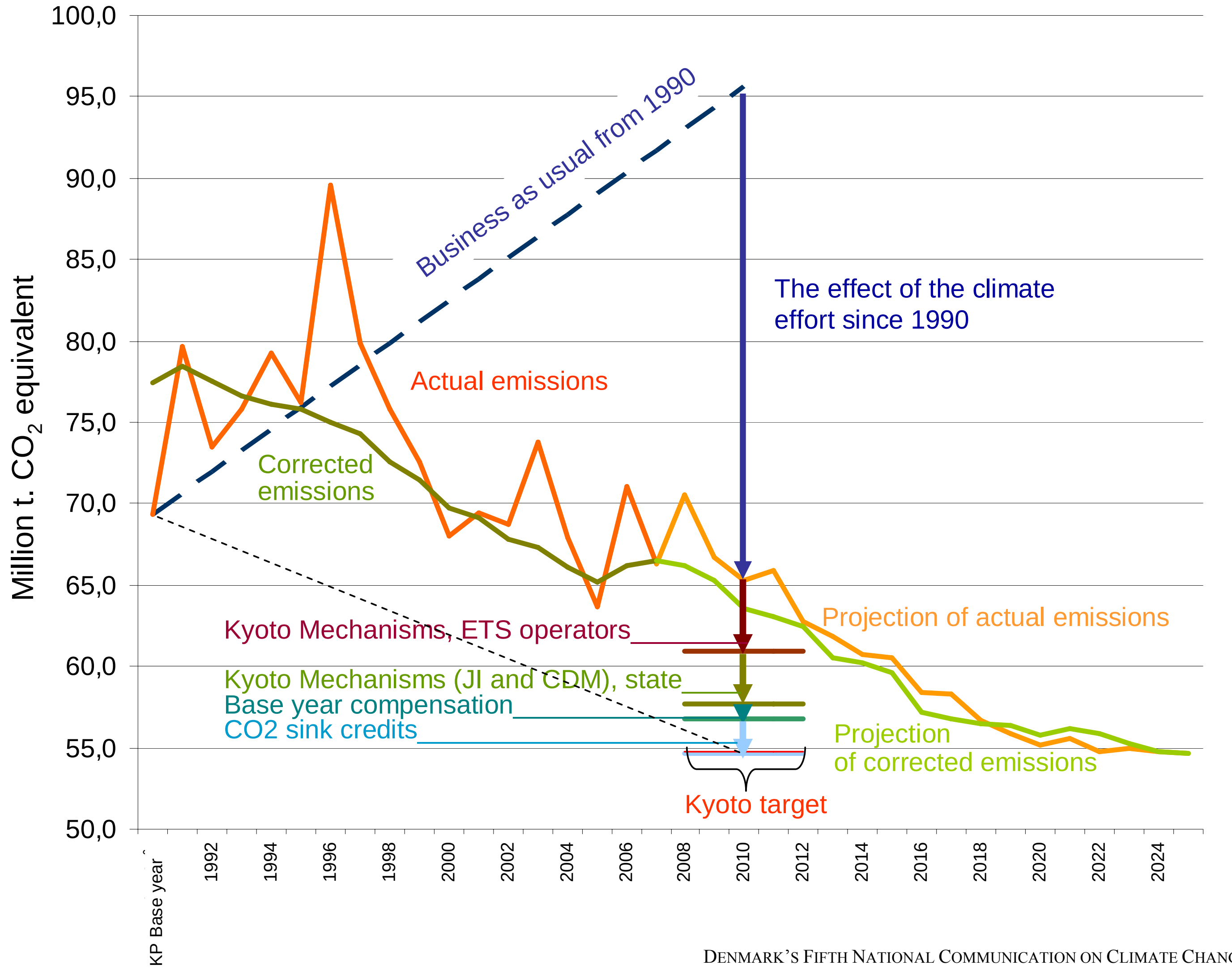
TABLE 1.4: HOW THE KYOTO TARGET WILL BE ACHIEVED ACCORDING TO DENMARK'S NATIONAL ALLOCATION PLAN 2008-12, THE “WITH MEASURES” PROJECTION FROM FEBRUARY 2009 WHICH INCLUDES THE EFFECT OF THE MEASURES ADOPTED WITH THE ENERGY AGREEMENT OF 21 FEBRUARY 2008 AND OTHER CHANGES UNTIL MID 2008 AND INFORMATION ON CREDITS FROM SINKS AND THE KYOTO MECHANISMS UPDATED IN MARCH 2009.

	Annual greenhouse gas emissions 2008-2012 in million tonnes of CO_2 equivalent[1]
The “without measures since 1990”-projection	**95,6**
The updated “with measures”-projection of February 2009[2]	**66,231**
Denmark’s assigned amount as annual average 2008-2012	**54,765**
Sink credits from afforestation since 1990 (KP, Article 3.3)	0,288
Sink credits from forest management, cropland management and grassland management (KP, Article 3.4)	1,9
Total sink credits	**2,188**
Kyoto Mechanism, JI- and CDM-projects financed by the state[3]	3,2
Base year compensation under the EU Burden Sharing	1,0
Total other state credits	**4,2**
Projection of ETS operator’s CO_2 emissions as annual average 2008-2012	29,8
ETS operator’s CO_2 allowances 2008-2012 as annual average	24,5
Total ETS operators credits from use of the Kyoto Mechanisms	**5,3**
Total credits	**11,688**
Denmark’s assigned amount and credits as annual average 2008-2012	**66,453**
Gap after credits from sinks and the Kyoto Mechanisms[4]	**-0,222**
Decided over delivery as compensation for travel by plane by state employees and COP 15 off-set	0,030
Gap after credits and compensation for travel and COP15[4]	**-0,192**

[1] The number of digits shown in the table are results of estimations and calculations and does not represent the certainty level of the figures.
[2] In 2009 political agreements were reached on a Green Transport Vision for Denmark, a general Tax Reform and a Green Growth Plan. The effects of these agreements and plans are not included in the projections in the table, but is expected to be included in the planned update of the government’s climate strategy in 2010.
[3] For the purpose of safe guarding the achievement of Denmark’s target under the Kyoto Protocol and the EU Burden Sharing, the 2009 national budget includes two reserves (DKK 500 million) for additional JI- and CDM projects to cover possible losses if, contrary to expectations, Denmark does not get compensation for the reference year, and/or to cover uncertainty in projections etc. Possible credits from these reserves are not included in the table.
[4] A negative gap means over delivery.

The emissions in the February 2009 baseline projection are 1,6 mill. tonnes of CO_2 equivalents lower than in the baseline projection without the additional measures adopted with the National Allocation Plan. The February 2009 baseline projection for the entire period 2007-2025 is shown in Figure 1.2, together with the historic trend – with and without corrections for the interannual variations in electricity exchange and temperature/heating degree days, and information on the amount of credits from sinks and the Kyoto Mechanisms projected in March 2009.

FIGURE 1.2: HOW THE KYOTO TARGET WILL BE ACHIEVED ACCORDING TO DENMARK'S NATIONAL ALLOCATION PLAN 2008-12, THE UPDATED "WITH MEASURES" PROJECTION FROM FEBRUARY 2009 WHICH INCLUDES THE EFFECT OF THE MEASURES ADOPTED WITH THE ENERGY AGREEMENT OF 21 FEBRUARY 2008 AND OTHER CHANGES AND UPDATED INFORMATION ON CREDITS FROM SINKS AND THE KYOTO MECHANISMS



On the basis of the February 2009 projection of greenhouse gas emissions and on the basis of the March 2009 update of information on credits from activities in the sinks categories under Article 3.3 and 3.4 of the Kyoto Protocol and on credits from the state planned and ETS-operator expected use of the Kyoto Mechanisms, Denmark will reach its target under the Kyoto Protocol and the EU Burden Sharing as shown in Table 1.4 and Figure 1.2.

As it can be seen from Table 1.4, the February 2009 greenhouse gas projection suggests that there will be a minor over delivery of nearly 0.17 million tones of CO_2 equivalent. However, several uncertainties will remain until the end of the commitment period 2008-2012. E.g. removals by sinks are highly temperature dependant and could be lower than expected and thus also the amount of sinks credits could be lower than projected. The projected over delivery is within the overall uncertainty due to unknown factors such as temperature and final delivery of credits from JI- and CDM-projects. For the purpose of safe guarding the achievement of Denmark’s target under the Kyoto Protocol and the EU Burden Sharing, the state budget includes a DKK 450 million reserve for additional JI- and CDM projects.

Furthermore, new knowledge about activities and emission factors could also have implications for the greenhouse gas emission projections. This has been the case after the February 2009 projection. For the purpose of analysing possible new and additional policies and measures with a view to achieving Denmark’s 2020 emission reduction target for the non-EU ETS activities, interim updates of the February 2009 “with (existing) measures” projection in 2009 suggested that additional initiatives could be needed to ascertain that Denmark can live up to its very ambitious targets - both the 2008-2012 target under the Kyoto Protocol and the 2013-2020 target under the EU Effort Sharing Decision for the sectors outside the EU ETS.

To be on the safe side of the 2008-2012 target, the government adopted additional initiatives in Novemver/December 2009.

In 2010, the government will present a new Climate Strategy 2020, focusing on possible further cost effective actions until 2020 for the purpose of achieving Denmark’s 2020 reduction target outside the EU Emission Trading Scheme.

1.5 VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

1.5.1 Climate development - effects and possibility for adaptation for Denmark

Analyses with global and regional climate models show the following general trend for the climate in Denmark in the period 2071-2100 in relation to 1961-1990:

- A rise in the annual mean temperature of about 3-5ºC, depending on the chosen scenario for emission of greenhouse gases. Greatest warming at night, and no major difference between the increase in summer and winter. Warming leads to fewer days with frost and snow and less days with snow cover. Average snow cover decreases to about 25% of present-day values.

- A 10-40% increase in winter precipitation and a reduction in the oder of 10-25% in summer precipitation. A clear tendency towards more episodes with heavy precipitation, particularly in autumn, and lengthy dry periods, especially in the summer.

- A tendency towards more frequent westerly winds and at the same time a shift of the storm tracks over the North Atlantic slightly eastward, leading to a small increase in storm activity over Denmark and the adjacent waters. On this basis, calculations with storm surge models show that the highest sea level in the more extreme cases could rise by 5-10% relative to today (about 0.3 m on the west coast). In addition to this there is the global rise in sea level which the IPCC estimate at between 0.1-0.9 m over the level today.

Uncertainties relating to the assessment of future climate change, especially in projecting precipitation and extreme weather phenomena such as storms and floods, are significant. The DMI models and most other models show climate sensitivity at about 3^{o}C for a doubling in the CO_2 content in the atmosphere. However, new model studies published in 2005 in the journal Nature show that climate sensitivity could be considerably greater than hitherto assumed.

The impacts of possible climate changes in Denmark have been evaluated several times since 1988, and most recently in the Danish EPA report of 2004: Adapting to the climate of the future. The general conclusion is that the direct impacts in moderate climate scenarios would be modest and could be countered by suitable, ongoing adaptation.

In October 2005 the Danish government initiated preparations to meet the impacts of climate change. On the basis of three possible future climate scenarios, IPCC's A2 and B2 and a scenario based on the EU 2 degrees target a catalogue of consequences and measures was established as a first step. As the next step, in March 2008, the Danish government launched a Danish strategy for adaptation to a changing climate.

The strategy is based on the notion that adaptation to climate change is a long-term process, and that it is still uncertain what the consequences of climate change will be and how soon they will take effect. The government will therefore initiate an information campaign and organise the area, with the aim of ensuring that climate change is incorporated into planning and development so that public authorities, businesses and citizens have the best possible basis for considering whether, how and when climate change should be taken into account.

The strategy comprises the following measures:

- establishing an organizational framework, including establishing a horizontal coordination forum for adaptation that will ensure a coordinated effort among public authorities

- a targeted information campaign, including creation of a web portal operated by an information centre

- a research strategy that will include establishment of a coordinating body to ensure that Danish climate research focuses on the adaptation question to a greater extent

After the Government's adoption of the strategy, a new coordination forum was created to ensure a common basis and cooperation and coordination across sectors and authorities. All relevant state authorities and representatives from the municipalities and region and the new coordination unit for research participate in the coordination forum.

One example is the water area, where two studies in 2003 and 2004 have indicated the need for extraordinary action. In its report, the Academy of Technical Sciences pointed in particular to the need to plan renovation of drainage systems so that they will also be able to function in a future wetter climate.

Another area is Danish agriculture, where the overall effects are estimated to be advantageous. Changes in cultivation practice can be implemented at short notice, and production is expected to grow with rising temperature and CO_2 concentration.

Denmark is placed centrally in a vegetation belt of temperate deciduous forest, and, with moderate future climate change, a majority of existing tree species that thrive well today are expected to persist in Denmark. Norway spruce, however, may be the exception.

About 1,800 km of the 7,400 km coastline are protected with dikes or other permanent installations. Increasing use is being made of beach nourishment.

1.5.2 Climate changes in Greenland and on the Faroe Islands

Analyses with global climate models show the following general trend in the climate in Greenland in the period 2071-2100 compared with 1961-1990 for a middle-high scenario:

- A rise in the mean annual temperature in South Greenland of about 2°C, slightly more in winter than in summer, and in North Greenland, a rise in temperature of 6-10°C in winter, but only small rises in summer.
- A general increase of 10-50% in precipitation. The winter increase could however be significantly bigger in North Greenland - locally up to more than 200%.

Analyses with global climate models show the following general trend for the climate on the Faroe Islands in the period 2071-2100 in relation to the period 1961-1990:

- A rise of around 3ºC in annual mean temperature. There is only a slight difference in temperature rise in summer and winter.
- A rise in winter precipitation of about 30%, but only slight or no increase in the summer.

1.6 Financial resources and transfer of technology

In 2007 Danish development assistance constituted about DKK 13.9 billion, corresponding to 0.81% of GNI. With the strategy for Denmark's assistance to developing countries, A World of Difference, the Danish government has laid down priorities for Danish development assistance for the period 2004-2008.

With this strategy, the government emphasises that focus will still be on long-term development work with a view to combating poverty and that the main priorities will be initiatives within social sectors, i.e. education, health, water and sanitation. At the same time, the Danish government's prioritisation of the global environment issues and the question of free trade and market-based economic growth is maintained and strengthened. Moreover, attempts have been made to establish better interplay between environmental assistance and Denmark's general effort to protect the global environment, including through climate initiatives under the Kyoto Protocol. International climate cooperation as well as adaptation to climate change of developing countries have high priority in Denmark's international development cooperation.

The government's strategy for development cooperation also involves stricter requirements for the governments in the cooperation countries with regard to respect for human rights and democracy. Systematic and lasting violations of human rights and democratic rules of play are irreconcilable with qualifying for Danish assistance. This has meant that development cooperation has ceased with some cooperation countries. At mid-2009, Danish programme cooperation countries were Bangladesh, Benin, Bhutan, Bolivia, Burkina Faso, Egypt, Ghana, Kenya, Mali, Mozambique, Nepal, Nicaragua, Tanzania, Uganda, Vietnam, and Zambia.

In international evaluations of Danish development cooperation policies and implementation Denmark receives good results. In the 2007 OECD Review of the Development Co-operation Policies and Programmes of Denmark the following was mentioned: "The final key feature of Denmark's development co-operation is its integrated institutional system within the Ministry of Foreign Affairs at headquarters and in partner countries. Since 2003 this has been complemented by decentralising the bilateral aid programme from headquarters to 16 key partner countries (the "programme countries"), a key step in implementing the aid effectiveness agenda. In 2005, the Danish programme was also decentralised to four multilateral missions. This process has been accompanied by a strengthened approach to quality assurance, supported by a new results-based system and an emphasis on knowledge management.".

1.7 Research and systematic observations

Research and observations within climate in the broad sense of the word are going on at a number of institutes and organisations and cover a wide range of disciplines, from natural science to evaluation of policies and measures and societal aspects.

The Danish Meteorological Institute (DMI) carries out observations of climate parameters (atmosphere and ocean), including observations under the World Meteorological Organisation (WMO)'s programmes and sub-programmes. Climate observations, together with climate research, have been one of DMI's main tasks for more than 125 years, with measurement, theory and modelling. DMI has research competence in carrying out calculations of the climate in the future using global and regional climate models.

The National Environmental Research Institute (NERI) under Aarhus University (AU) is in charge of monitoring the effect of climate change on nature and environment.

Research competence concerning physical expressions of past climate change is particulary at the Geological Survey of Denmark and Greenland (GEUS), the University of Copenhagen (KU) and Aahus University. GEUS also has competencies in glaciological studies of Greenland's ice sheet and its interaction with climate change, and the importance of climate change for the hydrological cycle. The Geophysical Department and the Geological Institute at KU and the Geological Institute at Aarhus University have very great expertise in palaeoclimate data, and the climate group at KU is known worldwide for its ice core drilling and analyses. NERI contributes important research competence in relation to the effect of climate change on ecosystems.

Other institutions, e.g. Forest and Landscape Denmark (SL) under KU, the Danish Institute of Agricultural Sciences (DJF under AU), Risø National Laboratory under the the Technical University of Denmark (DTU), University of Southern Denmark, Roskilde University, Aalborg University and the Danish Coastal Authority work with different aspects of climate research.

It is partly on the basis of research competencies in the above-mentioned areas that Denmark participates actively in IPCC's work. In addition, the Danish climate research contributes to several international projects under the World Climate Research Programme.

DMI monitors the main weather and climate parameters regularly. In the climate monitoring programme, classic methods of measurement are used and new, satellite-based observation methods are developed. DMI operates around 200 automatic measuring stations in the Realm (Denmark, Greenland and the Faroe Islands) with a broad measuring programme ranging from automatic water level or precipitation stations that measure only one parameter to stations with a full measuring programme, including automatic cloud height detectors and weather type detectors. To collect precipitation data, DMI also operates a network of about 450 manual precipitation stations, which are used mainly for mapping the precipitation climatology. The measurements are collected on a daily basis via telephone and are thus available shortly after measurements have been made.

Besides being of use for national programmes, the observations concern Denmark's international contribution in the form of observation components from Danish territory to the worldwide meteorological observation network WWW (World Weather Watch), UNFCC and other international programmes for mapping weather and climate within the GCOS (Global Climate Observing System) coordinated by the World Meteorological Organization (WMO).

The meteorological observations are stored in DMI's database, and observations from many Danish stations are available in electronic form right back to 1872, water level measurements back to 1890, and measurements of the surface temperature of the sea back to 1931.

1.8 EDUCATION, TRAINING AND PUBLIC AWARENESS

In Denmark there is an ongoing public debate in the media and elsewhere about climate change, anthropogenic greenhouse gas emissions and political reactions in terms of policies and measures. In 2009, the government published its new strategy for sustainable development – an update of the strategy from 2002. The Danish climate policy – including the Climate Strategy adopted in 2003 and the Danish strategy for adaptation to a changing climate from March 2008 - must be seen in the light of making a sustainable development of the Danish society. Part of the strategy is to involve the public and to practise openness about the strategy, decision-making and analyses. Denmark has a long tradition for involving the public and, in the environment field, this tradition was followed up by an international agreement - the Aarhus Convention from 1998. In the international UN negotiations on a common effort to mitigate the effect of climate changes, both Danish industry, and green and development-oriented organisations were represented in the Danish delegation. A considerable amount of information on climate change and Danish policies is provided on the websites of the Ministry of Climate end Energy (www.kemin.dk), the Danish Energy Agency (www.ens.dk), the Danish Meteorological Institute (www.dmi.dk), the Geological Survey of Denmark and Greenland (www.geus.dk) and on the websites of other relevant ministries and the institutions thereunder such as the Ministry of Finance (www.fm.dk), the Ministry of Transport (www.trm.dk), the Ministry of Food, Agriculture and Fisheries (www.fvm.dk), the Ministry of Taxation (www.skm.dk) and the Ministry of Foreign Affairs (www.um.dk)..

In 2008 and 2009, numerous new initiaties on education, training and public awareness regarding climate change issues have been taken with a view to support Denmark's role as host for the 15th Conference of the Parties to the UNFCCC 7-18 December 2009 in Copenhagen.

Both at the University of Copenhagen and at Aarhus University education in climate as an integral part of many educational programmes – which are often offered with cooperation with other relevant institutions such as DMI, NERI, GEUS etc.

In 2008-2009, the Ministry of Education has taken a series of initiatives for primary and lower secondary education, youth education programmes and tertiary education in order to put climate on the agenda. In the last two years the Danish Ministry of Education has made a special effort to encourage pupils/students, teachers and schools to put the climate on the agenda in the year 2008/09. It has happend through a series of initiatives for primary and lower secondary education, youth education programmes and relevant tertiary education.

A number of initiatives are being carried out to promote environmentally sound behaviour in companies and households, particularly for climate reasons, and with respect to energy use. Labelling schemes, printed matter, information lines, media spots and similar are used to increase public knowledge of possibilities for action and knowledge of less environmentally harmful technologies, and every year a number of public campaigns are carried out.

One example is the "One tonne Less" campaign launched by the Ministry of Climate and Energy in 2007.

2 National Circumstances

relevant to greenhouse gas emissions and removals

2 National circumstances
- relevant to greenhouse gas emissions and removals

The Kingdom of Denmark comprises Denmark, Greenland and the Faroe Islands. The UN Framework Convention on Climate Changes has been ratified on behalf of all three parts of the Realm. Therefore, this report includes information about Denmark, Greenland and the Faroe Islands. However, at the present time, more information is available on Denmark than on the other parts of the Realm. Where tables, figures, and other information in this report also cover Greenland and/or the Faroe Islands, this is stated.

2.1 DENMARK

Denmark's national circumstances relevant to greenhouse gas emissions and removals are described in this Section. Among the most significant circumstances affecting greenhouse gas emissions and removals in Denmark are the following:

- Denmark is situated in a temperate climate zone – This implies a need for heating, especially during wintertime, and significant inter-annual variations in greenhouse gas emissions due to inter-annual variations in winter-temperatures.

- Denmark is an industrialised country with arable land and an economy based on manufacturing of commodities, agricultural products and services for the global market – This implies a need for energy supply and electricity production.

- Denmark is a flat country – This implies insignificant access to hydro power in domestic electricity production and a long history of dependence on fossil fuels in the country's energy supply, especially coal and oil – until 1980s almost solely based on imports, but since 1997 self-sufficient in energy, due to production of oil and gas in the North Sea.

- Denmark has no nuclear power. Since 1990 Denmark has increasingly had a shift from coal and oil to natural gas and renewable energy sources, increased the use of combined heat and power production and decentralised power production where the combined production is utilised for district heating. Together with improvements in energy efficiency, keeping the energy demand almost constant despite a significant economic growth, and initiatives regarding the agricultural sector, waste, industrial greenhouse gases etc., Denmark's emissions of greenhouse gases related to domestic activities, including domestic electricity demand, has been decreasing.

- Denmark's electricity production capacity is an integral part of the Nordic electricity market, where hydro power in Norway and Sweden is also and integral part – This implies significant inter-annual variations in Denmark's total greenhouse gas emissions with elevated emission levels in years with low precipitations in Norway and Sweden and vice versa. In 1990, the base year under the United Nations Framework Convention on Climate Change and the Kyoto Protocol, Denmark's total greenhouse gas emissions were extremely low due to a extremely large electricity import from the Nordic countries, which experienced a particular high precipitation that year.

These highlighted national circumstances are not the only national circumstances relevant to Denmark's greenhouse gas emissions and removals. In the rest of this Section further information on relevant national circumstances and indicators is given.

As briefly introduced above policies and measures in Denmark are also affecting Denmark's greenhouse gas emissions and removals. Further information on policies and measures relevant to Denmark's greenhouse gas emissions and removals is included in Chapter 4.

2.1.1 Form of government and structure of administration

Denmark is a constitutional monarchy, and the power of the state is divided between the legislative branch, the executive branch, and the judicial branch. According to the Constitution of the Realm, legislative power lies with the Folketing, which consists of 179 members, two of whom are elected on the Faroe Islands and two in Greenland. The members are elected by the population for a period of normally four years. A new general election can mean that a member sits for less than this period.

The executive branch - the government - cannot have a majority of the Folketing against it, cf. the regulations in the Danish Constitution on votes of no confidence. Since 1953, Denmark has often had a minority government, i.e. a government supported by a minority of the members of the Folketing. In these situations the government will need to include a support party.

The number of ministers in the government varies. Since 1971 Denmark has had a Minister for the Environment and a Ministry of the Environment who represent Denmark in international negotiations on climate and which also have primary responsibility for coordination and implementation of legislation, plans etc. for the climate area.

For the last ten years or so, other ministries have also worked with environmental and climate issues. In 1988 the government decided to follow up the UN report on sustainable development, the Brundtland report, in which one of the main messages was the necessity of integrating the environmental issue into the administration within sectors such as transport, agriculture, and energy.

For this reason, a number of sector ministries have drawn up action plans in which the environment is an integral element. Examples are sector plans for energy, transport, agriculture, and development assistance. In the climate area, the government presented an overall status in connection with the presentation of its proposal for ratification of the Kyoto Protocol in April 2002. This status report was followed in February 2003 by a government proposal for a national Climate Strategy for Denmark until 2008-2012, including analyses from the sector ministries, which was adopted by the Folketing on 13 March 2003. As an element in the implementation of the EU Climate and Energy Package adopted in December 2008 the government is preparing a national Climate Strategy for Denmark until 2020 with a view to adopt this new strategy in 2010.

One of the main cornerstones of Danish democracy is autonomous local government. The specific environmental action takes place not only at national level but also at municipal level. The state sets the national rules and framework for environmental administration, while the municipalities, working within this framework, plan and decide initiatives that implement and support the national legislation.

The importance of local involvement is stressed in Agenda 21 - a global agenda for sustainable development in the 21st century, which was adopted at the Rio Conference in 1992. The government supports the popular interest and participation in climate and environmental issues in different ways - including through implementation of the Pan-European Aarhus Convention and support for the local Agenda 21 work initiated by most of the Danish municipalities.

In the light of Denmark’s role as host for the Fifthteenth Conference of the Parties under the UNFCCC in December 2009, many additional initiatives to raise awareness and involve citizens, municipalities, business community and other stakeholders have been taken – both on national and local level. Several municipalities have committed themselves to local targets for reducing greenhouse gas emissions.

2.1.2 Population

Today, Denmark has a population at around 5.5 mill. As will be seen from Table 2.1, population growth has been relatively small in the last 29 years.

TABLE 2.1 POPULATION OF DENMARK

Source: Statistics Denmark.

	1980	1990	2000	2009
Denmark's population (in mill.)	5.1	5.1	5,3	5.5

The latest forecasts show that population growth will continue to be moderate in the years ahead. For example, the population is expected to reach 5.68 mill. in 2020, rising to 5.95 mill. in 2050. The low birth rate in the 1980s means that young people between the ages of 20 and 29 years make up only 10% of the population, while the elderly, between 55 and 64 years of age, account for 14%.

Today, the population density is 128 per km^2.

Today, 76% of Danish wage earners are employed in service trades, while 18% are employed in manufacturing and 6% in agriculture, forestry and fisheries.

2.1.3 Geography

Denmark consists of the Jutland peninsula and more than 400 islands. It has a total area of 43,098 km^2 and lies at about 55º N and 11º E.

The whole of the country is lowland. The surface was formed by Ice Age glaciers and glacial streams. The highest hill is approximately 170 metres above sea level.

The coastline has a length of more than 7,300 km. To protect low-lying land against flooding and storm surge, it has been necessary to build dikes or other permanent installations along about 1,800 km of coastline. In addition, sandbags, breakwaters and similar protect other parts of the coastline, which would otherwise erode because they consist of soft materials deposited during the last Ice Age.

A rise in the water level due to climate change would obviously affect the protection of the coasts and create a greater risk of flooding and erosion.

The Danish landscape is indelibly stamped by the high population density. More than 66% of the land is used for agriculture or horticulture. Woodlands take up 14%, while towns, roads and scattered habitation take up 10%. The rest is nature or listed areas such as lakes, watercourses, heaths, dunes and beaches.

In relation to its size, Denmark is home to a wide variety of flora and fauna - in all, about 30,000 species.

2.1.4 Climate

The Danish climate is temperate with precipitation evenly distributed over the year. The country lies in the zone of prevailing westerly winds, which is characterised by fronts, low pressure, and changeable weather. Compared with other regions on the same latitude as Denmark, the climate is relatively warm due to the warm North Atlantic current that originates in the tropical sea off the east coast of the USA.

Denmark has a distinctly coastal climate, with mild, damp winters and cool, unsettled summers. Average temperatures vary from about half a degree in winter to about 15 degrees in summer. However, the weather in Denmark is greatly affected by the proximity of both the sea and the continent. This means that the weather can change, depending on the prevailing wind direction. The west wind from the sea brings relatively uniform weather in summer and winter: mild in winter and cool in summer. When the wind comes from south or east, the weather in Denmark is more similar to that of the continent: warm and sunny in summer and cold in winter. The weather in Denmark thus depends very much on the wind direction and the season.

Atmospheric pressure

Average atmospheric pressure in Denmark shows seasonal variation, reaching a minimum in November and a maximum in May.

Denmark's highest-ever atmospheric pressure, 1062.5 hPa, was recorded in Skagen on 23 January 1907, while just one month later, on 20 February, the lowest atmospheric pressure in the history of Denmark was also recorded in Skagen, at 943.9 hPa.

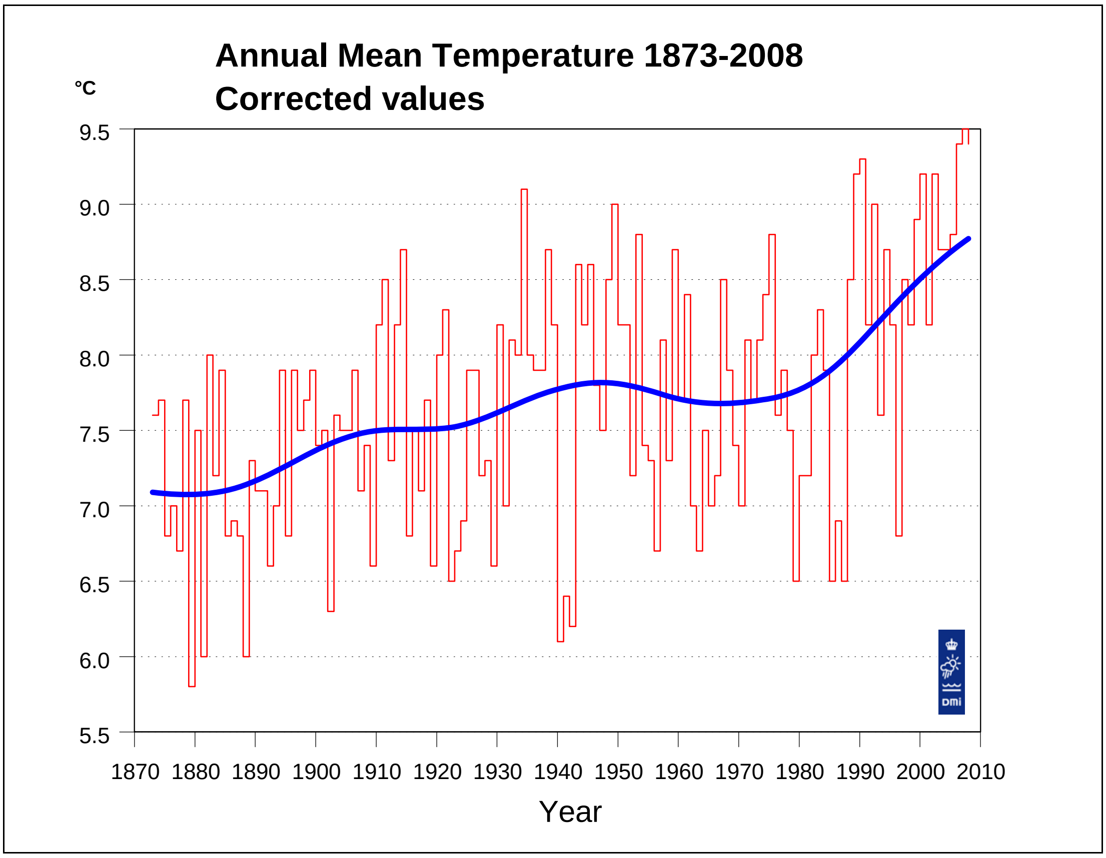
Temperature

The annual mean temperature varies from year to year, from below 6ºC to more than 9ºC, with an average of 7.7ºC. The coldest year so far was 1879, with a mean temperature of 5.9ºC, while the hottest recorded year was 2007, with 9.5ºC. The three years 2006, 2007 and 2008 are the warmest ever recorded in Denmark. 2008 and 2006 both had a mean temperature of 9.4°C. This is followed by 1990 with 9.3°C. Since 1988, almost every year has been hotter than normal, and the temperature showed a sharply rising trend from the 1990s. Since 1870, the temperature in Denmark has risen by almost 1.5ºC, but the ten hottest years occurred from the 1930s to present.

The temperature in January and February averages around 0ºC but can vary greatly from 12ºC to below -31ºC. The average temperature in July and August is around 15ºC, but again can vary from below -3ºC to more than 36ºC.

FIGURE 2.1 ANNUAL MEAN TEMPERATURE IN DENMARK 1873-2008 IN ºC

Source: Cappelen 2009a



Precipitation

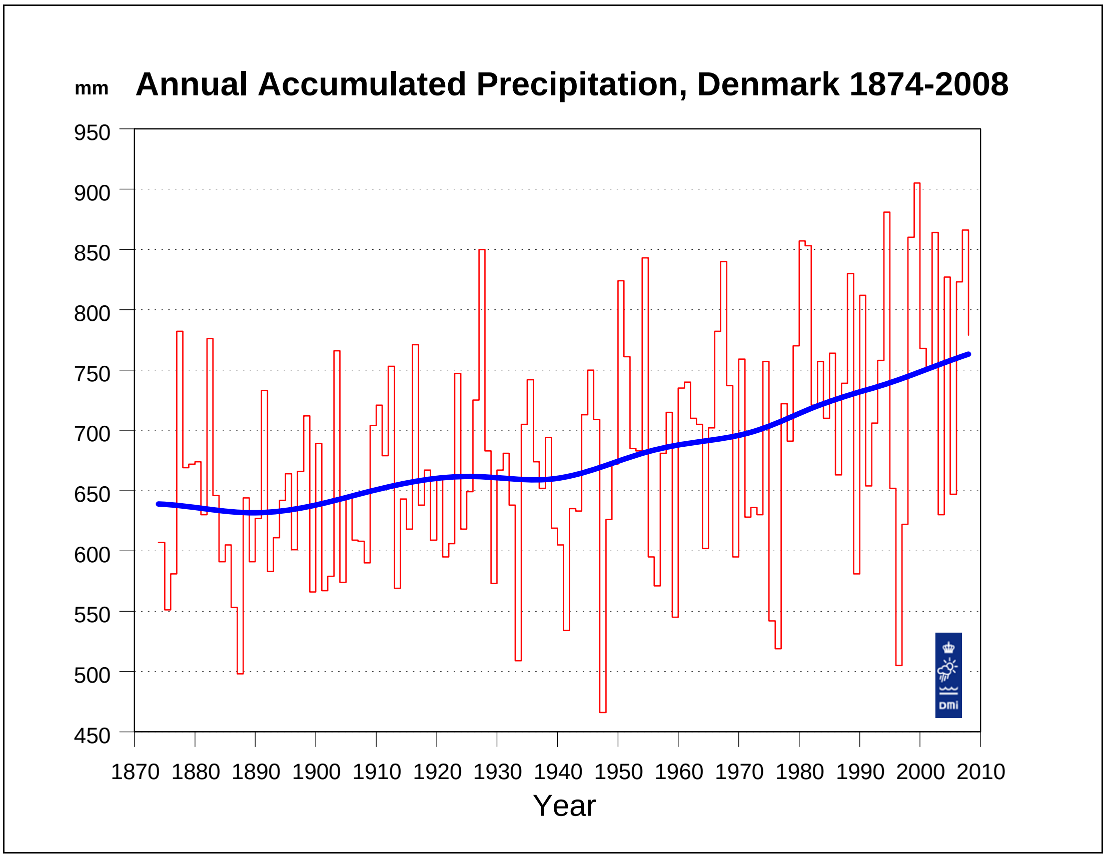
Average annual precipitation varies greatly from year to year and from place to place. The lowest annual precipitation for the country as a whole was 464 mm in 1947, and the highest was 905 mm in 1999, while the average annual precipitation is 712 mm.

The wettest months are normally September, October, and November, while the driest are February to May.

In the winter months, precipitation is sometimes in the form of snow. Annual precipitation in Denmark has on average increased by about 100 mm since 1870.

FIGURE 2.2 DANISH ANNUAL PRECIPITATION 1874-2008 IN MM

Source: Cappelen 2009a



Hours of sunshine and cloud cover

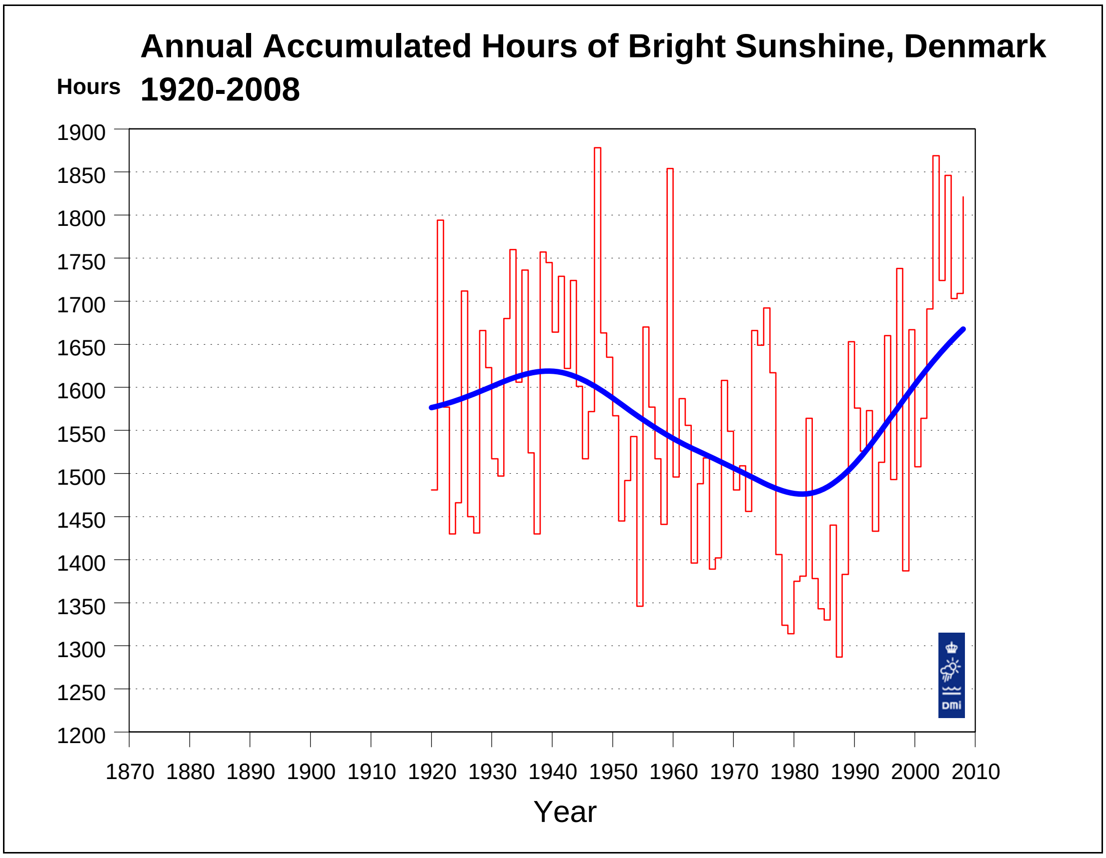
On average, Denmark as a whole has about 1,495 hours of sunshine annually, but this figure varies greatly from year to year. The sunniest year was 1947, with 1,878 hours, and the least sunny was 1987, with 1,287 hours. There is least sunshine in January and December with slightly more than 40 hours in most places, while May and June have the most sunshine with an average of about 210 hours.

Average annual cloud cover is 65%. 129 days are cloudy, i.e. with cloud cover at >80% and only 27 days are clear, with cloud cover at <20%.

Since 1980, the trend has been towards more hours of sunshine and less cloud cover.

FIGURE 2.3 ANNUAL HOURS OF SUNSHINE IN DENMARK 1920-2008

Source: Cappelen 2009a



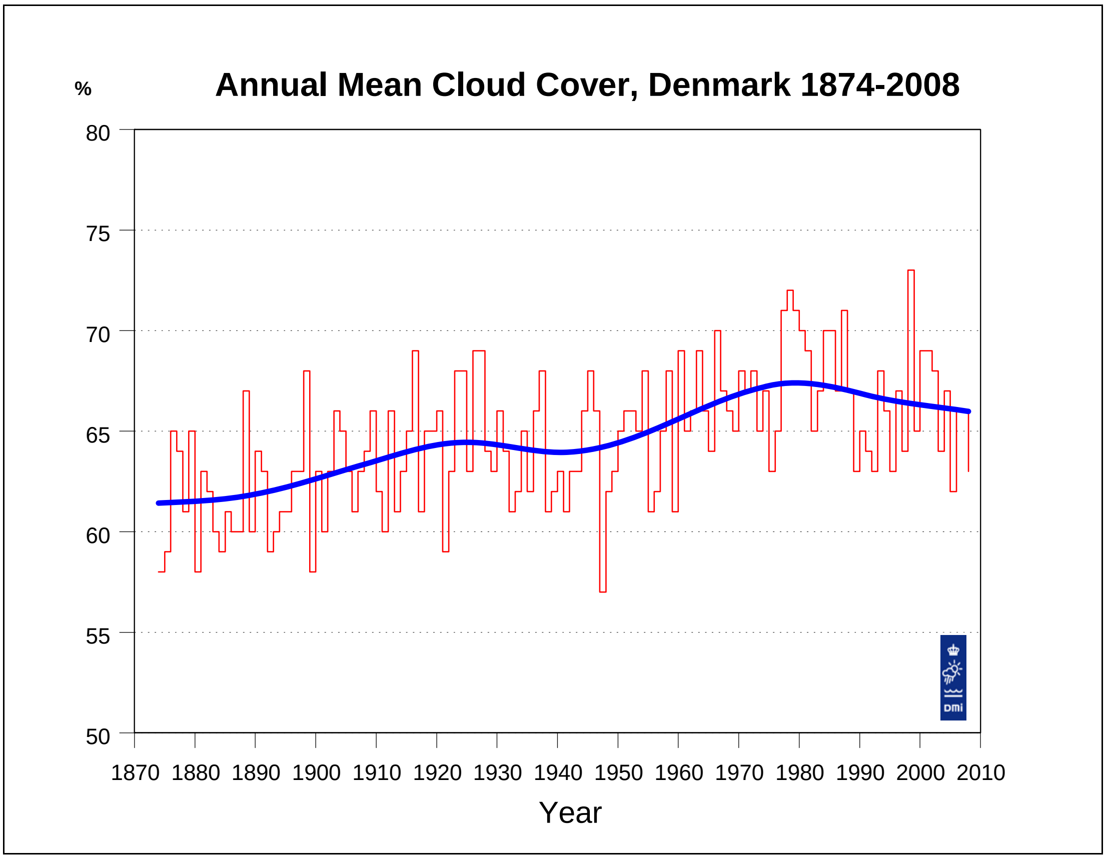
Wind

Countrywide, annual mean wind velocity is 5.8 m/s, and the wind is most frequently from westerly directions, from which about 25% of all winds come.

The number of days with severe wind (≥ 10.8 m/s) varies from about 30 in some places inland to almost 170 days at Skagen. On average, storm-force (≥ 24.5 m/s) occurs along the Danish coasts every three to four years. In December 1999 large parts of Denmark were hit by the worst-ever measured hurricane, and in some places mean wind velocities (average over 10 minutes) of more than 40 m/s were recorded, with gusts of more than 50 m/s.

FIGURE 2.4 ANNUAL MEAN CLOUD COVER IN DENMARK 1874-2008 IN PERCENT

Source: Cappelen 2009a



2.1.5 Economy

Since the last negative economic growth in Denmark in 1993, GDP (Gross Domestic Product, in fixed 2000 prises) grew with an average of 2.3% per year until 2008. In 2008 Denmark had a negative growth of 1,0% due to the global financial crisis. In 2008, GDP (in current prices) was DKK 1,735 billion, corresponding to DKK 315,600 per capita (1 Euro = DKK 7.45).

From Table 2.2, which shows key figures for the Danish economy, it will be seen that Denmark has a very open - and thus sensitive economy, in which export accounts for a substantial part of total demand. In addition, public expenditure accounts for a large part of GDP. Table 2.3 shows the business sector's contribution to GDP.

TABLE 2.2 KEY FIGURES FOR THE DANISH ECONOMY. CURRENT PRICES, 2008, IN DKK MILL.
Source: Statistics Denmark.

GDP	1,733,513
Imports	911,054
Exports	950,920
Consumer spending	851,184
Public expenditure	463,047
Gross investment	366,332

TABLE 2.3 THE BUSINESS SECTOR'S CONTRIBUTION TO GDP, CURRENT PRICES 2008, IN DKK MILL
Source: Statistics Denmark.

Sector	**Gross increase in value**	**%**
Agriculture	16,438	1.1
Raw materials, industry and energy	302,743	20.5
Construction	85,605	5.8
Trade, transport and communication	316,716	21,4
Finance and residential business	360,101	24.4
Services	396,420	26.8
Total	**1,478,023**	**100**

2.1.6 Energy

Energy production and energy-consuming activities are the main contributors to the emissions of greenhouse gases in Denmark. The energy sector alone (energy production and supply) accounts for 38% of Denmark's total emissions of greenhouse gases, primarily CO_2. In addition there are emissions from the energy-consuming activities in the transport sector, industry and households.

In the energy sector, CO_2 emissions have been reduced despite strong economic growth. This was achieved through long-term ambitious efforts, which must be followed up and developed further in order to maintain the positive trend.

Production and supply

As will be seen from Table 2.4, Denmark's own production of energy has grown almost 30-fold since 1980 and it almost more than tripled since 1990. Denmark is self-sufficient in energy, see Table 2.5. This is mainly due to the production of oil and gas in the North Sea, but renewable energy is also increasingly contributing to the country's energy supply.

TABLE 2.4 ENERGY PRODUCTION (PJ)

Source: Danish Energy Authority

	1980	1990	1995	2000	2004	2005	2006	2007
Production, total	**40**	**423**	**656**	**1165**	**1306**	**1315**	**1242**	**1137**
Crude oil	13	254	392	765	828	796	724	652
Natural gas	0	116	197	310	356	393	390	346
Renewable energy etc.	28	53	67	90	122	126	128	139

TABLE 2.5 DEGREE OF SELF-SUFFICIENCY (%)

Source: Danish Energy Authority

	1980	1990	1995	2000	2004	2005	2006	2007
Energy, total	**5**	**52**	**78**	**139**	**156**	**155**	**144**	**130**
Oil	2	71	105	204	239	228	210	187
Oil and natural gas	2	84	116	189	218	219	208	191

Today, 15,3.% of the actual consumption of energy is supplied by renewable energy. The renewable energy resources are mainly wind energy and biomass, which are used to produce electricity, combined heat and power, or district heating. Internationally, Denmark is among the leading nations in wind energy.

Energy consumption

Despite the economic growth, total energy consumption has remained largely unchanged at approximately 800 PJ since 1980, cf. Tables 2.6 and 2.7.

Denmark's dependence on oil and coal has fallen. Particularly in the production of electricity and heat, oil and coal have been substituted with other fuels. Thus, natural gas, waste and biomass are increasingly being used in small-scale and industrial CHP plants, natural gas and renewable energy is increasingly being used in large scale electricity production, and natural gas is increasingly being used for individual heating of buildings.

The distribution of gross energy consumption (energy consumption adjusted for foreign electricity trade) in 2007 was as follows: industry and agriculture accounted for 25%, domestic sector for 27%, transport for 26% and commerce and service for 15%. Refining and non-energy purposes accounted for the remaining 7%.

TABLE 2.6 ACTUAL ENERGY CONSUMPTION (PJ)

Source: Danish Energy Authority

	1980	1990	1995	2000	2004	2005	2006	2007
Energy consumption, total	**830**	**753**	**841**	**815**	**846**	**833**	**886**	**863**
Oil	555	343	372	368	345	346	345	346
Natural gas	0	76	133	186	195	188	191	171
Coal	252	255	272	166	184	155	233	195
Renewable energy etc.	28	53	67	93	132	139	141	154
Net imports of electricity	-4	25	-3	2	-10	5	-25	-3

TABLE 2.7 GROSS ENERGY CONSUMPTION, BREAKDOWN BY FUELS, ADJUSTED FOR CLIMATE FLUCTUATIONS AND NET EXPORTS (PJ)

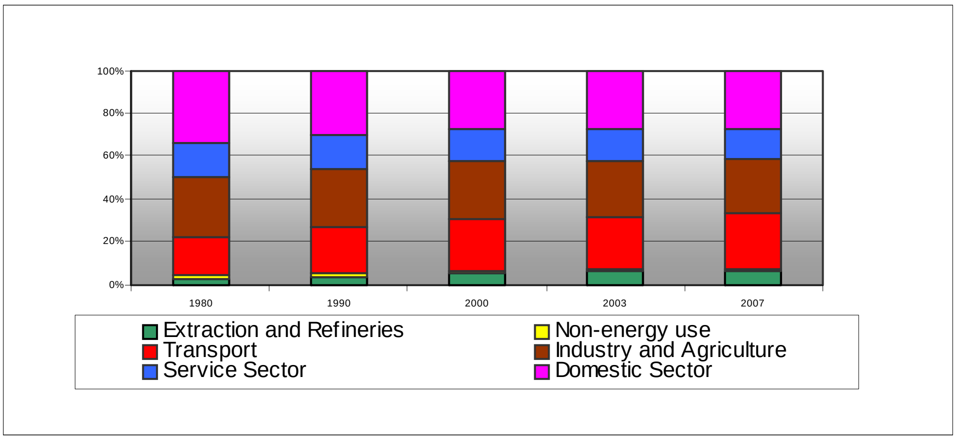
Source: Danish Energy Authority

	1980	1990	1995	2000	2004	2005	2006	2007
Gross energy consumption, total	**816**	**819**	**840**	**837**	**838**	**848**	**862**	**874**
Oil	548	355	374	374	347	350	345	349
Natural gas	0	82	134	192	195	192	191	175
Coal	241	327	265	176	163	166	182	192
Renewable energy etc.	27	55	67	95	133	140	144	158

Figure 2.5 shows adjusted energy consumption, sector by sector. Over the last 27 years relative consumption by the transport sector has risen, whereas relative domestic sector consumption has fallen.

FIGURE 2.5 ADJUSTED GROSS ENERGY CONSUMPTION, BREAKDOWN BY SECTOR

Source: Danish Energy Authority



Structure of the market

The structure of the market in the energy sector is characterised by a division between production and supply of oil and natural gas, electricity, and district heating.

Oil and gas supply

Oil and natural gas production activities in the North Sea continue to be of major importance to Danish society, even though the oil industry employs a limited workforce. Figures from the annual report recently published by the DEA, "Oil and Gas Production in Denmark 2007", show that production in the North Sea generated close to DKK 28 billion of revenue for the state in the form of taxes and fees. The state's share of the oil companies' profits was 63 per cent in 2007. Since 2004, oil production from Danish fields has declined by about 20 per cent, and natural gas sales also ended at a lower level in 2007. Combined with the relatively low dollar exchange rate, this meant that production in 2007 represented a lower value than the year before. However, the value of production in 2007 is based on an average oil price of USD 72.2, and there is every indication that the average oil price will rise sufficiently in 2008 to strengthen both the balance of payments and the state's revenue from the North Sea activities.

In 2007, the Danish Government presented an energy strategy containing a number of ambitious goals for Danish energy policy until 2025. In February 2008, all parties in the Danish Parliament, with the exception of the Red-Green Alliance, concluded the Energy Agreement, which defines goals and strategies for the Danish energy system until 2011.

The agreement provides for the further expansion of renewable energy, a reduction in energy consumption and more efficient energy use. For the oil and gas sector, the agreement includes strategies for identifying avenues of action and setting up initiatives that will improve the energy efficiency of North Sea production activities. This work is to be completed in the course of 2008.

The agreement is aimed to reduce Denmark's dependency on coal, oil and natural gas. However, despite concentrated efforts to expand renewable energy and generate energy savings, the Danish oil and gas sector will continue having significant influence on the Danish economy and security of supply for many years ahead.

Despite an appreciable decline in oil and gas production, the Danish state generated close to DKK 28 billion in revenue from the North Sea activities in 2007. After growing for many years, state revenue in 2007 recorded its first downward trend. The decrease of about DKK 3 billion compared to 2006 results from a natural decline in production and a falling dollar exchange rate that could not be fully offset by increasing oil prices.

Continued high oil prices are spurring oil companies to invest in exploration, field developments and technological developments, and the DEA expects investments in exploration to increase over the next few years. These activities in particular are expected to curb the decline in oil and gas production and thus hopefully enable Denmark to continue deriving substantial income from future activities in the North Sea.

Oil and gas production activities in the North Sea result in CO_2 emissions corresponding to 3.5-4 per cent of Denmark's total emissions. Over the past decade, CO_2 emissions have increased from about 60,000 tons per million ton oil equivalents to about 70,000 tons. A broad parliamentary majority wishes to identify the possibilities for improving energy efficiency in production. In cooperation with oil and gas field operators, the Danish Energy Agency expects to present an overall report on the potential of energy-efficiency measures at the end of 2009.

Concerning the production of natural gas and oil, Maersk Oil and Gas works at 15 fields, DONG Energy at 3 fields and Hess at 1 field.

Electricity

In connection with the implementation of the EU Directive on liberalisation of the electricity sector, a reform of this sector has also been carried out. This reform means full market opening and all electricity consumers have a free choice of electricity supplier.

On 29 March 2004 the government entered into a number of energy policy agreements with a broad majority of the Folketing parties and with the organisation representing electricity grid companies, Elfor. The agreements established a new overall framework for the market structure and ownership of the energy sector, and they include the main points described in the following text box.

Key elements of the agreement are that electricity grid companies transfer responsibility for system operation and the overall transmission net to the state with a view to separating ownership of the overall infrastructure from commercial activities relating to trading and electricity production. Owner shares in the overall electricity transmission network were taken over by the state company Energinet.dk, and responsibility for system operation is transported to the company from Elkraft System and Eltra. As regards natural gas, DONG Energy transferred its subsidiary Gastra to Energinet.dk, so that in the future the company will own and operate systems, electricity transmission and natural gas transmission in Denmark. This separation of ownership of the overall net from commercial activities relating to electricity and gas, has provided an important basis for efficient competition in the Danish energy sector.

As part of the energy policy agreements in 2004 and the agreement with Elfor, the provisions of the Electricity Supply Act on distinction between free and tied-up capital were repealed, thus providing an incentive to reorganise companies and adapting the structure in the electricity sector. The result has been that a number of grid companies and municipalities in Jutland and on Funen have relinquished their interests in Elsam. The remaining municipalities and grid companies who are shareholders have also disposed of their holdings. On 10 December 2004 the Minister for Finance and the boards of Elsam A/S and DONG Energy made an agreement on merging Elsam and DONG energy.

The framework agreement of 10 December 2004 and the DONG Energy A/S agreements mean there is the prospect of forming a large Danish energy company which will be able to compete with the larger foreign energy companies and act as a dynamo for strong commercial and technological development of the energy area in Denmark.

Following the agreements of 29 March 2004, small-scale heat and power production and other mandatory electricity are now based on market forces. Decentral plants have been given an incentive to organise electricity production on the basis of the prices of electricity on the market, because subsidies are now granted as financial, subsidies, independent of production, while electricity production is settled at the market price. This reorganisation is being introduced stepwise, so that plants above 10 MW operate under the new terms as from 1 January 2005, and plants between 5 and 10 MW do so no later than 1 January 2007. Small plants below 5 MW may remain under the old scheme indefinitely.

In order to achieve a better functioning electricity market, the regulations on mandatory electricity production were also repealed as from 1 January 2005. All electricity produced is now sold on the electricity market, and consumers can buy their entire consumption on market terms.

District heating

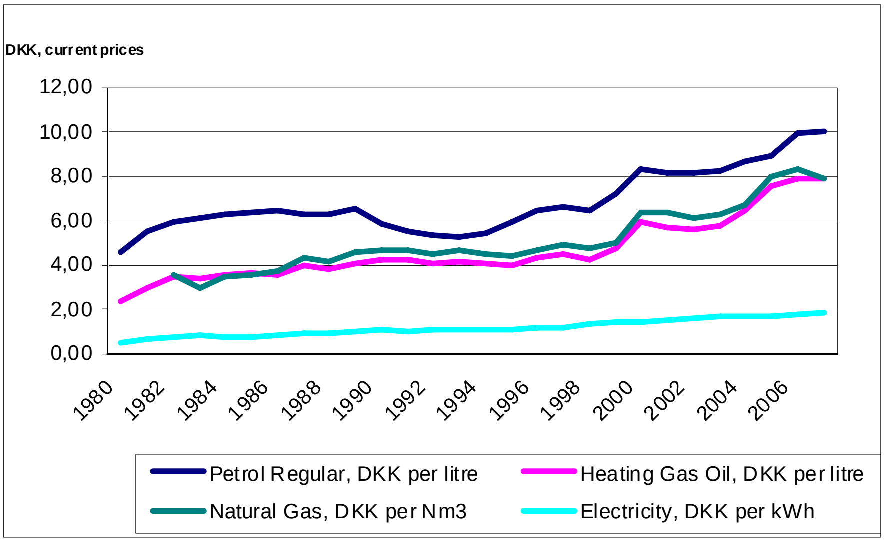
Approximately 60 % of the demand in the domestic sector for heating is supplied by district heating and almost 50 % of the full heating demand. The heat is supplied from primary and small-scale CHP plants, waste incineration plants and biomass-fired district heating stations. Apart from the primary plants, the plants are owned either by municipalities or by local cooperatives that are owned by the consumers. In 2007, approximately 33 % of the district heating was produced on renewable energy sources and 16 % biodegradable waste.

Prices and taxes

Energy prices are one of the key factors governing energy consumption. In 2006 total spending on energy, including taxes and VAT, amounted to DKK 158.8 billion. Of this figure, domestic users paid DKK 68 billion, manufacturing industries DKK 43 billion, and the commercial sector and the service industries, including public services, DKK 38.9 billion. As a general rule, enterprises subsequently receive a full refund of energy taxes and VAT, but not of CO_2 taxes.

Figures 2.6 and 2.7 show the energy prices paid by domestic users. Figure 2.6 shows the current consumer prices, including taxes and VAT. Figure 2.7 shows the development in fixed 2007 prices. The fixed prices have been adjusted for the change in general prices according to the consumer price index.

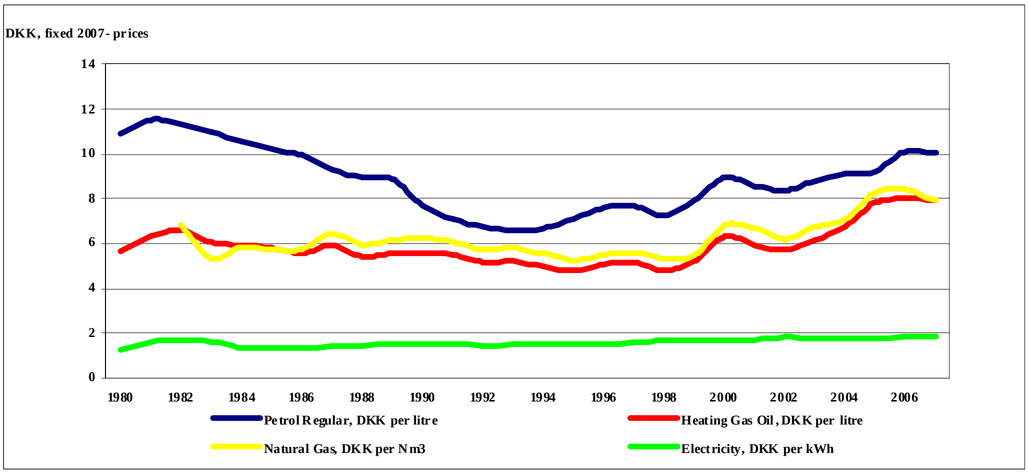
FIGURE 2.6 ENERGY PRICES FOR DOMESTIC USERS IN CURRENT PRICES, DKK
Source: Danish Energy Authority



The prices of heating oil and natural gas follow each other because this is laid down by law. The tax on petrol has risen over time, and this has affected the price of petrol.

Measured in fixed prices, the prices of petrol, heating oil and natural gas fell from 1980 until the early 1990s, cf. Figure 2.7. The price of electricity increased slightly over the period.

FIGURE 2.7 ENERGY PRICES FOR DOMESTIC USERS IN FIXED 2007 PRICES, DKK
Source: Danish Energy Authority

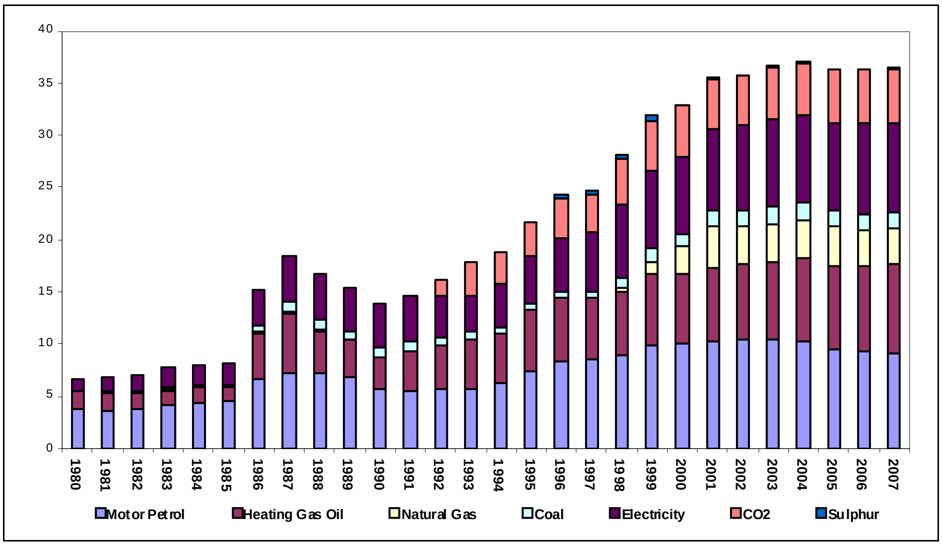


As an added incentive to enterprises to improve their energy efficiency and reduce Danish emissions of CO_2, a green tax package with gradually increasing taxes on CO_2 and SO_2 emissions as well as energy taxes was introduced in 1996. Enterprises with particularly high energy consumption can contract with the Danish Energy Authority on energy-efficiency improvements in return for a discount in the CO_2 taxes and possibly heating taxes. Denmark wants CO_2 taxes on the allowance-regulated fuel consumption for industrial production processes to be repaid as far as possible, and preferably in fully. Therefore Denmark will change the CO_2 Taxes Act within the scope defined in the directive on energy taxation. The European Commission must approve the amendment, for instance under the rules on state subsidies.

In 2007 the revenue from energy taxes amounted to DKK 36.4 billion, up from DKK 36.3 billion in 2006. The largest contribution, DKK 9.2 billion, comes from petrol. Total revenue has increased by 161% in relation to 1990, when there were no CO_2 and sulphur taxes. In 2007 energy taxes accounted for more than 4.4% of total tax revenue.

FIGURE 2.8 REVENUES FROM ENERGY, CO2 AND SULPHUR TAXES. CURRENT PRICES IN BILLION DKK

Source: Danish Energy Authority



Trade

In 2007, net foreign exchange earnings from energy products amounted to DKK 25.8 billion. There was a surplus on foreign trade in oil, natural gas, and electricity, but a deficit on foreign trade in coal.

TABLE 2.8 IMPORTS AND EXPORTS OF ENERGY

Source: Danish Energy Authority

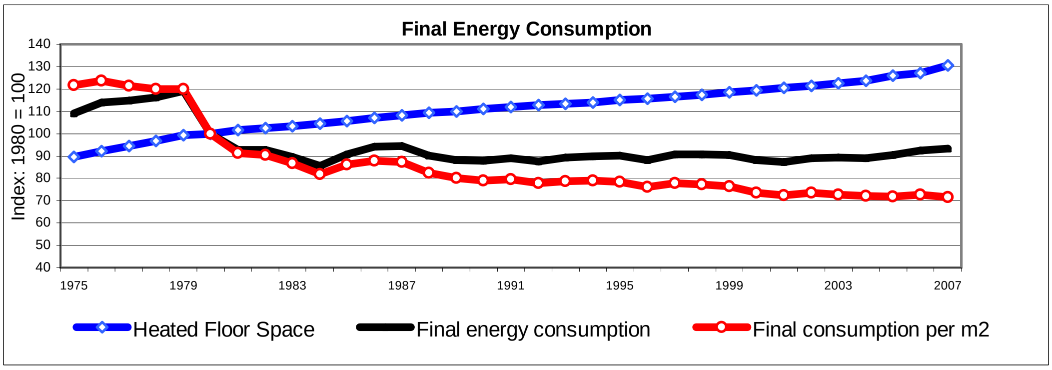
	Imports							
	1980	1990	1995	2000	2004	2005	2006	2007
Crude oil, PJ	259	174	229	159	161	117	116	87
Oil products, PJ	363	183	205	256	209	251	230	251
Coal, PJ	185	262	321	161	189	149	217	200
Natural gas, PJ	0	0	0	0	0	0	0	0
Electricity, Gwh	1979	11973	4013	8417	8 673	12 943	6 766	10 427
	Exports							
	1980	**1990**	**1995**	**2000**	**2004**	**2005**	**2006**	**2007**
Crude oil, PJ	2	118	203	203	642	586	497	404
Oil products, PJ	82	126	183	195	177	178	195	202
Coal, PJ	0	0	1	3	4	2	3	5
Natural gas, PJ	0	39	63	121	155	210	196	170
Electricity, Gwh	3216	4925	4807	7752	11 545	11 573	13 702	11 377

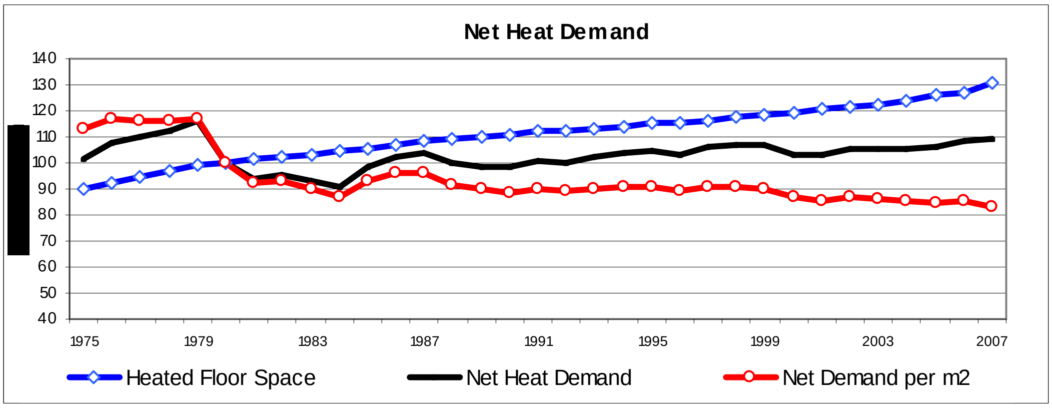
2.1.7 Domestic sector

Figure 2.9 illustrates the changes in energy consumption for heating in Danish households. The Figure shows both development in final energy consumption and the changes in net heating consumption. Net heating consumption is the heating used after losses in boilers and heating installations, and it is the best measurement of actual heating consumption.

FIGURE 2.9 CHANGES IN DOMESTIC ENERGY CONSUMPTION FOR HEATING COMPARED WITH THE AREA HEATED

Source: Danish Energy Authority. Energy Statistics 2007





As can be seen, energy consumption for heating dropped significantly from the late 1970s to the early 1980s, primarily because of the oil crisis and subsequent initiatives in the early 1980s to insulate buildings.

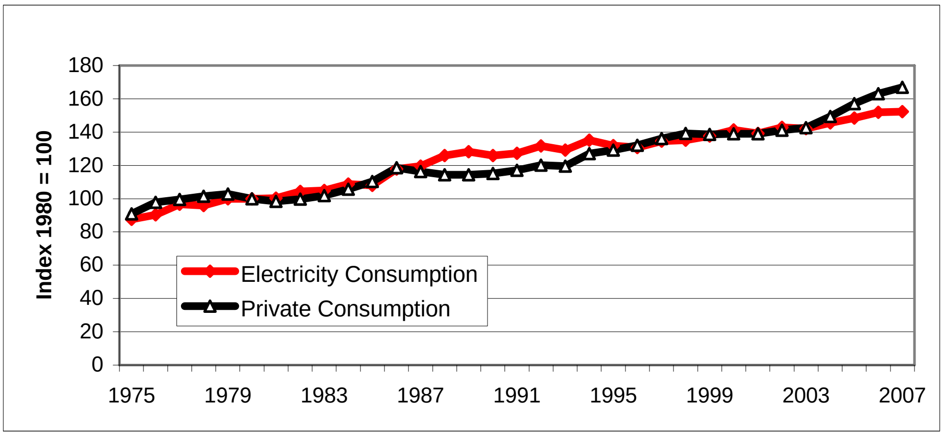
Since the start of the 1990s the absolute final energy consumption for heating has been roughly constant, implying a drop in consumption per m^2. This is due to considerable conversion from oil to district heating. Net heat demand per m^2 has also been roughly stable throughout the 1990s. As newly built houses have had lower energy consumption, this means there has been a slight increase in the heating consumption per m^2 of existing buildings.

Figure 2.10 shows the changes in electricity consumption by domestic appliances and lighting (excluding electric heating). Electricity consumption has increased since 1975 and relatively parallel with the increase in private consumption. On average, the increase has been 1.8% per year, but somewhat lower in recent years; in the period 1990-2007 only 1% per year.

As a result of converting electric heating, total consumption by households, including heating, has been roughly constant since the late 1990s. In 2007, the domestic sector accounted for 6% of Denmark's total greenhouse gas emissions.

FIGURE 2.10 CHANGES IN DOMESTIC ELECTRICITY CONSUMPTION FOR APPLIANCES ETC., EXCL. ELECTRIC HEATING

Source: Danish Energy Authority. Energy Statistics 2007



2.1.8 Transport

Efficient and flexible transportation of goods and persons is a vital element of the foundation of the modern welfare society. At the same time, transport is in itself an important economic sector that contributes to economic growth, employment, and foreign exchange earnings.

The positive effects of the transport sector must be seen against the fact that the sector burdens society in different areas - traffic accidents, air pollution, noise, congestion, and CO_2 emissions. In Denmark, this burden has been reduced in some important areas - primarily in the form of better traffic safety and less air pollution - at the same time as traffic has increased.

However, there has not been a corresponding development with respect to CO_2, and the transport sector has not yet succeeded in decoupling economic growth and greenhouse gas emissions, as has been done in the energy sector. Transport performance, energy consumption and CO_2 emissions within the transport sector have developed largely in step with economic growth. One reason for this is that a number of measures that have been used in other sectors, e.g. the energy sector, including efficiency improvements and substitution of energy sources, have not been directly available for the transport sector or have been associated with high costs.

The developments in passenger and goods transport performances are shown in Tables 2.9 and 2.10 respectively.

In 2007, greenhouse gas emissions by the transport sector – of which almost 99% is CO_2 -were about 35% over the 1990 level and accounted for about 22% of Denmark's total greenhouse gas emissions.

The trend in CO_2 emissions in the transport sector is of considerable importance to the total trend in the greenhouse gas emissions.

TABLE 2.9 TREND IN PASSENGER TRANSPORT PERFORMANCE IN BILLION PASSENGER KM

Source: Ministry of Transport, the Road Directorate and Statistics Denmark

	1970	1975	1980	1985	1990	1995	2000	2005	2006	2007
Aircraft	0.2	0.3	0.4	0.4	0.5	0.5	0.4	0.3	0.3	0.3
Trains[1]	2.8	3.1	4.4	4.8	4.7	4.7	5.4	6.1	6.3	6.4
Ferries	0.5	0.5	0.5	0.5	0.6	0.6	0.2	0.2	0.2	0.2
Cars	33.4	37.8	38.6	43.2	50.3	54.0	59.8	60.9	62.3	63.9
Buses[2]	4.6	5.7	7.3	8.8	7.6	9.1	9.1	7.3	7.3	7.4
Total	**41.5**	**47.4**	**51.2**	**57.7**	**63.7**	**68.9**	**74.9**	**74.8**	**76.5**	**78.2**
Bi-cycles[3]				2.7	3.2	2.8	2.2	2.3	2.3	2.3

[1] Data on passenger-kilometres by trains are Metropolitan S-trains, Copenhagen Metro and other trains.
[2] Data on Buses are Buses in scheduled services, Coaches and other buses.
[3] Bicykles are both bicykles and Mopeds. Bicycles are not included in total

TABLE 2.10 TREND IN GOODS TRANSPORT PERFORMANCE , BILLION TONNE KM1

Source: Ministry of Transport, the Road Directorate and Statistics Denmark

	1980	1985	1990	1995	2000	2005	2006	2007
Freight trains	1.1	1.3	1.2	1.4	2.0	2.0	1.9	1.8
Freighters	1.9	1.8	1.6	1.8	1.7	n.a.	n.a.	n.a.
Lorries	7.8	8.3	9.4	9.3	11.0	11.1	11.5	11.8
Pipelines	n.a.	0.9	2.9	4.6	7.1	7.8	7.5	6.7
Total	**10.8**[2]	**12.3**	**15.1**	**17.1**	**21.8**	**20.9**[3]	**20,9**[3]	**20,3**[3]

[1] Goods transport by air accounts for only a small proportion of total goods transport.
[2] Pipelines not included.
[3] Discontinued statistics on freighters not included.

2.1.9 The business sector

Industry's production value accounts for about 30% of total Danish production. Table 2.11 shows that the largest industries in Denmark are the food, drink and tobacco, engineering, electronics, and the chemical industry.

TABLE 2.11 TURNOVER BY INDUSTRY IN 2007, DKK MILL.

Source: Statistics Denmark.

Manufacturing industry	**558 456**
Food, drink and tobacco	129 596
Textile, leather and clothing	10 416
Wood	15 928
Paper and printing	41 948
Chemical industry	56 369
Non metallic minerals	20 760
Iron and steel	3 667
Non ferrous metals	3 451
Machinery and metal products	186 404
Transport equipment	15 919
Other industries	73 998

The total business sector (industry, building and construction, together with public and private services) accounts for about 15% of Denmark's total emissions of greenhouse gases. By far the largest part of these emissions is CO_2 from energy consumption, but the sector is also a source of emissions of industrial greenhouse gases.

In Denmark, the industrial sector's energy consumption accounts for about 18% of total energy consumption. This 18% does not include energy consumption for transport and space heating.

In the last 20 years relative consumption by the business sector varied considerably. Up to 1983, consumption fell considerably due to increases in the price of oil. When oil prices fell in 1986, energy consumption began rising again. In the period 1990-2007 energy consumption by the industrial sector rose by just 0.7%, while electricity consumption in the same period increased by almost 19%. From 2006 to 2007 energy consumption fell by almost 1,6%.

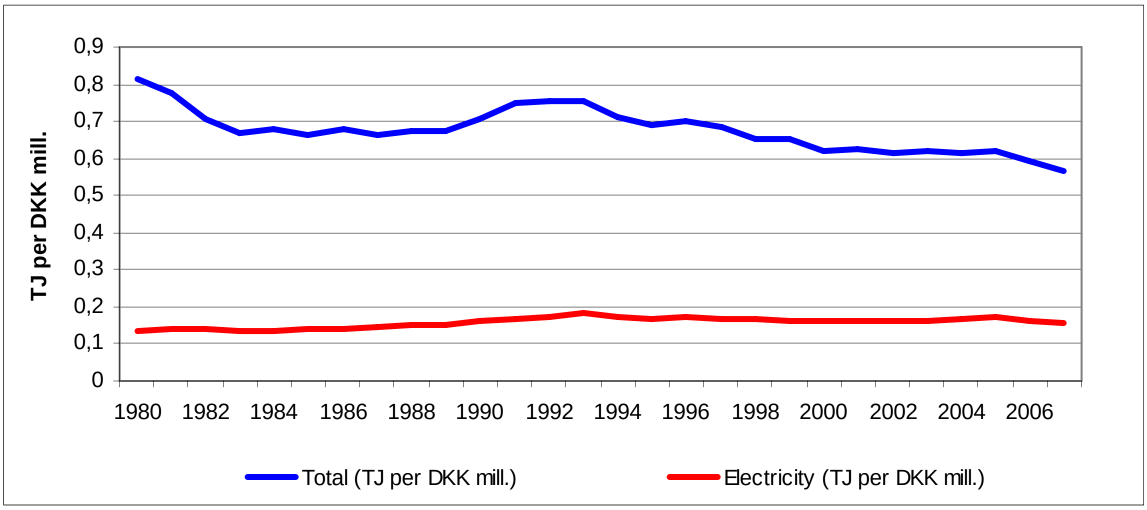
Since 1994 energy and electricity intensity has fallen, see Figure 2.11.

The change in the trend in energy and electricity intensity in 1993 corresponds with change from a period of low economic growth to a period of high growth, implying better utilisation of production capacity. At the same time, from 1993 the first CO_2 taxes were introduced on energy consumption by businesses, with associated subsidies for energy savings, agreement schemes etc. Advice to businesses from electricity companies was also introduced in the early 1990s.

The main action against the industrial sector's energy consumption until 2007 has been based on the green tax package for businesses passed by the Folketing in 1995. The package contained a combination of taxes and rebates to enterprises through, among other measures, government grants to promote energy savings by enterprises.

FIGURE 2.11 ENERGY AND ELECTRICITY INTENSITY IN THE INDUSTRIAL SECTOR, ADJUSTED FOR INTER-ANNUAL CLIMATE FLUCTUATIONS

Source: Danish Energy Authority and Odyssee[1]



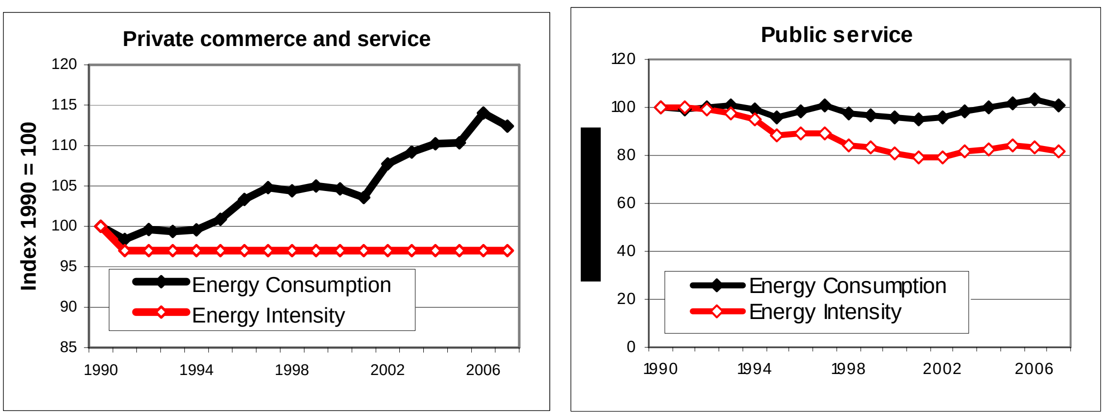
[1] ODYSSEE is a joint project between ADEME, the EIE programme of the European Commission/DGTREN and all energy efficiency agencies in the EU-15 and Norway.

As can be seen from Figure 2.12, over the past 15 years there has been a steady increase in energy consumption by the private commerce and services sector. Primarily electricity consumption has been rising. The growth in energy consumption by the service sector is due to high growth in this sector and reflects a development where services are becoming increasingly important in the economy. As the figure shows, there has been a constant drop in intensity of on average 2.2% per year from 1975-2007. Since 1990 the drop has been on average 1.6% per year.

Energy consumption in public services (the public sector), as shown in Figure 2.12, has been roughly constant over the last 15-20 years, and since the early 1990s there has been a considerable fall in energy intensity.

FIGURE 2.12 CHANGES IN ENERGY CONSUMPTION AND ENERGY INTENSITY (ENERGY CONSUMPTION IN RELATION TO GROSS ADDED VALUE) IN PRIVATE COMMERCE AND SERVICE AND PUBLIC SERVICE

Source: Statistics Denmark.



For industrial greenhouse gases (HFCs, PFCs and SF_6), regulation through taxes, and rules on phasing out the use of these substances have been implemented. With certain exceptions, the phasing-out process has taken place in the period 2003-2009. Most recent, Statutory Order no. 552 of 2 July 2002 Regulating Certain Industrial Greenhouse Gases introduced on January 1st 2007 a ban on the use of HFC's in cooling plants, heat pumps, air conditioning plants (comfort cooling) and dehumidifiers with charges with or above 10 kg.

2.1.10 Waste

The waste sector's contribution to the emissions of greenhouse gases consists primarily of methane and account for 2% of the total greenhouse gas emissions in 2007. Methane emissions come from the decomposition of organic waste at landfill sites and – to a minor extent – from wastewater treatment plants. In 2006 a total of 1.002,000 tonnes waste were landfilled in Denmark, corresponding to 6% of the total amount of waste.

Methane emissions from the waste sector are expected to fall in the future because the municipalities are now obliged to assign all waste suitable for incineration to incineration plants. This means that only a small quan-tity of organic waste will be deposited at landfills compared with the quantity deposited before the introduction of this obligation in 1997.

In addition, gas from a number of landfills is being used in energy production, which contributes to a direct reduction in methane emissions and an indirect reduction in CO_2 emissions.

Emissions of the industrial gases HFC and SF_6 from disposal of, for example, refrigerators and certain thermal glazing, which contain these substances, are included under the business sector.

There are also CO_2 emissions in connection with disposal of oil-based products, e.g. packaging, plastic bags, etc. The amount of plastic waste sent for incineration is expected to increase at the same time as recycling of plastic waste is increasing from 2007 onwards. Since waste incineration in Denmark is included in energy production, these CO_2 emissions must be included under the energy sector in accordance with the inventory rules from the IPCC.

Finally, in connection with incineration, a large amount of the waste is used as an energy source. As many of the incineration plants as possible have been converted to CHP production. In other words, the heat is used to supply district heating, and the electricity is sold to electricity suppliers. In 2007, 29 incineration plants in Denmark converted 23% of the entire waste production, or 3,489,000 tonnes and contributed 4.5% of the entire Danish electricity production and 20% of all Danish production of district heating.

By recycling waste, energy (fossil fuels) is usually saved and thus emissions of greenhouse gases, in that it is often more energy-demanding to manufacture new raw materials than to recycle material in waste. However, Denmark imports most of the raw materials, therefore energy savings accrue abroad. Therefore, the reduced greenhouse gas emissions cannot be credited to the Danish CO_2 accounts, even though Denmark has made the effort to increase recycling.

The government presents national waste strategies for hearing by interested parties. These national strategies announce national targets for waste management, future state initiatives and guidelines for waste management plans by the local authorities. In Denmark, the local authorities are responsible for managing all waste. Practical management is carried out by the private sector (primarily collection and recycling) or by the municipalities (primarily landfilling and incineration).

2.1.11 Buildings and urban structure

One-twentieth of the area of Denmark is urbanised. 85% of Danes are town-dwellers, and most enterprises, institutions, etc., are situated in towns. Many pollution problems are therefore concentrated in the towns.

Today, the total built-up area is 709 mill. m^2. Table 2.12 shows the distribution of the area between housing, factories, offices, etc.

TABLE 2.12 KEY FIGURES FOR THE STOCK OF BUILDINGS IN 2009, MILL. M2

Source: Statistics Denmark

Total building area	Buildings for year-round habitation	Factories and workshops	Supply (electricity, heating, gas, water) and transport	Commerce, trade and administration	Institutions and buildings for cultural and recreational purposes	Farm buildings
709.3	356.6	55.7	14.5	77.1	68.6	136.9

Today, about 13,000 homes are built per year, which is one-fourth of the number built in the first half of the 1970s. House building is expected to remain at this level. In recent years, house building has accounted for slightly more than half of all investment in building activities, and about half of the investment in the housing sector has gone on alterations and extensions. Building for industry and commerce now accounts for around half of all building in towns.

Towns and cities are generally characterised by separation of residential and industrial areas, industrial buildings being situated in specially designated zones on the outskirts of the towns. The growth in the service industries and the growth in manufacturing with a small environmental impact imply new possibilities for integrating industry and housing, thereby reducing the need for transport between home and work.

Approximately two-thirds of the total building space is heated. The most important types of heating are district heating and central heating using oil and gas. Half of the heated space is heated by district heating and, as seen from Table 2.13, the use of both district heating and natural gas has increased at the expense of oil.

TABLE 2.13 DEVELOPMENT IN THE MAIN FORMS OF HEATING IN BUILDINGS, IN % OF TOTAL HEATED SPACE

Source: Statistics Denmark.

	1981	1991	2000	2004	2005	2006	2007	2008
District heating	29.4	38.6	58.1	60.2	60.4	60.7	61.0	61.3
Central heating with oil	57.2	37.4	19.2	16.9	16.4	15.9	15.3	14.8
Central heating with natural gas		9.0	12.9	13.8	14.2	14.4	14.7	15.0
Furnaces fired by oil and similar	2.2	1.5	1.7	1.2	0.9	0.9	0.9	0.8
Other heating[1]	5.8	5.6	8.1	7.9	8.1	8.1	8.1	8.1

[1] Central heating (not oil and natural gas), electric ovens and not specified

2.1.12 Agriculture

Over the last 40 years the agricultural area in Denmark has fallen from 72% (30,900 km^2) of the total area in 1960 to 63% (27,105 km^2) in 2006. Table 2.14 shows the breakdown by type of crop over the last 36 years.

TABLE 2.14 USE OF AGRICULTURAL LAND, LIVESTOCK, AND NITROGENOUS FERTILISER

Source: Danish Institute of Agricultural Sciences, Food and Resource Economic Institute and Statistics Denmark

	1970	1980	1990	2000	2006
Grain (%)	59	62	56	57	56
Pulses and industrial seed (%)	2	4	14	5	5
Root crops (%)	10	8	8	5	3
Grass and greenfeed in rotation (%)	17	14	12	16	17
Permanent grass (%)	10	9	8	13	7
Other crops (%)	2	3	2	4	12
Cattle ('000)	2,842	2,961	2,239	1,868	1,535
Pigs ('000)	8,361	9,957	9,497	11,921	13,361
Sheep ('000)	70	56	159	145	170
Poultry ('000)	19,169	15,507	16,249	21,830	17,425
Nitrogen in fertilisers ('000 tonnes N)	271	394	400	252	195

The proportion of agricultural land under grass and greenfeed in rotation and permanent grass fell considerably from 1970 to 1990, but rose considerably during the 1990s, due partly to increasing use of grass fields for dairy farming, and partly to the change in EU subsidy schemes, which means that grass or industrial seed must be grown on set-aside land. Furthermore the area with maize and cattle feed is included with the area with grass and greenfeed, and the area with maize has increased significantly from 0.4% of the agricultural area in 1980 to 5% in 2006. This is due in part to a warmer climate which has made maize easier to grow.

From 1980 to 2006 the number of farms fell from 119,155 to 47,385. In the same period the average size of farms increased from 24 ha to 64 ha. This development has reduced the importance of agriculture as a source of primary employment. However, in the same period agricultural production has grown, both in quantity and value, and agricultural exports still make up a large proportion - 10% - of Denmark's total exports.

During the 1990s interest in organic farming increased considerably. In 2006 organic farms accounted for approximately 6% of land under cultivation.

In the last 30 years use of nitrogen by agriculture has varied greatly, cf. Table 2.14.

Up to 1990 there was a big increase in the use of nitrogenous fertiliser, but during the 1990s use of this type of fertiliser fell considerably, and in 2006 nitrogen consumption was below the 1970 level. The use of nitrogen originating from manure has dropped since 1980. Consumption of phosphorus and potassium in fertilisers fell throughout the period.

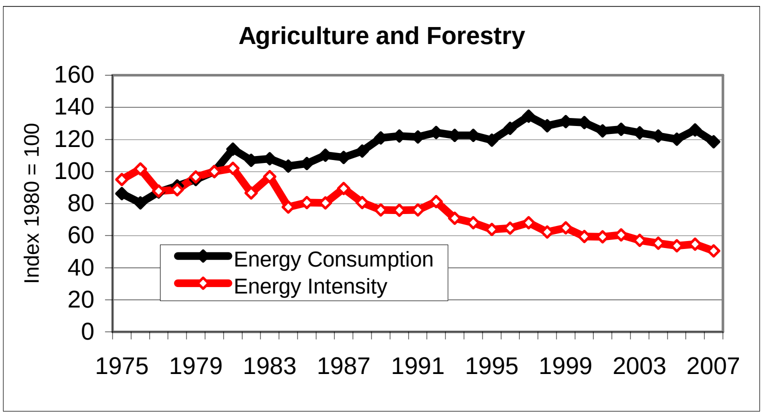
The cattle population fell by 46% from 1970 to 2006, cf. Table 2.14. Most of the cattle are dairy cows. Since milk production remained approximately unchanged throughout the period, the fall in cattle population is due to higher productivity per animal. In the same period, the pig population increased by 60%. The sheep population has more than doubled in relation to 1970, while the poultry population is now below the level of 1970. Since the 1970s, initiatives aimed at nutrients etc. have led to favourable trends, including with regard to greenhouse gases, where agriculture has reduced emissions by about 21% since 1990.

The agricultural sector accounted for about 18% of Denmark's total emissions of greenhouse gases in 2007. These were primarily methane and nitrous oxides. CO_2 from fuel consumption in the agricultural sector accounts for about 3% of total Danish emissions.

Figure 2.13 shows the change in energy consumption and energy intensity in agriculture and forestry until 2007. Energy consumption in agriculture and forestry increased 35% from 1980 to 1997 followed by a steady decrease until the level in 2007 being still 18% above the level in 1980. From 1990 to 2007 the decrease has been approximately 3%. However, in the period from 1980 there has been an even greater increase in gross added value and thus a drop in energy intensity.

FIGURE 2.13 CHANGE IN ENERGY CONSUMPTION AND ENERGY INTENSITY (ENERGY CONSUMPTION IN RELATION TO GROSS ADDED VALUE) IN AGRICULTURE AND FORESTRY

Source: Energy Statistics 2007



2.1.13 Forestry

Approximately 14% of Denmark is forested. Originally focus was mainly on the potential of conifers, but in recent years focus has changed towards indigenous, deciduous tree species as offering greater long-term production and nature potential. Denmark's forests are managed as closed canopy forests. The main objective is to ensure sustainable and multiple-use management of the forests and to manage them in line with the overall management of the countryside. Instead of clear-cut systems, forest owners are to a higher degree applying near-to-nature forest management regimes. Unlike our Scandinavian neighbours, Denmark is not a country in which forestry plays an important role in the national economy.

The Danish Forest Act protects a very large part of the existing forests against conversion to other land uses. Afforestation, for which public subsidies are made available, is as standard protected as forest reserve. In principle, this means that most of the forested land in Denmark will remain as forest.

The ambition is to have about 25% of Denmark's area forested by the end of the 21st century. A considerable increase in the forest area is therefore to be achieved.

Denmark is the only part of the Realm in which forestry is practised. Greenland and the Faroe Islands have almost no forest.

2.2 GREENLAND

2.2.1 Form of government and structure of administration

For thirty years the relationship between Greenland and Denmark has been regulated by the Greenland Home Rule Act no. 577 of 29 November 1978. The Home Rule was introduced on 1 May 1979 and the Home Rule authorities, i.e. the Greenland Parliament (*Inatsisartut*) and the Government (*Naalakkersuisut*), have conducted affairs in accordance with the provisions laid down in the act of 1978. In 2009 a new Act on Greenland Self-Government was introduced.

The parliament has 31 members. The members are elected directly at general elections held every four years. The parliament elects a government responsible for the central administration under the Premier.

After the 2009 election the administration was divided into nine ministries: the Premier’s Office, the Ministry of Finances, the Ministry of Internal Affair, Environment and Nature, the Ministry of Fisheries, Hunting and Agriculture, The Ministry of Industry and Labour, the Ministry of Family Affairs, the Ministy of Health, the Ministry of Infrastructure, and the Minstry of Culture, Education and Church. Within each ministry there are a number of agencies and departments.

The local administrative structure resembles the structure at the national level. Since 1979, Greenland has been divided into 18 municipalities governing local affairs, e.g. schools, waste management and local planning. In 2009 a structural reform merged the former 18 municipalities into 4 administrative regions. The aim of the reform is primarily to reduce public spending while providing better services to the citizens.

Greenland Home Rule succeeded by Greenland Self-Government

In 2004, a Danish-Greenlandic Commission on Self-Government was established to discuss the future relationship between Denmark and Greenland, and to identify fields of responsibility that could be transferred to Greenland. The commission concluded its work in 2008 and presented to both the governments and the public a detailed commission report and a draft for an Act on Greenland Self-Government to succeed the Greenland Home Rule Act of 1978.

The people of Greenland endorsed the draft Self-Government Act at a public referendum on 25 November 2008. The act was passed by the Greenland Parliament and the Danish Parlimament in spring 2009 and subsequently Home Rule was succeeded by Sef-Government on 21 June 2009.

The new act recognises the people of Greenland as a people pursuant to international law with the right to self-determination, and includes a provision establishing *Kalaallisut*, the Inuit language spoken in Greenland, as the official language. Furthermore, the draft act on Self-Government states that Greenland can have jurisdiction and financial responsibility of almost all aspects of public affairs in the parliament, *Inatsisartut*, so decides. However, a self-governed Greenland will still be within the Realm and will still share some fields of responsibility with Denmark and the Faroe Island, i.e. the constitution, franchise and the eligibility for election, citizenship and central institutions like the National Bank.

The Self-Government Act also outlines the future economic relationship between Denmark and Greenland. The Danish-Greenlandic Commission stated that Greenland has the right to the mineral resources in Greenland. In § 5 of the Self-Government Act, Greenland will still receive an annual grant of DKK 3.202 mill. Future revenues from mineral and hydrocarbon activities will reduce the state subsidy by half the revenue exceeding DKK 75.0 mill. annually.

Under the Self-Government Act financial independence from Denmark is realized when the activities in the oil- and mineral industry reach DKK 6.404 mill. annually. Talks on the future relationship between Denmark and Greenland will then commence. The Act on Home Rule did not address the question of independence, but in accordance with § 21 of the Self-Government Act the people of Greenland can decide on independence in a future referendum.

Greenland is not a member of the European Union, but Greenland participates in the Overseas Countries and Territories (OCT) scheme, that gives Greenland access to the European marked. This scheme is important as Europe is the primary market for Greenland's export of fish.

In international forums where discussions and agreements may influence Greenlandic public affairs, Greenland and Denmark jointly participates. International conventions are ratified by the Realm, but the Greenland Government can ask for an exemption.

Denmark has ratified the Climate Convention. Greenland participated in the Danish delegation working towards the Kyoto protocol of greenhouse gas emissions. The latter was ratified by Denmark, in agreement with Greenland, on 31 May 2002.

2.2.2 Population

The population of Greenland has increased by 14 % over the last three decades, and the total population today is around 56.500. Of them almost 90 % were born in Greenland.

TABLE 2.15 POPULATION OF GREENLAND (2010 AND 2015 PROJECTIONS)
Source: Statistics Greenland and Greenland Home Rule

	1980	*1990*	*2000*	*2008*	*2010*	*2015*
Population	49.773	55.558	56.124	56.462	57.595	58.128
Born in Greenland and still part of the population	40.947	46.142	49.369	50.180	51.301	51.921

Estimated changes in the population show a small increase in 2010 and 2015, but the proportion of the population born outside Greenland is not expected to change.

Migration and immigration patterns are dominated by the strong, historical connections between Greenland and Denmark. In 2006 Greenland experienced an immigration of 2.404 individuals, but less than 200 immigrants were born outside Greenland, the Faroe Islands and Denmark. Of the 2.215 immigrants one in three were returning to their land of birth.

Migration patterns follow the same trends as described above.

Currently, 13.864 individuals born in Greenland are living in Denmark.

2.2.3 Geography

With an area of 2.166.086 km^2, Greenland is the world's largest island. It extends over almost 24 latitudes. The northernmost point is Cape Morris Jessup, only 740 km from the North Pole, while Cape Farewell in the south shares latitude with Oslo, Norway.

Greenland is covered by the Greenland Ice Sheet, a continuous, slightly convex ice sheet that covers 85% of the island and reaches heights of more than 3.000 m above sea level. Areas not covered by the ice are home to the rich Arctic flora and fauna.

The coastal line covers 44.087 km. The coast is dominated by deep fiords and archipelagos, and conditions for marine activities can be challenging as icebergs, sea ice and storms are common. The population of Greenland lives mainly in the coastal regions with access to the open waters and hence fishery, hunting and sea transportation is important to the Greenland society.

Surrounding the island of Greenland are Atlantic and Arctic waters. Greenland meets the North Atlantic Ocean to the south, and the Greenland Sea and the 240 km wide Denmark Strait between Greenland and Iceland to the east. The west coast of Greenland meets the Davis Strait and the Baffin Bay, and in the north Smith Sound and Nares Strait, waters that separates Greenland from Ellesmere Island, Canada. In Nares Strait a mere 26 kilometres separate Greenland from Canada. North of Greenland lays Lincoln Sea and Wandels Sea of the Arctic Ocean.

2.2.4 Climate

Greenland's northern location and the cold and more or less ice-filled seas that surround it are the main reasons for its cold climate.

The high arctic zone, with average temperature during the warmest months of the year below 5°C, covers the entire Greenland Ice Sheet and the costal region of northern Greenland. The high arctic zone borders with the towns of Upernavik and Uummannaq on the west coast and Ittoqqortoormiit on the east coast of Greenland. But inland the high arctic zone reaches as far south as 61°N.

The low arctic zone, with average temperatures during the warmest months of the year between 5°C and 10°C, covers the coastal areas on both the east and west coast from Cape Farewell to 72°N. The open sea area in the south brings relatively cool summers and mild winters to this area.

In the valleys of the deep fiords the average temperature may climb above 10°C in the summer, categorizing these as small and isolated areas with a subarctic climate.

The Arctic Climate Impact Assessment (2004) forecasts increases in average temperatures by 2°C in the low arctic areas of South Greenland over the next century, and along with an increase in rainfall the lengthened growing season will bring a more vigorous plan cover. In North Greenland the average winter temperature will increase by 6 - 10°C, but dramatic changes in the average summer temperature are not expected. According to the ACIA report Greenland will see an increase in rain- and snowfall by 10 to 50 per cent.

Atmospheric pressure

Atmospheric pressure is generally highest in April/May. The weather in Greenland is most stable at this time of year. After this, in the summer months, the variation in atmospheric pressure is small, but in winter it is much greater, with a generally higher atmospheric pressure towards the north than towards the south, leading to a higher frequency of cold winds from northerly directions and higher wind velocities.

The biggest pressure extremes in Greenland occur in the winter period because of the great temperature contrasts in the atmosphere. The highest atmospheric pressure measured in Greenland was 1059.6 hPa, which was recorded in January 1958. The lowest was 936.2 hPa, recorded in 1986 and 1988.

Wind

Storms typically occur in connection with the passage of low-pressure systems. Between these systems, there are undisturbed periods of varying duration throughout the year, when the wind is governed by local conditions.

An example is the ice sheet's katabatic wind system, the extent of which is enormous. A katabatic wind is a wind that blows down an incline, moving from the central part out towards the edge. The wind velocity accelerates with increasing incline of the surface, and the topography can cause channelling, resulting in an extremely high velocity at the edge of the ice.

Greenland has many days with little or no wind. In some places on the east coast this is the case for 60% of the time.

Gusts can be very strong. Gusts of up to 75.1 m/s were measured in Danmarkshavn in 1975, but even stronger gusts undoubtedly occur in connection with the so-called piteraqs. These fall winds, which are katabatic, locally channelled winds from the ice sheet, occur in several locations in Greenland, and are characterised by a very abrupt change from light wind to storm. In Greenlandic, piteraq means "that which assaults one".

Temperature

The summer temperatures on both the west and the east coast differ by only a few degrees from south to north, despite a distance of about 2,600 km. The reason for this is the summer midnight sun in north Greenland. Conversely, winter darkness and the absence of warm sea currents mean that the temperature during the winter period differs considerably from north to south.

There is also a big difference in the temperature conditions at the outer coast and inside the fjords. In summer, drift ice and the cold water along the coast can mean that it is warmer inside the fjords, while in winter, on the other hand, the presence of the sea makes it warmer in the coastal areas than inside the fjords.

Foehn winds can disturb this picture in the wintertime. Foehn winds are very common in Greenland, and in winter the hot, dry winds can cause the temperature to rise by 30ºC within a relatively short space of time, resulting in melting of snow and ice. The temperature record of 13.9ºC of 23 November 1987 in Nuuk is an example of the effect of a Foehn wind.

The highest temperature recorded in Greenland since 1958 is 25.5ºC. It was recorded in Kangerlussuaq in July 1990.

In Greenland, frost can occur in all the months of the year except deep inside the fjords at Narsarsuaq Airport and Kangerlussuaq for a couple of the summer months. The "frost-free" period in southern Greenland varies from 60 to 115 days per year.

The coldest place in Greenland is naturally on the ice sheet, where the temperature can fall to below -70ºC. Temperatures in Greenland have shown a slightly rising trend for the last 135 years, although, on a shorter time scale, temperatures have generally fallen since the 1940s. This has been most marked on the west coast, where a rising trend has only been seen since 1990s. On the east coast, however there has been a rising trend since the mid 1970s. In 2003 there were record high annual temperatures in several parts of Greenland.

FIGURE 2.14 ANNUAL MEAN TEMPERATURE 1873-2008, 0C STATIONS IN DENMARK (KØBENHAVN), THE FAROE ISLANDS (TÓRSHAVN AND WEST GREENLAND (NARSARSUQ, NUUK, ILULISSAT, UPERNAVIK AND PITUFFIK).

Source: Cappelen 2009a

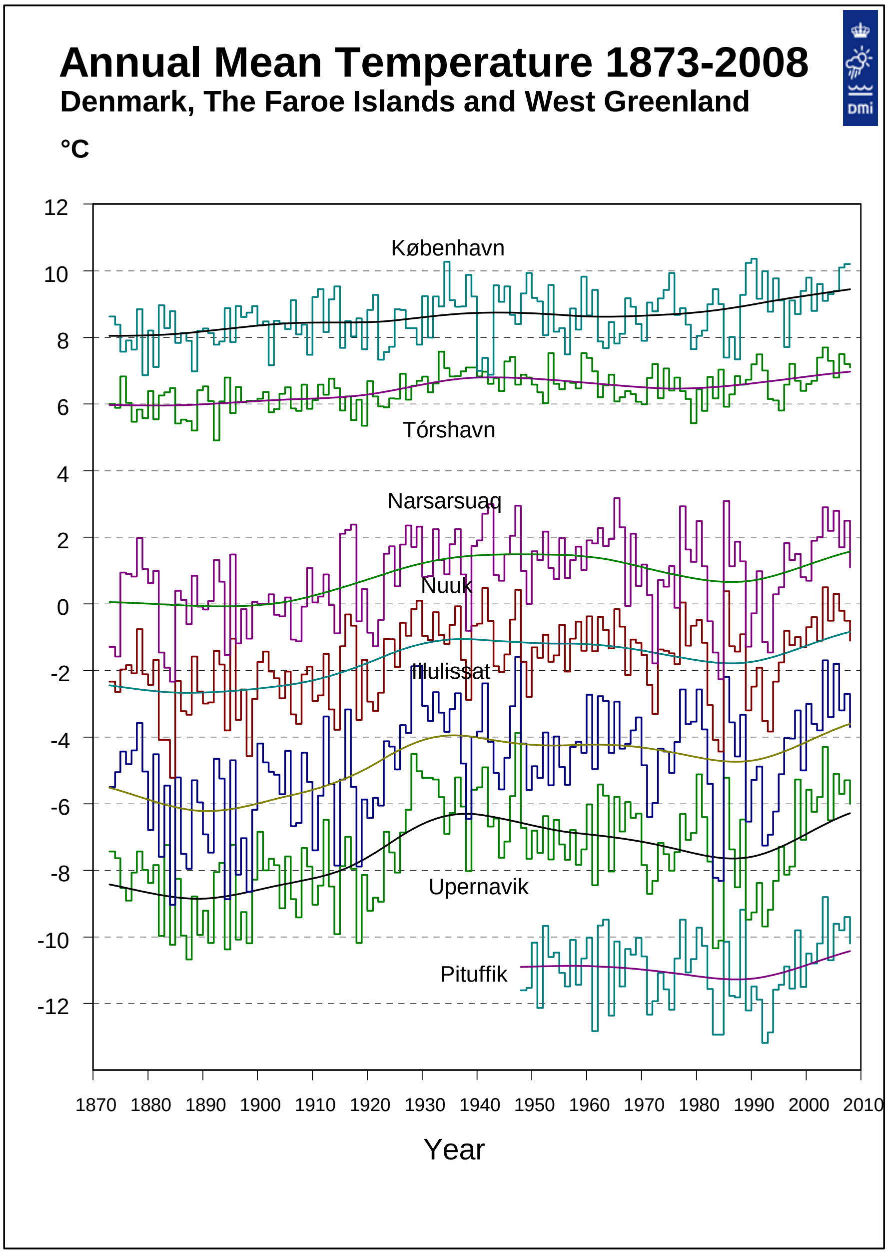
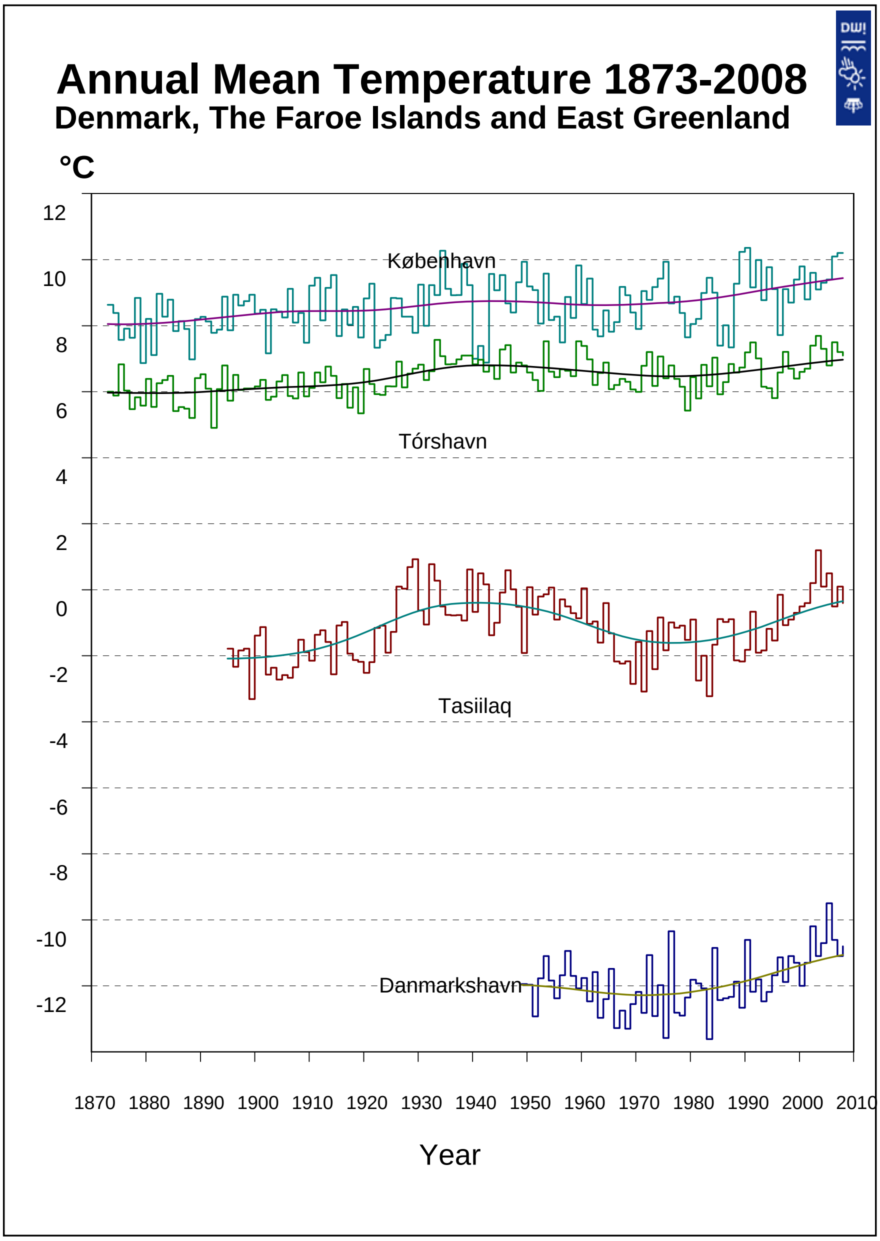


FIGURE 2.15 ANNUAL ANNUAL MEAN TEMPERATURE 1873-2008, 0C STATIONS IN DENMARK (KØBENHAVN), THE FAROE ISLANDS (TÓRSHAVN) AND EAST GREENLAND (TASIILAQ AND DANMARKSHAVN).

Source: Danish Meteorological Institute



Precipitation

Recorded precipitation in Greenland decreases with rising latitude and from the coast to the inland area. Particularly for southern stations there is considerable seasonal variation.

In the extreme south and particularly in the south-eastern region, precipitation is significant, average annual precipitation ranging from 800 to 2,500 mm along the coasts. Further inland, towards the ice sheet, considerably less precipitation is recorded. In the northern regions of Greenland there is very little precipitation, from around 250 mm down to 125 mm per year. In a few places there are arctic deserts, i.e. areas that are almost free of snow in winter, and where evaporation in summertime can exceed precipitation.

Not surprisingly, snow is very common in Greenland. In fact, at most stations in the coastal region it can snow all year round without snow cover necessarily forming. There are thus many days with snow during the year, mostly in the southern part of the country. The snow depth is greatest in southern Greenland, averaging from one to more than two metres in all the winter months and sometimes reaching up to six metres. In southern Greenland the snow cover can disappear altogether during the winter in connection with warm Foehn winds.

Towards the north, snow cover has already formed in most places by September and normally disappears again in June/July.

Hours of sunshine

The part of Greenland north of the Polar Circle, 66.5ºN, has midnight sun and polar night of varying length depending on the latitude. Midnight sun means that the sun is in the sky 24 hours a day, while polar night means that the sun does not rise above the horizon at all.

Despite the polar night, the northern stations have more hours of sunshine than the southern stations. This is due to the "long" day, of course, but also to generally less cloud cover. However, although the surface of the soil receives more solar heat than in the tropics at around the summer solstice because of the long day, a considerable part of the energy is reflected because of the oblique angle of incidence and the snow-and-ice-covered surfaces.

2.2.5 Economy

The economy of Greenland is a small-scale economy based on trade with other countries.

Under the Realm Greenland has received an annual state subsidy to finance fields of responsibility assumed from Denmark. Under Self-Government Greenland will still receive an annual grant, but new fields of responsibility assumed must be financed by the Greenland Government. Future revenues from mineral activities in Greenland will reduce the state subsidy by half the revenue exceeding DKK 75 mill.

TABLE 2.16 KEY FIGURES FOR THE GREENLAND ECONOMY. 2006 CURRENT PRICES, IN DKK MILL.
Source: Statistics Greenland (2008:1)

	2006
GDP[1]	10.500
GNI[2]	10.394
State subsidy	3.120
Imports	2.674
Exports	1.728
Public expenditure	5.568
Burden of taxation (BNI, 2004) [3]	25 %
Annual growth in GDP	2.6 %

[1] The Gross Domestic Product includes the annual state subsidy.

[2] Gross National Income (GNI): GDP with net-come reiceved from other countries.

[3] Burden of taxation in 2004: taxes as percentage of the GNI (2004).

Greenland has experienced general growth over the last decade. Annual rates of growth in GDP have ranged from -0.5 % to a high 7.1 % in 2000. The 2006 national budget of Greenland saw a GDP of 187.341 per capita, corresponding to an increase of DKK 10.000 per capita in one year.

Exports

The fishing industry is of immense importance to the economy of Greenland as fish and seafood is the only large-scale export from Greenland. The estimated relationship between the GDP and the real export value of fish and seafood shows that a 1 % increase in the export value of fish and seafood leads to a 0.29 % increase in the Greenland GDP, according to time series data ranging back to 1966. Therefore, changes in both the world market prises and the availability of important stocks of fish are important to the entire economy.

Reported landings of commercial fish show dramatic changes over the years. In the 1960's Atlantic cod was the most important commercial fish in Greenland and annual catches peaked at 500.000 tonnes. Since then the cod fishery has collapsed. According to the US National Oceanic and Atmospheric Administration (NOAA) low recruitment played a role in this change. The periodic fluctuations of cod stocks have been linked to changes in both sea and air temperature. A long-term warming of the West Greenland Shelf Large Marine Ecosystem (LME) was interrupted by cold events that peaked in 1970, 1983-84 and again in 1996. The decline in cod stocks coincide with cool periode, while warmer periods are paralleled by increases in stocks. Overfishing and the effects on stock size and stock interactions appear to coincide with climatically driven variability. Scientists hypotize both that variation in larval and juvenile drift lead to recrutiment variability, and that the present abundance of northern shrimp in the West Greenland waters are partly a result of a lower abundance of Atlantic cod and redfish.

Current changes in stocks calls for another re-orientation of the industry as the northern shrimp is replaced by increased stocks of Atlantic cod.

Occupational hunting is common in the northern and eastern parts of Greenland and locally the income from hunting is important to the well being of the community, but hunting does not contribute extensively to the national economy. In 2005 the formal and informal value of hunting was estimated at DKK 390 mill. annually, which is less than 4 % of the GDP.

TABLE 2.17 VALUE OF EXPORT IN 2000 AND 2007, IN DKK MILL.

Source: Annual economic report of the Greenland Home Rule, 2007

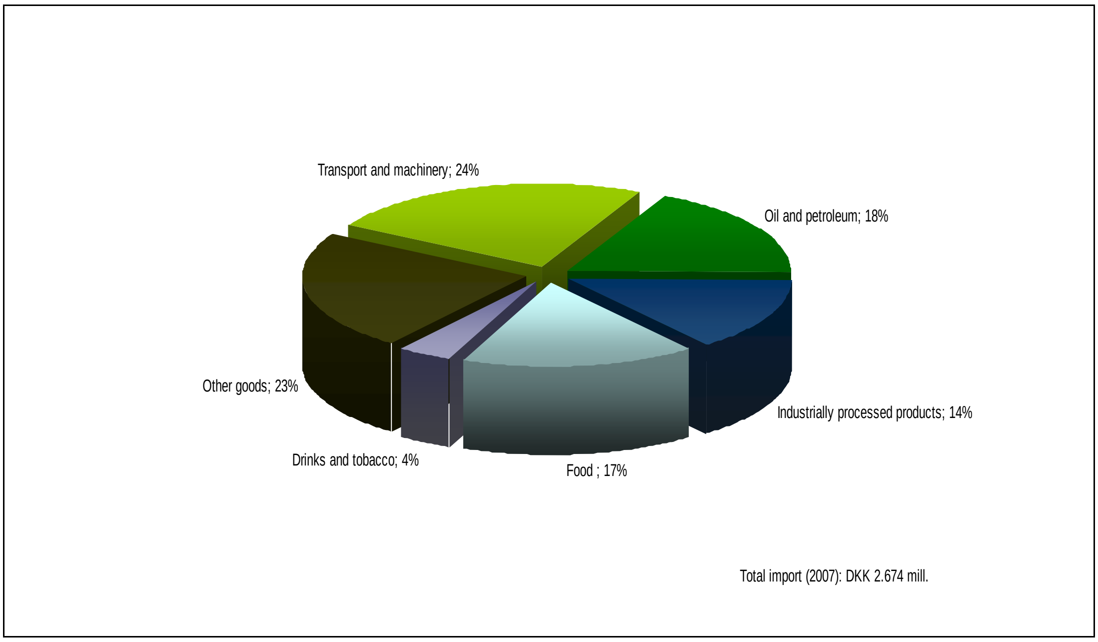
	2000	**2007**
Total value of export	2.120	2.436
Total value of export of fish and seafood	2.106	2.188
Value of export of single stocks as share of total value of export of fish and seafood		
Northern shrimp	63,8%	60,9 %
Atlantic cod	2,5 %	3,8 %
Greenland halibut	17,3 %	21,4 %
Snow crab	10,9 %	4,7 %
Other	5,5 %	9,1 %

Imports

As the inland production is limited, Greenland is an open economy depending on imports of a wide range of goods.

FIGURE 2.16 IMPORT, 2007, IN DKK MILL

Source: Statistics Greenland, 2008



2.2.6 Energy

As in other modern societies, a large part of Greenland's CO_2 emissions come from energy production and supply. Approximately 55 % of all energy consumption is used for heating and electricity.

Because of the vast distances between towns in Greenland it is neither financially nor technically viable to establish a supply grid connecting them. This means that each town has its own power plant or combined heating and power plant (CHP plant), and each settlement has its own power plant - so-called island operation. At the same time, the climatic conditions mean that the towns cannot tolerate lengthy interruptions in their electricity supply. It is therefore also necessary to have reserve and emergency plants.

There is only one power plant that supplies two towns; the Qorlortorsuaq hydropower plant which has supplied both Narsaq and Qaqortoq in South Greenland with electricity since 2008. In the two towns there are still back-up plants.

Renewable energy

Greenland has ambitiously invested in renewable energy since the 1990’s with investments making up 1 % of annual GDP.

Up to 1993 all energy production for electricity and district heating was based on diesel-driven power, heating and CHP plants. From 1993, when the hydropower station at Buksefjord went into operation, the capital Nuuk, where around 25 % of Greenland's population live, has been supplied with hydroelectricity for electric heating, lighting, and power. In 2008 the plant was expanded with an extra turbine to meet the increasing demand for electricity for power and heating in the Nuuk area.

In 2005 a small hydropower plant in East Greenland started operation, and in 2008 a hydropower plant in South Greenland began operations to supply Narsaq and Qaqortoq. A fourth hydropower plant will supply Sisimut, the second largest town in Greenland, with renewable energy from early 2010, increasing the share of hydropower electricy from the current 43 per cent of electricity production to 60 per cent.

Heating

Since 1993 all buildings built with public subsidies in Nuuk have been supplied with electric heating, and electric boilers with interruptible electric heating have been installed in existing district heating stations. The electric boilers operate as long as surplus electricity is available. When it is not, the oil boilers take over. The electricity for this is supplied at a competitive price. Currently, 59 % of the production from the Buksefjord hydropower plant is used in permanent and interruptible electric heating in Nuuk, while 21 % of the production from Qorlortorsuaq is used in permanent and interruptible electric heating in Narsaq and Qaqortoq.

In 2002, 38 % of all electricity produced in Greenland went to permanent and interruptible electric heat in Nuuk.

In 10 towns the residual heat from electricity production is used for district heating. In addition, blocks of flats have their own individual heating plant, while most single-family houses have oil-fired central heating.

In settlements, most of the houses have a central heating furnace or oil stoves.

Electricity

The towns of Nuuk, Tasiilaq, Narsaq and Qaqortoq are powered by electricity from hydropower plants. Furthermore, a new hydropower plant will start production in 2010 to supply the town of Sisimiut with electricity. Thereby the share of the population covered by a renewable source of electricity will increase from 42 % to 52 %.

In the remaining towns and settlements electricity is produced at diesel-driven power plants. Plans are to optimise the utilisation of the power plants.

Consumption of Energy

The consumption of energy by source is illustrated below, see table 2.18. No statistics of energy consumption by source in recent years is available. But due to the 2005 opening of Tasiilaq hydropower plant, the 2008 opening of the Qorlortorsuaq hydropower plant and the opening of an extra turbine in the Buksefjord hydropower plant an increase in the consumption of energy from hydropower plants is expected to meet a larger share of the total demand for energy in Greenland. A new plant will open in 2010 to supply the town of Sisimiut with renewable energy.

TABLE 2.18 ENERGY CONSUMPTION BY SOURCE, IN 1995, 1997, 1999, 2001 AND 2003

Source: Statistics Greenland based in information from Polaroil A/S, Statoil A/S and Nukissiorfiit.

	1995	*1997*	*1999*	*2001*	*2003*
Hydropower	165	156	178	175	184
Energy recovered from waste	29	26	31	24	22
Petroleum	237	270	314	259	252
Solar	1.635	1.795	1.775	1.927	1.765
Gasoline/Benzene	103	106	121	134	165
Liquefied petroleum gas (LPG)	3	3	2	2	2
Charcoal	-	-	0	0	0
Consumption of energy, total	**2.171**	**2.355**	**2.421**	**2.521**	**2.688**

2.2.7 Transport

Passenger transport is primarily done by air, even if one ferry and a number of small passenger vessels operate in Greenland waters.

TABLE 2.19 VESSEL DATA SUMMARY

Source: Ministry of Infrastructure and Environment, Government of Greenland. Data presented to the Arctic Marine Shipping Assessment in 2008

	Type of vessel	2008
Research/ ice breakers/ government /military	Private ice breakers	2
	Research vessels	16
	Special purpose vessel	4
Shipping	Bulk carriers	1
	Container ships	5
	Bulk carriers	1
	Tanker	2
Transport	Ferry	1
	Passenger/ vessel	10
	Passenger/ cruise ship	29
Fishing	Offshore fishing vessel (>24 meter)	27
	Inshore fishing vessel (<24 meter)	397

Passenger transport by air

The regions of Greenland are connected by ships, aeroplanes and helicopters.

Since the 1990's Greenland has seen an increase in both sea and air passenger transport, and the need for a flexible and fast transport between the towns have increased parallel to the general development of society.

Greenland is connected to Europe by air, either via Copenhagen or Reykjavik, Iceland. Air Greenland, the main operator in public air transportation, connects Kangerlussuaq in mid-west Greenland and Narsarsuaq in south Greenland to Copenhagen, Denmark. Air Iceland runs a service on the east coast of Greenland, and in the summer Air Iceland also connects Nuuk with Reykjavik, Iceland.

Scandinavian Airlines (SAS) have operated a summer route from Copenhagen to Kangerlussuaq, but this service closed in 2009. Air Greenland opened a service from Kangerlussuaq to Baltimore, USA, in 2007, but decided to close this route again

Passenger transport by land

There are no roads connecting towns and settlements in Greenland, but in most towns there are bus services. Private car ownership is common and the number of taxies is generally high.

In 2005 there were 5.065 vehicles registered by the motor vehicle administration, and of them 380 vehicles were registered as new. Greenland had 169 registered taxis, 63 busses and 371 vans and trucks.

Passenger transport by sea

Passenger transport by sea is serviced by one ferry and 11 small vessels, operating in Greenland waters. The ferry travels the west coast of Greenland, while passenger vessels carry both passengers and goods between towns and settlements. The largest passenger vessel carries 60 passengers and the total capacity of passenger vessel services is less than 200 passengers.

Private boat ownership is common and boats are used for local transportation too.

Cruise ship tourism

Greenland has seen an increase in tourism over the last decade, and especially cruise ship tourism has increased. The number of cruise ships sailing in Greenland waters is increasing year by year, and there is an increased focus on cruise ship activities and the protection of the arctic environment and nature.

TABLE 2.20 CRUISE SHIP TRAFFIC IN GREENLAND WATERS: CRUISE SHIPS, CALLS MADE AND PASSENGER TOTAL, 2003-2008.

Source: Greenland Tourism and Business Council, and Marine Rescue Coordination Centre Groennedal

Year	***Cruise ships***	***Calls***	***Passenger total***
2003	14	164	9.655
2004	24/29[4]	195	15.654
2005	25	115	16.446
2006	28	157	22.051
2008	35/ 43[5]	NA	NA

Generally, cruise ships travel concentrates in the areas of mid-western Greenland, i.e. the Kangerlussuaq, Sisimiut and Ilulissat areas. In south Greenland visits to Qaqortoq, Narsaq and Narsarsuaq are popular. Alternative cruise ship destinations are developing these years – especially in the very northern regions of Uummannaq and Qaanaaq and on the Greenland east coast by the National Park of Northern and Eastern Greenland.

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[4] In 2004 Greenland Tourism registerede 24 calls made by cruise ships, while MRCC Groennedal/ Island Command Greenland registerede 29 cruise ships in Greenland waters.

[5] In 2008 Greenland Tourism registered 35 calls made by cruise ships, while MRCC Groennedal/ Island Command Greenland registered 43 cruise ships in Greenland waters.

Shipping

Royal Arctic Line (RAL) is the major shipping agent in Greenland, servicing Greenland and Aalborg, Denmark.

In 2009 52 return trips are scheduled between Aalborg, Denmark and the Greenland west coast, while 9 trips are scheduled between Aalborg, Denmark and the Greenland east coast.

Royal Arctic Line has experienced an increase in shipping activities by up to 30 per cent since 2004. The increase is due to increased export of fish and shrimp and increased import of consumer goods, machinery and materials for construction.

Both the planned production of aluminium and the opening of mines will further increase shipping between Greenland and the markets in Europe and America.

2.2.8 Industry

Greenland has a small inland production of industrial produce. As mentioned in 2.1.5 on the economy, the export is based almost entirely on the fisheries while most industrial produce is imported.

Fishery

In Greenland, the primary industry is still fishery. Fish and seafood is the single important produce for export, accounting for 90 % of the total value of export in 2007. Furthermore, the fishery industry is important as many people are employeed in the production and transportation of fish and seafood.

Mineral and hydrocarbon industry

The mineral and hydrocarbon industry is developing, and the industry might be of crucial importance to the industrial development of Greenland.

The Bureau of Minerals and Petroleum, Greenland Government, have issued a series of licences for the exploration of oil, gas and minerals, but licences for exploitation are still few.

TABLE 2.21 MINERAL ACTIVITIES: PROSPECTING, EXPLORATION AND EXPLOITATION LICENCES IN 1995, 2000, 2000, 2002, 2004, 2006 AND 2008.

Source: Bureau of Minerals and Petroleum, Greenland Government

	Prospecting licences	***Exploration licences***	***Exploitation licences***
1995	21	35	-
2000	15	24	-
2002	6	17	-
2004	12	22	1
2006	12	33	2
2008	12	68	3

The exploration activitives have shown that there are economic potentials related to a wide range of mineralisations. The current exploitation licences are targeted at the exploitation of gold, zink/lead, and olivine, where promising exploration projects are targeted at molybdenum, diamonds, rubies, eudialyt, iron and other minerals.

The number of hydrocarbon licences awarded has also increased signifivantly over the last years. By 2009, a total of 17 prospecting licences and 13 licences for exploration and exploitation of hydrocarbons have been issued.

Aluminum industry

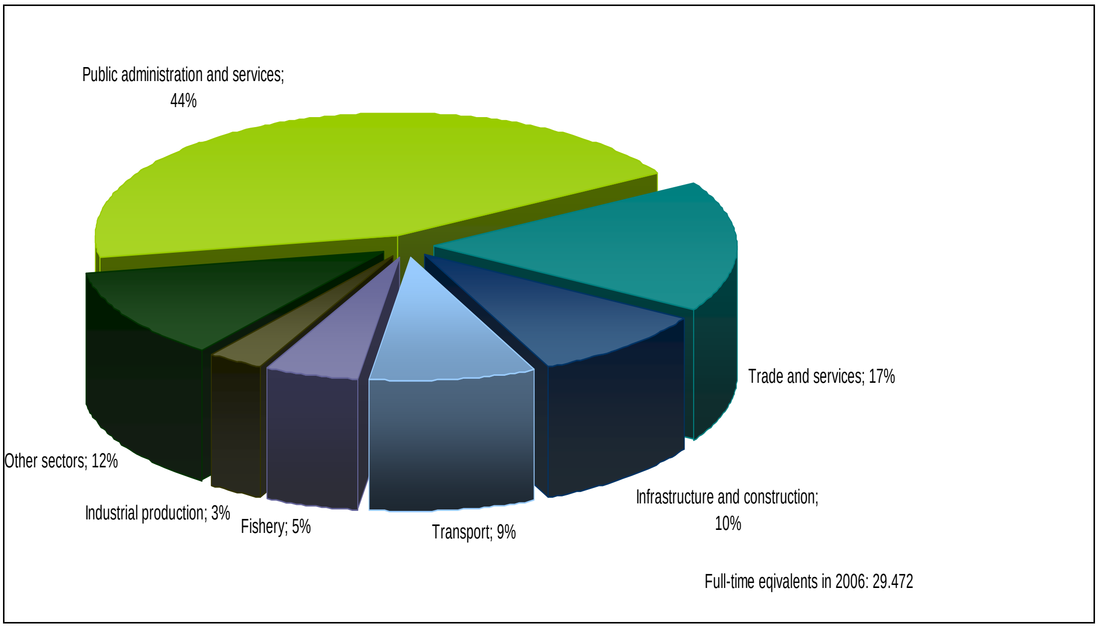
In Greenland plans are to establish an aluminium smelter on the Maniitsoq island. In operations the smelter will bring jobs to 300-400 individuals, effecting the community as new jobs and activities are established. The smelter will be powered by hydropower, but the production of alumium will still increase CO_2-emissions in Greenland by 60%

The labour market in Greenland

As society resembles strong aspects of the Scandinavian welfare model, public administration and services dominate the labour marked in Greenland. Public administration and services, making up 44.3 % of the labour market, compromises both the public administration and a wide range of services, i.e. pre-schools and schools, institutions and health services. Other important sectors are trade and services, infrastructure and construction, and transportation.

FIGURE 2.17 LABOUR MARKET STATISTICS WITH BUSINESS NOMENCLATURE, 2006. IN FULL-TIME EQUIVALENTS.

Source: Statistics Greenland, 2008:3)



Fishery and industrial production currently make up 8 % of the labour full-time eqivalents, but Greenland is likely to see an increase in industrial production within the next decade. The exploration of both hydrocarbons and minerals may result in new mining projects, and in Maniitsoq plans are to establish an aluminium smelter.

2.2.9 Waste

The Ministry of Internal Affairs, Environment and Nature estimates, that the annual production of waste is 35.000 - 37.000 tonnes. Two-thirds of this waste is produced by households, while the remaining waste is produced in commercial activities.

The Ministry of Internal Affairs, Environment and Nature, Greenland Government has conducted a study of the composition of both household waste and waste from commercial activities in 2006. From this study the most important fraction of waste is organic waste (44 %), followed by combustible waste (17.5 %), both wet and dry paper and cardboard (18 %), glass (7.5 %), plastics (7 %), metal (3.5 %), environmentally hazardous waste (1.5 %).

The composition of waste from commercial activities includes comparatively more paper and cardboard (27 %), more plastic waste (9 %), more environmentally hazardous waste (3 %) and more non-combustible waste (5 %), but less glass (3 %), metal (3 %), organic waste (34 %) and other combustible waste (16 %).

Solid waste management today is based on incineration facilities and open landfills. In Qaqortoq, Nuuk, Maniitsoq, Aasiaat, Sisimiut, and Ilulissat incineration plants are in use, handling approximately 65 % of the waste produced in Greenland. Much of the residual heat from the six facilities is used for district heating.

In small towns and settlements 46 small-scale incineration facilities have been established. They incinerate approximately 9 % of the waste produced. The small-scale incineration facilities were introduced as an environmentally sound alternative to the use of open landfills, but open landfills is still in use. The Environmental and Nature Agency are preparing a national strategy on waste management to be introduced within the next few years.

Schemes for the recycling of single fractions of waste are established locally, i.e. oil- and chemical waste, batteries, electronic waste etc. These fractions are recycled in foreign facilities.

TABLE 2.22 WASTE MANAGEMENT IN GREENLAND, 1990, 1995, 2000, 2005 AND 2007. IN 1.000 TONNES. WASTE DISPOSAL IS CORRECTED FOR OPEN BURNING

Source: Ministry of Internal Affairs, Environment and Nature, Greenland Government.

	1990	*1995*	*2000*	*2005*	*2007*
Managed waste disposal corrected for open burning	5.61	5.95	4.35	4.19	4.19
Unmanaged waste disposal corrected for open burning	1.34	1.29	0.91	0.83	0.83
Waste incineration, energy recovery	6.9	7.55	12.9	15.3	15.3
Waste incineration	NO	0.22	3.14	3.45	3.45
Open burning	15.5	16.20	11.7	11.2	11.2
Total waste produced	**29.38**	**31.21**	**33.09**	**35.01**	**35.01**

Since 1990 Greenland has seen a 20 % increase in the amount of waste produced. But within the same period of time new fascilities for waste incineration has increased incineration with energy recovery, while both open burning and disposal has decreased.

There are no waste water treatment plants in Greenland, and waste water produced both on land and at sea is disposed off into the ocean. Households are generally connected with public sewers, but there are still households with no access to sewerage. Industrial waste water management is regulated by Government regulations on environmental operational permits.

2.2.10 Buildings and infrastructure

As of 1 January 2007 there were a total of 22.075 dwellings in Greenland. 83,6 % of the housing was available in the 17 towns, while the remaining housing was found in the settlements.

TABLE 2.23 HOUSING STATISTICS: DISTRIBUTION OF HOUSING, TOTAL HOUSING, HOUSING SIZE IN M2 AND ROOMS, AND NEW HOUSING, IN 1997, 2004 AND 2006.

Source: Statistics Greenland

	1997	*2004*	*2006*
Housing in towns	16.568	17.642	18.466
Housing in settlements	3.376	3.476	3.609
Housing, total[6]	19.940	20.928	22.075
Housing, total in m^2	1.289.681	1.379.633	1.488.342
Average size in m^2	63,7	63,8	65,5
Average size in no. of rooms	2,9	2,9	2,9
New housing	94	231	225

The public sector plays a very important role in the housing sector. Most housing is government housing or built with a government grant. Grants are available for housing built by the owners themselves, cooperative housing, private housing, as well as municipal rental housing. The public sector also subsidises renovation and improvements to private dwellings, e.g. insulation and replacement of windows reducing the energy consumption. A large proportion of the houses are 15 – 20 years old and a refurbishment programme has been initiated. This modernisation includes reducing the energy consumption of individual houses.

[6] Housing excludes dormitories and retirement homes.

Table 2.24 shows the distribution of new housing in the four municipalities of Greenland. While there are large fluctuations from one year to another, most new housing is established in the capital of Nuuk, in Sisimiut, Ilulissat and Qaqortoq. Within the next decade, the need for housing will increase by up to 600 in the small town of Maniitsoq due to the planned production of aluminium from a smelter placed on the island, but the new activities may also affect the demand for housing in neighbouring Sisimiut and Nuuk.

TABLE 2.24 INCREASE IN HOUSING BY MUNICIPALITY, IN 1997, 2004 AND 2006.

Source: Statistics Greenland

	1997	*2004*	*2006*
Kommune Kujalleq	**19**	**24**	**27**
Nanortalik	4	10	-
Qaqortoq	15	13	19
Narsaq	-	1	8
Kommuneqarfik Sermersooq	**22**	**131**	**101**
Paamiut	-	-	-
Nuuk	6	113	81
Illoqqortoormiit	5	-	4
Ammassalik	11	18	16
Qeqqata Kommunia	**13**	**25**	**49**
Maniitsoq	11	11	-
Sisimiut	2	14	49
Qaasuitsup Kommunia	**40**	**51**	**48**
Kangaatsiaq	-	3	1
Aasiaat	7	6	5
Qasigiannguit	2	-	-
Ilulissat	12	21	32
Qeqertarsuaq	1	-	3
Uummannnaq	3	4	3
Upernavik	11	14	4
Qaanaaq	4	3	-
New housing	**94**	**231**	**225**
Total housing	19.940	20.928	22.075

2.2.11 Agriculture

Agriculture is scarce in Greenland due to climatic conditions, but agricultural activities are found in South Greenland. 50 farms are registered in the Narsaq, Qaqortoq and Nanortalik area, while three farms are registered as far north as Nuuk and Paamiut.

Even if Greenland has seen an increase in agriculture, farming and livestock are still small of scale. Since 1990 the hectares of improved grassland has increased by more than 100 %, while the number of farms has seen only small fluctuations.

The average farm is estimated at 15-18 hectares.

TABLE 2.25 CROPLAND, IMPROVED GRASSLAND, MOUNTAINOUS GRASSLAND, IN 1990, 2001, 2004 AND 2007

Source: Statistics Greenland, Home Rule Government (LULUCF: GHG inventory for Greenland, 2009), and Agricultural Advisory Service, Ministry of Fisheries, Hunting and Agriculture.

	1990	*2001*	*2004*	*2007*
Cropland	NE	5	5	5
Improved grassland	490	776	888	973
Mountainous grassland	242.000	242.000	242.000	242.000

The mountainous grassland is only used for grazing in the short summer period of 3-4 months for the stock of sheep. The major part of the mountainous grassland is bare rock and mountains.

Since 1990 the increase in grassland has often taken place with draining and ditching. The drained area today is approximately 250 hectares. Of the cropland and improved grassland an estimated 75 % is on light, sandy soils with a varying content of organic matter. The remaining areas are fens with high organic matter content. Improved grassland is used for the production of fodder, i.e. grassing and hay production.

The agricultural yield i.e. hay produced per hectare, compares to farming in marginal lands in Iceland and northern Scandinavia. But in order to develop sustainable farming and increase the variety of products, more land must be cultivated.

The increase in improved grassland is a result of the increased demand for fodder for sheep, reindeer, cattle and horses. An estimated 5 hectares is used for the production of vegetables, primarily potatoes, carrots and turnips. In 2008 the production of potatoes reached 20 tonnes. Broccoli, salads and other vegetables are produced on a trial basis and an inland production of fresh vegetables is still to be developed.

TABLE 2.26 STOCK OF SHEEP, REINDEERS, CATTLE AND HORSES IN 1990, 2000 AND 2008

Source: Statistics Greenland, Home Rule Government, (LULUCF: GHG inventory for Greenland, 2009), and Nunalerinermut Siunnersorteqarfik /Agricultural Advisory Service

	1990	*2000*	*2008*
Sheep	19.929	20.444	21.080
Reindeer (domestic)	6.000	2.000	2.500

In sheep farming, the production of meat has stabilized at 20.000 lamb and sheep annually.

Reindeer are farmed at two stations; Isortoq Reindeer Station and Tuttutooq. In 2005 Isortoq Reindeer Station produced meat from 1.807 reindeer, while the somewhat smaller Tuttutooq produced 160 reindeer.

2.2.12 Forestry

Forestry in Greenland, like agriculture, is found in South Greenland. Coniferous plantations and woods, with threes of an average height more than 5 meters, cover a total area of 54 hectares. Until 2007 more than 200 hectares have been afforestated in total.

There are four forests which may qualify to meet the FAO criteria of forest definitions, e.g. larger than 0.5 hectares, a width larger than 20 meters, a minimum height of 5 meters at maturity and a minimum crown cover of 10%.

TABLE 2.27 FORESTRY IN GREENLAND: PLANTED (YEAR), AREA (IN HECTARES), DENSITY (IN TREES PER HECTARE), AND 1990 AND 2007 AVERAGE TREE HEIGHT (IN METERS)

Source: Statistics Greenland, Greenland Government, and Nunalerinermut Siunnersorteqarfik /Agricultural Advisory Service

	Planted	***Dominant tree***	***Ha***	***Density***	***1990 average tree height***	***2007 average tree height***
Qinngua Valley	Natural	Birch (*Betula pubescens ssp. czerepanovii*) Mountain ash (*Sorbus groenlandica ex. decora*)	45	100	NO	6
Qanassiassat Forest	1953-63	Conifer (*Picea sp,Larix)*	1	800	5	10
Kuussuaq Forest	1962-64 (1982)	Conifer (*Picea glauca, Larix sibirica*)	5	900	3	9
Greenland Arboretum	(1976-)	Conifer and decidous (*Larix sp., Picea sp. Abies sp., Pinus sp., Betula sp. Alnus sp.* etc.)	3	400	4	7
Total			**54**			

The largest forested area in Greenland is the Qinngua Valley: a 45 hectares natural wood with multi-aged birch and mountain ash. No early observations were made, but as the Qinngua Valley forest is at its peak the average tree height is estimated to be almost 6 meters in 1990 too.

The Qanassiassat, the Kuussuaq, and the Greenland Arboretum (Kalaallit Nunaata Orpiuteqarfik) are plantations established since the 1950's. The Qanassiassat Forest and the Kuussuaq Forest are both small plantations with dense vegetation and a marked increase in average tree height since 1990, while the Greenland Arboretum has less dense vegetation and trees smaller.

In each of the three plantations, 3.000 plants were planted per hectare. The average plant loss is 30 % in the South Greenland plantations, and after 20 and 40 years the plantations are thinned. Due to promising results from the existing plantations a large scale afforestation project is planned in collaboration with the Icelandic Forestry Commission. The area covered by the project is a 100 hectare plantation in the area near Qanassiassat.

Greenland will probably never be truly competitive in the production of commercial timber, but small scale plantings, e.g. an inland production of Christmas trees for the national marked and a small scale timber production might accompany the agricultural sector in the nearest future.

2.3 THE FAROE ISLANDS

2.3.1 Form of government and structure of administration

The Faroe Islands have home rule status, and their internal affairs are governed by the Faroese parliament (the Lagting). The Faroe Islands are not a member of the EU.

International agreements entered into by the Danish government cover the Faroe Islands and apply to them to the same extent, unless the Faroese government specifically requests exemption or deviation from them.

Denmark's ratification of the Climate Convention covers the Faroe Islands as well, but at the request of the Faroese government, geographical exemption was taken for the Faroe Islands in connection with Denmark's ratification of the Kyoto Protocol.

2.3.2 Population

In 2007 the Faroe Islands had a population of 48.327 - an increase of 6.100 since 1977. Net immigration was relatively small up to the beginning of the 1980s but increased relatively sharply in the years 1984-89 as a consequence of a high level of economic and employment activity. In the years 1990-1995 this picture changed to extensive emigration due to a serious deterioration in the economic and employment situation. In 1993 and 1994 alone, net emigration corresponded to 8% of the total population. From 1996 to 2004, the population was growing. But since 2004 the increase has stopped. In 2007 the capital, Tórshavn, had a population of 12.367, corresponding to slightly more than 25% of the entire population.

2.3.3 Geography

The Faroe Islands consist of 18 small, mountainous islands situated in the North Atlantic at about 62^{o}N and 7^{o}W. The islands extend over 113 km from north to south and 75 km from east to west, and the total area is 1,399 square kilometres. The highest points, almost 890 metres above sea level, are on the northern islands. 17 of the islands are inhabited.

2.3.4 Climate

The climate on the Faroe Islands is strongly affected by the warm North Atlantic current and frequent passage of cyclones, which, depending on the location of the polar front, mainly come from southwest and west. The climate is characterised by mild winters and cool summers and the weather is often moist and rainy.

The high pressure over the Azores sometimes shifts towards the Faroe Islands. This can result in stable summer weather lasting several weeks, with quite high temperatures. In winter, on the other hand, the low pressure systems can move more southerly around the islands than normal, bringing in cold air from the north and a lengthy period of sunny winter weather.

The maritime climate is also a result of the cold east Iceland current (polar current), which splits into two currents from eastern Iceland towards the Faroe Islands. The mixing of the water masses from this and the warm Gulf Stream causes a relatively big difference in the sea temperatures around the islands, and this in turn causes local variations in the climate.

Atmospheric pressure

The normal atmospheric pressure at sea level in Tórshavn is 1008 hPa on an annual basis, lowest from October to January (1004-1005 hPa) and highest in May (1014 hPa). The lowest atmospheric pressure recorded was 930.3 hPa on 11 January 1993, and the highest was 1048.9 hPa recorded on 13 December 1995. The islands have long periods with both low pressure and high pressure.

The Faroe Islands lie close to the normal cyclone paths over the North Atlantic, and big and frequent changes in atmospheric pressure, with rises and falls of 20 hPa within 24 hours are common throughout the year. Sometimes, however, such violent cyclones develop that pressure falls of more than 80 hPa/24 hours occur.

Temperature

The annual mean temperature in Tórshavn is 6.5°C. The temperature in January and February is around 3.5°C, and in July and August, around 10.5°C. The annual mean temperature varies from place to place and is lowest at Vága Floghavn, 6.0°C, and highest in Sandur on the island of Sandoy, 7.0°C.

Since the 1990s the temperatures in Tórshavn exhibited a slightly rising trend.

Precipitation

Annual precipitation in Tórshavn is 1284 mm, most in autumn and least in summer. There are big geographical variations in precipitation, mainly due to the topography of the islands.

It rains a lot on the Faroe Islands. Indeed, the Hvalvík has as much as 300 days with precipitation, and Tórshavn, 273 days. In the winter, precipitation is often in the form of snow. On average, Tórshavn has 44 days of snowfall per year, mostly in December and January. There is no snow at all in June, July, and August, but there can be snow in September.

Since the mid 1970s, precipitation in Tórshavn has been roughly stable, with a slightly increasing trend in recent years.

Hours of sunshine, cloud cover and relative humidity

Tórshavn has 840 hours of sunshine per year, most in May and June, the average being around 125 hours. In some Decembers there are no hours of sunshine at all. The highest number of hours of sunshine in a calendar month was 232 hours, observed in May 1948 and in May 2000.

The location in the North Atlantic, combined with frequent low-pressure fronts, results in a large number of cloudy days (>80% cloud cover) - 221 days in Tórshavn.

The number of hours of sunshine in Tórshavn has showed a slightly increasing trend in the last 20 years.

The Faroe Islands have a moist climate, and the relative humidity is very high, 88% on an annual basis in Tórshavn. It is highest around August, and this is also when most fog occurs.

Wind

The mean wind is generally high on the Faroe Islands, particularly in autumn and winter (6-10 m/s). The wind is normally lightest in summer (4.5-6 m/s). There are normally no storms from April to August, while autumn and winter are windy, with many storms, some of which can reach hurricane force.

The highest 10-minute mean winds are about 50 m/s, recorded at Mykines Lighthouse in March 1997 and January 1999. In 1997, gusts of almost 67 m/s were recorded at Mykines Lighthouse.

Although the weather is generally windy, there are also still periods, mostly in summer and mostly of short duration.

2.3.5 Economy

The Faroe Islands is a modern, developed society with a standard of living comparable to other Nordic countries. However, the economy is not yet as diversified as in other highly developed countries.

Fishery and related industries are of such importance that its influence determines the overall performance of the Faroese economy. This dependence on a resource-based industry is evident in the Export Account of Goods, since fish products account for about 95% of the export value.

An economy with high dependence on fish products and exportation is bound to be vulnerable to the changes in catches, fish prices, and exchange rates. These often cyclical and unforeseen changes are volatile, and have left their mark on the economic history of the islands.

The Faroese economy is very sensitive to the international market for fish. Consequently, export income can fluctuate significantly from one year to the next, and these fluctuations spread quickly throughout the economy.

The national accounts to 2007 indicate that a proportionally larger output value now comes from production related to construction, transportation, banking, and other financial services. The proportional output value from fishery and the manufacturing of fish products has declined correspondingly. Faroese companies are also actively seeking investment opportunities abroad at a much higher level than in the past. These developments, together with a shift since the mid-1990's towards a more market oriented economic policy, will most likely contribute to a more diverse and stable economy.

TABLE 2.28 GROSS NATIONAL PRODUCT AT FACTOR COST 1999 - 2006, BREAKDOWN BY SECTOR
Source: Hagstova Føroya

Million DKK	1999	2000	2001	2002	2003	2004	2005	2006
Non-financial sector	3.953	4.372	5.099	5.108	4.755	4.809	4.967	5.884
Financial sector	218	250	280	305	361	339	334	401
Public Services	1.481	1.597	1.753	1.921	2.045	2.223	2.324	2.403
Households and NPISH	1.122	1.280	1.325	1.441	1.414	1.408	1.409	1.584
Total	**6.774**	**7.499**	**8.457**	**8.775**	**8.575**	**8.779**	**9.034**	**10.272**

2.3.6 Energy

The joint municipal company SEV is responsible for the production and sale of electricity on the Faroe Islands. In 2007 production amounted to about 270 mill. kWh cf. Table 2.29. Of this, about 39% was based on hydroelectricity, while the remainder was produced at diesel-driven plants. An increasing part of the electricity production is based on wind power. In 2007 the wind power contributed with 5,8%, or 15.7 mill. KWh of the total production. .

Sales of electricity in 2007 were distributed between 31% for domestic users, 32% for industry, agriculture and fisheries, and 16% for the service sector, with the remainder for street lighting etc.

TABLE 2.29 ELECTRICITY PRODUCTION 1999-2003 (GWH)
Source: The Office of the Danish Chief Administrator in the Faroe Islands (2008)

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Hydropower	70.2	76.0	76.0	95.9	85.7	94.4	99.0	101.0	104.5
Diesel power	130.6	136.4	154.8	143.2	160.3	147.0	135.6	143.6	149.2
Wind power	0.6	0.5	0.5	0.6	3.0	7.5	10.3	14.9	15.7
Total	**201.4**	**212.9**	**231.3**	**239.7**	**249.0**	**248.9**	**244.9**	**259.5**	**269.4**

Since a number of oil finds in British territorial waters close to the Faroese border in the 1990s, there has been a reasonable presumption that there is oil in Faroese territory, and the first licensing round was held in 2000, the second in 2004 and the was held in 2008 . The first licences for exploration and production of hydrocarbons in the subsoil off the Faroe Islands were granted in August 2000. The first three exploration wells were drilled in 2001. Since then three wells have been drilled (2003, 2006 and 2007/08). So far none of the finding have beencommercially viable.

2.3.7 Transport

Goods transport between the Faroe Islands and the rest of the world is mainly by sea. Two shipping companies operate freighter services all year round. Since 1998, the Faroese company Smyril Line has carried freight in connection with their passenger winter sailings to Denmark. The Icelandic company SAMSKIP also operates freight services throughout the year and has an office on the Faroe Islands.

Besides Vágar Floghavn, the Faroe Islands have 12 helicopter pads. Air services is provided by the Faroese company ATLANTIC AIRWAYS. The number of air travellers to and from the Faroe Islands has risen sharply in the last few years.

Passenger transport by sea takes place mainly in the summer period. There are both regular services (Smyril Line) and cruise liners. The number of foreign passenger ships calling at the Faroe Islands has been increasing in recent years.

For 20-30 years up to the beginning of the 1990s and again over the last few years, major investments have been made in enlarging and modernising the transport infrastructure on the islands and the communication links with the outside world. The first undersea tunnel on the Faroe Islands, Vágatunnilin, opend in 2002, connecting Vágoy (airport) with Streymoy . In 2006, the second undersea tunnel of the Faroes, Norðoyartunnilin, which joins Borðoy with Eysturoy, opened. Constructing roads, tunnels, and harbours is costly because of the difficult topographical conditions. Since an economic downturn at the beginning of the 1990s, the number of motor vehicles has increased by almost 1,000 per year since 1995 and in 2007 there were 27,720 motor vehicles, of which about 20,000 were cars and 4,500 lorries and vans.

2.3.8 Industry

The sectorial composition of the Faroese economy reveals a relatively large primary sector, brought about by the sizeable fishing fleet and a thriving Fish Farming Industry.

TABLE 2.30 DISTRIBUTION OF EMPLOYMENT BY SECTORS, PRIMO 2009
Source: Landsanki føroya – Governmental Bank

	Denmark	Iceland	Faroe Islands
Primary sector	3.4%	7.3%	11.6%
Secondary sector	23.4%	23.0%	22.2%
Tertiary sector	73.2%	69.7%	66.2%

As a result, fish and fish products accounted for 94.3% of exports in 2007 and about 60% of total foreign income stemmed from fish and fish related industries.

However, during the past several years, employment in the primary sector has been decreasing and this trend shows no signs of abating, hence reinforcing the sectorial diversification, which ought to make the economy less volatile in the long run.

2.3.9 Buildings and urban structure

For many years, the Faroese authorities have made every effort to counteract migration from the small or isolated villages and islands, in particular through a major road-building programme and other transport measures. However, population development is generally poorer in these outlying areas than in other parts of the country.

Housing is predominantly single-family houses, most of which are relatively large and of high standard.

2.3.10 Agriculture

Until the end of the nineteenth century, farming was the Faroe Islands' main industry, but with the economic and industrial development since then, particularly within fisheries. Farming in 2008 accounts for only 0.3% of the Faroe Islands' gross national income at factor cost.

With a view to increasing the self-sufficiency of the Faroe Islands, the government is providing grants for investments in farming.

With about 5% of the land under cultivation, the Faroe Islands can supply just over half of its total demand for lamb and mutton, most of its demand of milk, half of the demand for potatoes, , and a small fraction of demand for beef. In 2007 the Faroe Islands had about 1000 dairy cows and about 78.000 sheep.

2.3.11 Forestry

There is no commercial forestry on the Faroe Islands, but there are a number of plantations on the islands, which are maintained by the Faroese forestry authority.

3
Greenhouse gas inventory information

including on national systems and the national registry

3 Greenhouse gas inventory information

- including on national systems and the national registry

3.1 Summary Tables of Greenhouse gas inventories

Denmark's greenhouse gas inventories are prepared in accordance with the guidelines from the Intergovernmental Panel on Climate Change (IPCC) and are based on the methods developed under the European CORINAIR programme.[7]

The Danish emission inventories follow the method described in CORINAIR's guidelines[8] and IPCC's guidelines[9]. In accordance with the latter guidelines, some of the default methods and emission factors have been modified so that they reflect better Danish conditions.

A description of methods, emission factors and activity data is given in Denmark's national emission inventory reports (NIR)[10] to the Climate Convention, which also includes data in the common reporting format (CRF). The latest NIR and the latest combined Danish inventory of greenhouse gases and other air pollutants can be seen at the National Environmental Research Institute's website[11] and in Nielsen et al, 2009.

Greenhouse gas inventories for Greenland and the Faroe Islands are included in the national emissions inventory reports to the Climate Convention.

Since the UNFCCC has been ratified on behalf of all three parts of the Realm, the Kyoto Protocol has been ratified on behalf of Denmark and Greenland, and only Denmark is a part of the European Union territory to which the EU agreement on joint fulfilment under Article 4 of the Kyoto Protocol applies, three sets of summary tables have been reported in the NIR 2009. The most aggregated summary tables are shown in this Chapter in Table 3.1 (Denmark, Greenland and the Faroe Islands), Table 3.2 (Denmark) and Table 3.4 (Denmark and Greenland) respectively.

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[7] A detailed description of the CORINAIR system used for Danish emissions inventories is given in Illerup et al. 2000 and Winther et al., 1998.

[8] EMEP/Corinair (2007): Emission Inventory Guidebook. 3rd edition, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections, 2007 update. Available at: http://www.eea.europa.eu/publications/EMEPCORINAIR5/page002.html (13-04-2009).

[9] IPCC (1997): Greenhouse Gas Inventory Reporting Instructions. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Vol 1, 2 and 3. The Intergovernmental Panel on Climate Change (IPCC), IPCC WGI Technical Support Unit, United Kingdom.

[10] Nielsen et al., 2008 and 2009.

[11] www.dmu.dk

CRF summary tables for Denmark with more disaggregated information on Danish source categories are given in Annex A1.

In all summary tables, the base year presented, is the base year under the UNFCCC which is 1990. Under the UNFCCC, time series of emission inventories, including emissions in 1990, are often recalculated in the annual reporting due to new knowledge regarding emission factors, activity data, methodologies etc. Under the Kyoto Protocol, the assigned amount for Denmark and Greenland for the period 2008-2012 was determined in 2007 on the basis of the base year reported with annual inventory reporting in 2006. The fixed base year and the calculation of the assigned amount under the Kyoto Protocol are further described in section 3.5.

3.2 DESCRIPTIVE SUMMARY OF DENMARK'S EMISSIONS AND REMOVALS OF GREENHOUSE GASES

The total inventories for Denmark, Greenland and the Faroe Islands (the Realm) are given in Table 3.1, and emissions from Greenland and the Faroe Islands are indicated under the box ”Other”.

The emission estimates for Greenland and the Faroe Islands are being improved yearly with more detailed estimates being available year by year. In this regard, a full set of CRF tables with disaggregated information on source and sink categories which also includes Greenland is expected to be included in the annual reporting from 2010.

As will be seen from Table 3.1, Greenland's and the Faroe Islands' greenhouse gas emissions are small compared with those of Denmark (each about 1% of the total emissions), and they have been almost constant since 1990.

The Danish emissions (i.e. excluding emissions from Greenland and Faroe Islands) of the greenhouse gases CO_2 (carbon dioxide), CH_4 (methane), N_2O (nitrous oxide), and the so-called potent greenhouse gases (F-gases), which include HFCs (hydrofluorocarbons), PFCs (perfluorocarbons), and SF_6 (sulphurhexafluoride) during the period 1990-2007 are shown in Figures 3.1-3.4 aggregated into the IPCC's 6 main sectors and the most relevant sub-sectors. Total Danish greenhouse gas emissions measured in CO_2 equivalents on the basis of the potential of each gas for global warming is shown together with the distribution with respect to gas and source/sector in Table 3.2 and Figures 3.5 and 3.6 respectively. The development in Danish greenhouse gas emissions, 1990-2007 broken down by source and sink categories from Table 10 of the CRF, is shown in Annex A1.

In the following sections 3.2.1 to 3.2.6, further information on Danish emissions of individual greenhouse gases, indirect greenhouse gases and SO_2 is provided.

TABLE 3.1 DENMARK'S, GREENLAND'S AND THE FAROE ISLANDS' TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES, 1990 - 2007

Source: The National Environmental Research Institute (NERI).

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	CO_2 equivalent (Gg)																	
CO_2 emissions including net CO_2 from LULUCF	54 631	63 037	57 357	59 900	63 032	59 969	73 969	64 506	59 502	57 552	55 867	55 244	53 571	58 516	54 418	51 732	58 567	53 467
CO_2 emissions excluding net CO_2 from LULUCF	54 079	64 725	58 906	61 057	64 649	61 638	75 186	65 685	61 456	58 786	54 236	56 013	55 549	60 806	55 243	51 571	59 442	54 594
CH_4 emissions including CH_4 from LULUCF	5 730	5 818	5 845	6 005	5 928	6 024	6 138	6 030	6 055	5 931	5 923	6 056	6 026	6 008	5 819	5 711	5 658	5 781
CH_4 emissions excluding CH_4 from LULUCF	5 731	5 819	5 846	6 006	5 929	6 024	6 139	6 030	6 055	5 932	5 923	6 056	6 027	6 009	5 819	5 712	5 658	5 781
N_2O emissions including N_2O from LULUCF	10 559	10 349	9 917	9 674	9 494	9 388	9 026	8 933	8 845	8 533	8 320	8 050	7 705	7 596	7 330	6 772	6 515	6 813
N_2O emissions excluding N_2O from LULUCF	10 559	10 349	9 917	9 674	9 494	9 388	9 026	8 932	8 845	8 533	8 320	8 050	7 705	7 595	7 330	6 772	6 515	6 813
HFCs	NA,NE,NO	NA,NE,NO	3	94	135	218	329	325	413	508	611	657	685	710	766	812	832	858
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0	1	2	4	9	12	18	22	22	19	16	14	16	15
SF_6	44	64	89	101	122	108	61	73	60	65	59	30	25	31	33	22	36	30
Total (including LULUCF)	**70 965**	**79 268**	**73 212**	**75 775**	**78 711**	**75 706**	**89 525**	**79 870**	**74 884**	**72 601**	**70 797**	**70 059**	**68 034**	**72 881**	**68 381**	**65 063**	**71 624**	**66 965**
Total (excluding LULUCF)	**70 414**	**80 956**	**74 761**	**76 932**	**80 329**	**77 376**	**90 743**	**81 050**	**76 838**	**73 836**	**69 167**	**70 829**	**70 013**	**75 171**	**69 206**	**64 902**	**72 500**	**68 092**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	CO_2 equivalent (Gg)																	
1. Energy	52 083	62 665	56 752	59 113	62 817	59 912	73 416	63 720	59 570	56 883	52 186	53 977	53 578	58 909	53 228	49 611	57 431	52 546
2. Industrial Processes	2 240	2 343	2 379	2 452	2 550	2 724	2 827	3 017	2 994	3 217	3 387	3 288	3 194	3 210	3 017	2 435	2 516	2 533
3. Solvent and Other Product Use	179	174	169	164	159	141	154	139	128	127	127	113	115	104	99	113	130	124
4. Agriculture	13 010	12 890	12 604	12 473	12 127	11 906	11 570	11 398	11 404	10 817	10 582	10 519	10 234	9 962	10 003	9 929	9 586	10 072
5. Land-Use Change and Forestry (LUCF)	551	-1 689	-1 549	-1 158	-1 618	-1 670	-1 218	-1 180	-1 955	-1 235	1 630	-770	-1 979	-2 291	-825	161	-875	-1 128
6. Waste	1 548	1 565	1 564	1 601	1 589	1 563	1 563	1 544	1 508	1 514	1 498	1 498	1 523	1 528	1 412	1 389	1 379	1 366
7. Other	1 354	1 319	1 293	1 129	1 086	1 130	1 212	1 230	1 234	1 279	1 389	1 435	1 369	1 458	1 447	1 425	1 457	1 451
Total (including LULUCF)	**70 965**	**79 268**	**73 212**	**75 775**	**78 711**	**75 706**	**89 525**	**79 870**	**74 884**	**72 601**	**70 797**	**70 059**	**68 034**	**72 881**	**68 381**	**65 063**	**71 624**	**66 965**

3.2.1 Carbon dioxide, CO_2

Most CO_2 emissions come from combustion of coal, oil and natural gas at power stations and in residential properties and industry, road transport is also a major contributor.

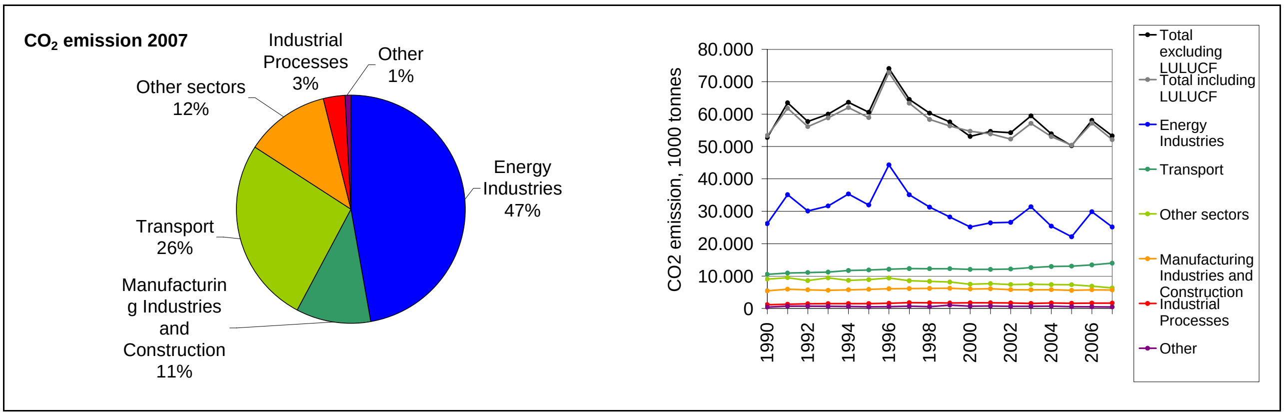
The relatively large fluctuations in the emissions from year to year are due to trade in electricity with other countries - primarily the Nordic countries. The large emissions in 1991, 1994, 1996, 2003 and 2006 are due to large electricity exports. This effect is further demonstrated in section 3.6 where emission trends with corrections for inter-annual variations in temperature and electricity exchange are shown.

From 1990 to 1996, emissions showed a rising trend, but they have fallen since 1997 because many power stations have changed their fuel mix from coal to natural gas and renewable energy. As a result of the reduced use of coal in recent years, most of the CO_2 emissions now come from combustion of oil or oil based products both in stationary and mobile sources.

Emissions from road transport in 2007 accounted for approx. 20 % of the total CO_2 emissions.

In 2007, total actual CO_2 emissions inventoried under the Climate Convention, excluding land-use change and forestry (LULUCF), were about 1 % higher than in 1990. If LUCF is included, net emissions were about 2 % lower.

FIGURE 3.1: CO2 EMISSIONS BY SECTOR ANS DEVELOPMENT IN 1990-2007
Source: The National Environmental Research Institute (NERI)



3.2.2 Methane, CH_4

Anthropogenic methane (CH_4) emissions primarily stem from agriculture, landfills, and the energy sector, among which agriculture contributes the most by far.

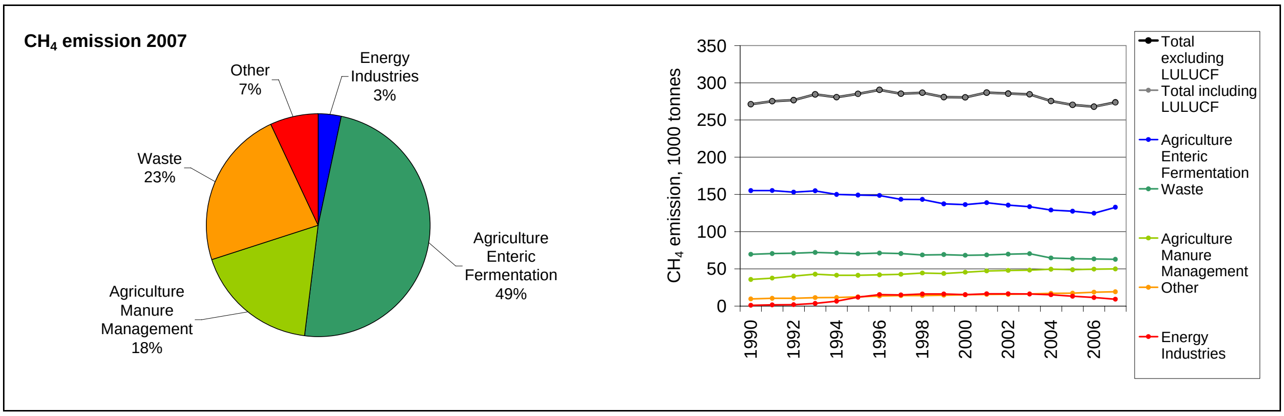
The emissions from agriculture are due to the formation of methane in the digestive system of farm animals (enteric fermentation) and manure management.

Emissions of methane from landfills are decreasing, because the production of methane has fallen year by year since the abrupt fall in landfilling in 1997.

Emissions of methane from the energy sector increased until 2003 due to an increased use of gas-driven engines, which emit large amounts of methane compared to other combustion technologies, however in later years new legislation establishing emission limits for existing gas-driven engines come into force pursuant to Statutory Order No. 720 of 5 October 1998 combined with decreased use of gas engines have resulted in lower emissions. In 2007, total methane emissions were 1 % above the 1990 level.

FIGURE 3.2 CH4 EMISSIONS BY SECTOR AND DEVELOPMENT IN 1990-2007

Source: The National Environmental Research Institute (NERI)



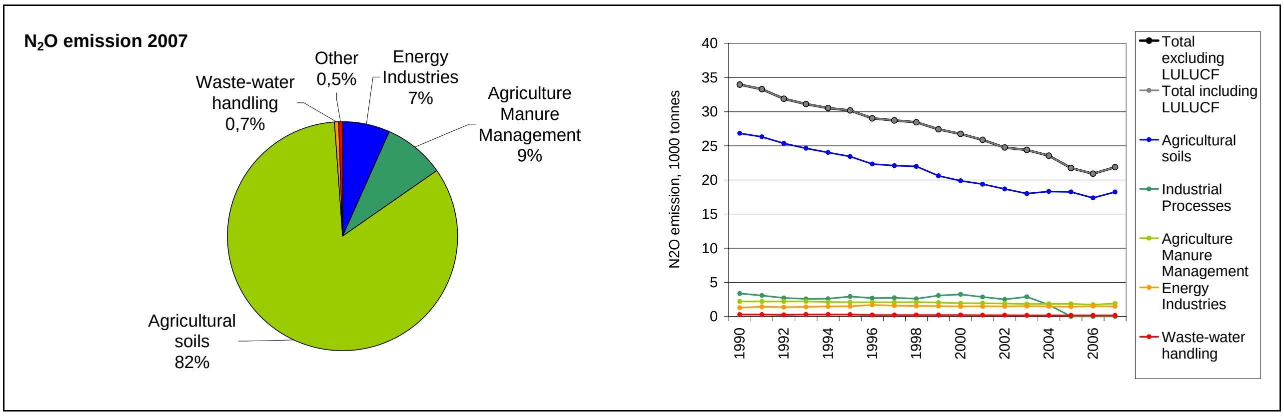
3.2.3 Nitrous oxide, N_2O

Agriculture constitutes the largest source by far of nitrous oxide (N_2O) emissions, since N_2O can be formed in the ground, where bacteria convert nitrous compounds from fertilizer and manure. Bacterial conversion of nitrogen also occurs in drain water and coastal water. This nitrogen largely comes from agriculture's use of fertiliser, and emissions from these sources are therefore included under agriculture. From 1990, N_2O emissions from agriculture had dropped 31 % due to the reduced use of commercial fertilizers and more efficient use of manure. A small share of the nitrous oxide emissions originates from power and district heating plants, and cars with catalytic converters. Previously a plant producing nitric acid was in operation in Denmark, however this plant shut down in 2004 eliminating N_2O emissions from this activity.

In 2007, total nitrous oxide emissions were 36 % below the 1990 level.

FIGURE 3.3 N2O EMISSIONS BY SECTOR AND DEVELOPMENT IN 1990-2007

Source: The National Environmental Research Institute (NERI)



3.2.4 The f-gases: HFCs, PFCs, and SF_6

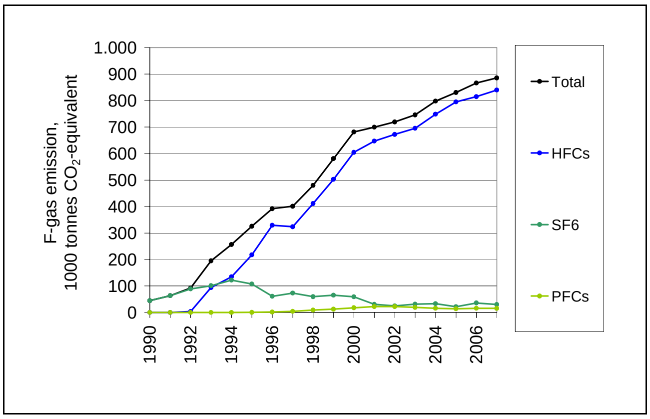
The contribution of f-gases (HFCs, PFCs and SF_6), to Denmark's total emissions of greenhouse gases is relatively modest. However, the emissions of these gases increased significantly during the 1990s. Collection of data on the consumption of these substances started in the mid 1990s. Therefore, f-gas data and emissions inventories from before 1995 are somewhat less certain than in 1995 and later. In accordance with the Kyoto Protocol, Denmark has selected 1995 as the base year for the f-gases.

The HFCs, which are primarily used in refrigeration and air conditioning, are the biggest contributor to f-gas emissions. From 1995 to 2007 annual emissions of HFCs increased from 217,700 to 840,000 tonnes of CO_2 equivalents. Emissions of PFCs increased in the same period from 500 to 15,400 tonnes CO_2 equivalents, the emissions of PFCs peaked in 2002 with 22,200 tonnes CO_2 equivalents. The emissions of SF_6 decreased from 107,300 in 1995 to 30,400 tonnes of CO_2 equivalents in 2007.

Total F-gas emissions rose by 172% from 1995 to 2007.

FIGURE 3.4 DEVELOPMENT IN HFC, PFC, AND SF6 EMISSIONS IN 1990-2007

Source: The National Environmental Research Institute (NERI)



3.2.5 Total Danish emissions and removals of greenhouse gases

Table 3.2 and figures 3.5 and 3.6 show the development in the Danish greenhouse gas emissions and removals as CO_2 equivalents and by gases and sources according to the guidelines on reporting of summary information under the Climate Convention. CO_2 is the most important greenhouse gas followed by N_2O and CH_4. From 1996, when total emissions (excl. LULUCF) were estimated to 89.5 mill. tonnes of CO_2 equivalents, as mentioned previously emissions fluctuate based on electricity trade therefore total greenhouse gas emissions ion 2003 corresponded to 73.7 mill. tonnes of CO_2 equivalents (excl. LULUCF). In 2007 the total emissions were estimated to 66.6 mill. tonnes of CO_2 equivalents,

Of the total Danish greenhouse gas emissions in 2007, CO_2 made up 80%, methane 9%, nitrous oxide 10%, and F-gasses 1%. If net contributions of CO_2 emissions by sources and removals by sinks from forests and soil are included (i.e. with LULUCF), then net total Danish greenhouse gas emissions corresponded to 65.5 mill. tonnes of CO_2 equivalents in 2007.

FIGURE 3.5 DANISH GREENHOUSE GAS EMISSIONS BY TYPE OF GAS IN 1990 - 2007.

Source: The National Environmental Research Institute (NERI)

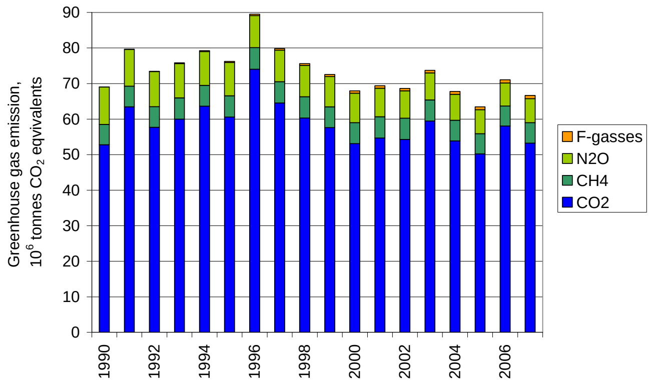


FIGURE 3.6 DANISH GREENHOUSE GAS EMISSIONS BY SOURCE/SECTOR IN 1990 – 2007

Source: The National Environmental Research Institute (NERI)

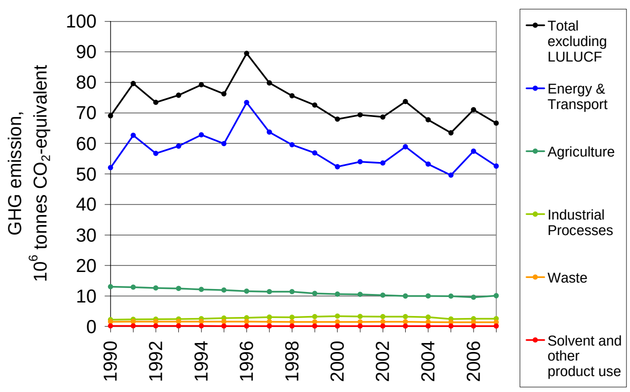


TABLE 3.2 DANISH GREENHOUSE GAS EMISSIONS AND REMOVALS BY GAS AND SOURCE AND SINK CATEGORIES IN 1990 - 2007

Source: The National Environmental Research Institute (NERI)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	CO_2 equivalent (Gg)																	
CO_2 emissions including net CO_2 from LULUCF	53 345	61 784	56 130	58 834	62 011	58 905	72 823	63 344	58 337	56 343	54 721	53 885	52 280	57 139	53 054	50 390	57 194	52 101
CO_2 emissions excluding net CO_2 from LULUCF	52 793	63 473	57 679	59 991	63 628	60 574	74 040	64 524	60 291	57 578	53 090	54 655	54 258	59 429	53 879	50 229	58 069	53 228
CH_4 emissions including CH_4 from LULUCF	5 695	5 783	5 811	5 972	5 893	5 988	6 102	5 993	6 019	5 897	5 889	6 022	5 994	5 975	5 785	5 678	5 625	5 748
CH_4 emissions excluding CH_4 from LULUCF	5 695	5 784	5 812	5 973	5 894	5 989	6 103	5 994	6 020	5 897	5 890	6 023	5 994	5 975	5 786	5 678	5 625	5 748
N_2O emissions including N_2O from LULUCF	10 527	10 318	9 885	9 645	9 465	9 358	8 996	8 901	8 814	8 501	8 288	8 017	7 673	7 563	7 296	6 739	6 482	6 780
N_2O emissions excluding N_2O from LULUCF	10 527	10 318	9 885	9 645	9 464	9 358	8 996	8 901	8 814	8 501	8 288	8 017	7 673	7 563	7 296	6 739	6 482	6 780
HFCs	NA,NE,NO	NA,NE,NO	3	94	135	218	329	324	411	503	605	647	672	695	749	795	815	840
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0	1	2	4	9	12	18	22	22	19	16	14	16	15
SF_6	44	64	89	101	122	107	61	73	59	65	59	30	25	31	33	22	36	30
Total (including LULUCF)	**69 611**	**77 949**	**71 919**	**74 646**	**77 626**	**74 577**	**88 313**	**78 640**	**73 650**	**71 322**	**69 580**	**68 625**	**66 665**	**71 422**	**66 934**	**63 638**	**70 167**	**65 514**
Total (excluding LULUCF)	**69 060**	**79 638**	**73 468**	**75 803**	**79 243**	**76 246**	**89 531**	**79 820**	**75 605**	**72 558**	**67 950**	**69 394**	**68 644**	**73 713**	**67 759**	**63 477**	**71 043**	**66 641**
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	CO_2 equivalent (Gg)																	
1. Energy	52 083	62 665	56 752	59 113	62 817	59 912	73 416	63 720	59 570	56 883	52 358	53 977	53 578	58 909	53 228	49 611	57 431	52 546
2. Industrial Processes	2 240	2 343	2 379	2 452	2 550	2 724	2 827	3 017	2 994	3 217	3 387	3 288	3 194	3 210	3 017	2 435	2 516	2 533
3. Solvent and Other Product Use	179	174	169	164	159	141	154	139	128	127	127	113	115	104	99	113	130	124
4. Agriculture	13 010	12 890	12 604	12 473	12 127	11 906	11 570	11 398	11 404	10 817	10 582	10 519	10 234	9 962	10 003	9 929	9 586	10 072
5. Land-Use Change and Forestry (LUCF)	551	-1 689	-1 549	-1 158	-1 618	-1 670	-1 218	-1 180	-1 955	-1 235	1 630	-770	-1 979	-2 291	-825	161	-875	-1 128
6. Waste	1 548	1 565	1 564	1 601	1 589	1 563	1 563	1 544	1 508	1 514	1 498	1 498	1 523	1 528	1 412	1 389	1 379	1 366
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (including LULUCF)	**69 611**	**77 949**	**71 919**	**74 646**	**77 626**	**74 577**	**88 313**	**78 640**	**73 650**	**71 322**	**69 408**	**68 625**	**66 665**	**71 422**	**66 934**	**63 638**	**70 167**	**65 514**

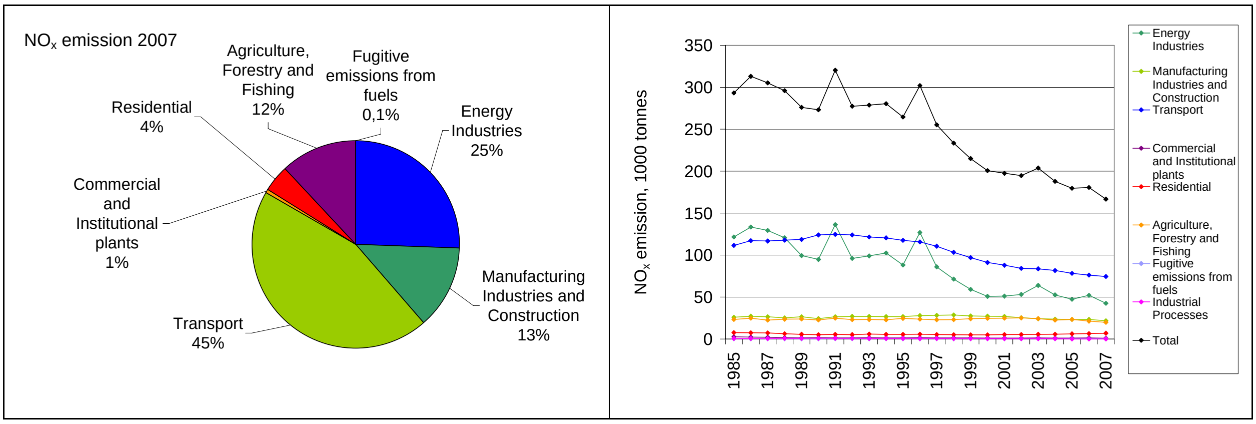
3.2.6 Danish emissions of indirect greenhouse gases and SO_2

NO_X

The three largest sources of emissions of nitrogen oxide (NO_x) are transport, power and district heating plants and other mobile sources such as fishing vessels and agricultural vehicles. In 2007, the transport sector contributed 45 % of total Danish NO_x emissions, which had fallen from approximately 300,000 tonnes in the mid 1980s to 166,000 tonnes in 2007 – a fall of 45 %. The increased use of low-NO_x burners and de-NO_x units at power and district heating plants has reduced emissions from these plants. In addition, the increased number of cars fitted with catalytic converters has contributed to the trend in reductions.

FIGURE 3.7: NOX EMISSIONS BY SECTOR AND DEVELOPMENT IN 1985-2007

Source: The National Environmental Research Institute (NERI)

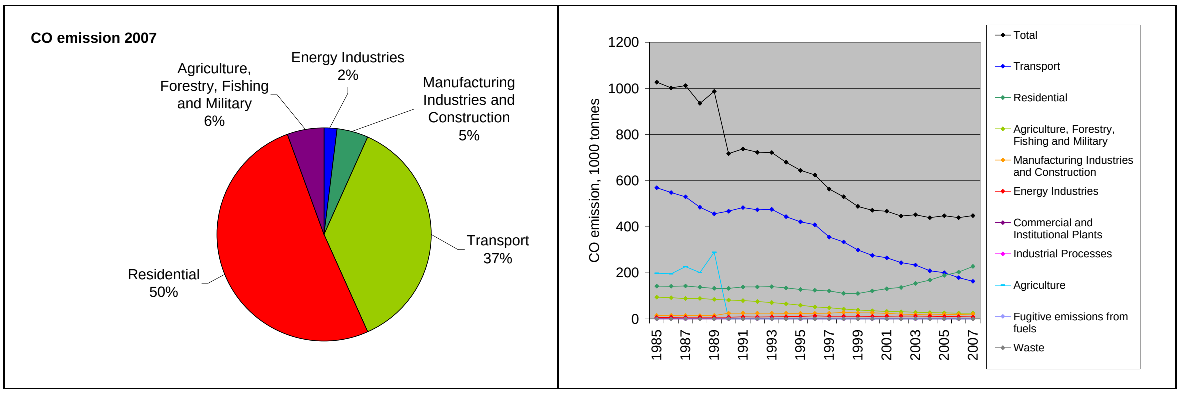


CO

Road transport still accounts for the largest part of CO emissions despite a fall in CO emissions from this source due to the introduction of catalytic converters for vehicles in 1990. In addition, other mobile sources and combustion of wood by households are significant sources. Emissions of CO were reduced by 38% from 1990 to 2007.

FIGURE 3.8: CO EMISSIONS BY SECTOR AND DEVELOPMENT IN 1985-2007

Source: The National Environmental Research Institute (NERI)

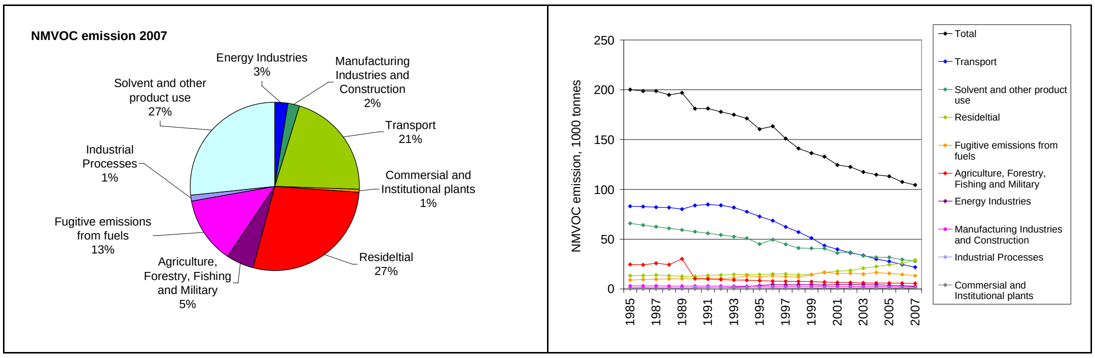


NMVOC

The most significant emission sources of NMVOC are use of solvents, road traffic and other mobile sources. Total anthropogenic emissions of NMVOC were reduced by 42 % from 1985 to 2007 – especially due to the increased number of cars fitted with catalytic converters and reduced emissions in connection with use of organic solvents.

FIGURE 3.9: NMVOC EMISSIONS BY SECTOR AND DEVELOPMENT IN 1985-2007

Source: The National Environmental Research Institute (NERI)

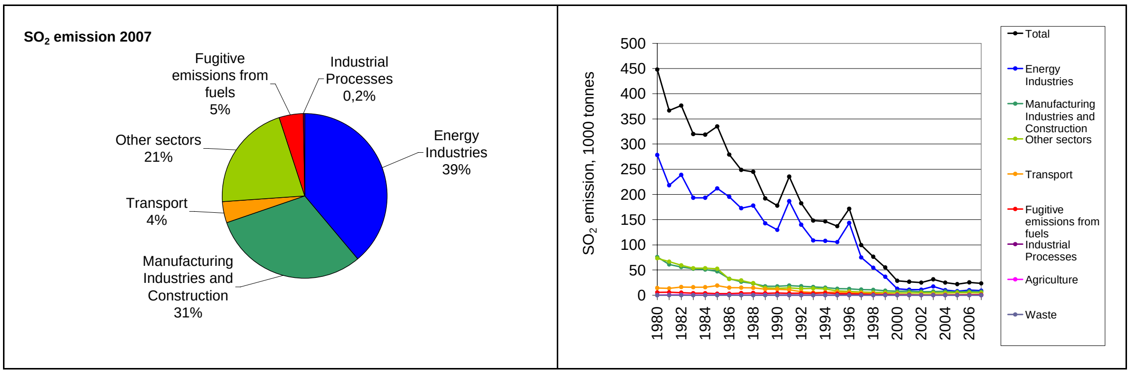


SO_2

The greater part of all SO_2 emissions comes from combustion of coal and oil at power and district heating plants. Emissions of SO_2 have undergone a remarkable development - from 1980 to 2007 total emissions fell by 95%. The reason for this is primarily the installation of desulphurisation units at the large power plants as well as the use of fuels with low sulphur content for power stations, industry and the transport sector.

FIGURE 3.10: SO2 EMISSIONS BY SECTOR AND DEVELOPMENT IN 1980-2007

Source: The National Environmental Research Institute (NERI)



3.3 NATIONAL SYSTEMS IN ACCORDANCE WITH ARTICLE 5, PARAGRAPH 1, OF THE PROTOCOL

This section contains information required information under Article 7 of the Kyoto Protocol. The table given in Annex A2 allows identifying all the Kyoto Protocol elements that are allocated in different sections of this report.

Objectives

In pursuance of Article 5, Section 1 of the Kyoto Protocol, the Parties to the Protocol shall establish national systems for the estimation of greenhouse gas emissions. The objective of establishing the national systems is to ensure good quality inventories. This is achieved by following the IPCC Guidelines for planning, implementation and execution of the activities connected with the work on the greenhouse gas inventories. The national system must also ensure that the inventories are transparent, consistent, comparable, complete and accurate.

Organisation of work etc.

The Danish National Environmental Research Institute (NERI) is responsible for producing the Danish greenhouse gas emission inventories and the annual reporting to the UNFCCC. NERI is therefore the contact point for Denmark's national system for greenhouse gas inventories under the Kyoto Protocol. Furthermore NERI participates in work under the auspices of the UNFCCC, where guidelines for reporting are discussed and decided upon, as well as participating in the EU monitoring mechanism for inventories of greenhouse gases, where guidelines for reporting to the EU are regulated.

BOX 3.1 NERI'S PARTNERS IN THE WORK ON THE ANNUAL INVENTORIES

The Danish Energy Authority, the Danish Ministry of Climate and Energy:
Annual energy statistics that are compatible with the format used for emission inventories and fuel consumption data for large incineration plants.

The Danish Environmental Protection Agency, the Danish Ministry of the Environment:
Database on waste volumes and emissions for potent greenhouse gases (F gasses).

Statistics Denmark, the Danish Ministry of Economic and Business Affairs:
Statistical yearbook, sales statistics for industry, and agricultural statistics.

The Danish Institute of Agricultural Sciences, Aarhus University:
Data on use of fertilizer, fodder, and nitrogen emissions from livestock.

The Danish Road Directorate, the Danish Ministry of Transport:
Number of vehicles grouped by categories corresponding to the EU classifications, kilometres travelled and speeds shown by town, main roads and motorways.

Forest and Landscape Denmark, Copenhagen University:
Background data for forests and removals of CO_2 by forests.

The Civil Aviation Administration, the Danish Ministry of Transport:
Aircraft data (aircraft types and flight routes) for all flight departures and arrivals in Danish airports.

DSB, the Danish Ministry of Transport:
Fuel related emission factors for diesel locomotives.

Danish enterprises:
Environmental accounts and other information.

The work on the annual inventories is carried out in cooperation with other Danish ministries, research institutes, organisations and private enterprises. The most important partners for this work are mentioned in Box 3.1.

The partners mentioned in Box 3.1 provide a range of data that are needed to produce the inventory. NERI therefore has formal agreements with many of the partners to ensure that NERI receives the necessary data on time.

Calculation methods

The Danish emissions inventory is based on the IPCC guidelines for calculation of greenhouse gas emissions (the Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (Houghton et al., 1997) and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (Penman et al., 2000)) and the European CORINAIR (COoRdination of INformation on AIR emissions) program for calculation of national emissions. Generally, emissions are calculated by multiplying the activity data (e.g. fuel consumption, number of animals or vehicles) by an emission factor (e.g. the mass of material emitted per unit of energy, per animal or per vehicle). Activity data are mainly based on official statistics. The emission factors are either national values or values recommended in the IPCC guidelines.

Key sources

Choice of calculation method for the individual sources depends among other things on how significant the source is. The sources that together accounted for 95 % of greenhouse gas emissions in 2007 or accounted for 95 % of the change in emission levels from 1990 to the most recently calculated year (2007) are defined as key sources according to the IPCC guidelines. An analysis of the Danish sources shows that 24 sources account for 95 % of total greenhouse gas emissions and that the three largest sources – that together account for 57 % – are CO_2 from the combustion of coal at stationary incineration plants, CO_2 from road transport and CO_2 from combustion of natural gas at stationary combustion plants.

Procedure for recalculation

At the same time as the annual calculation of emissions for a new year takes place, any necessary recalculations of emission inventories from previous years are also carried out. Recalculations are made if errors or oversights are found or if better knowledge becomes available. If better knowledge becomes available, statistical data, improvements of method, activity data or emission factors are updated according to new knowledge and research. In order to ensure consistent emission inventories, recalculations will be carried out on the whole time series, as much as circumstances permit.

Uncertainty

Uncertainty in the greenhouse gas inventories is calculated as recommended in the IPCC guidelines and covers more than 99 % of total Danish greenhouse gas (GHG) emissions. The result of the calculations shows that total GHG emissions were calculated to have an uncertainty of 5.8 % and the increase in GHG emissions since 1990 was calculated to be -6.3 % ± 2.5 %. Uncertainty is greatest for N_2O emissions from stationary combustion and agricultural land, whilst the uncertainty for CO_2 emissions from the energy sector is only 5.9 % and the uncertainty for the development is 1.8%.

Quality assurance and quality control

As part of the national system, NERI is drawing up a manual to use in quality assurance and quality control of the emission inventories. The manual is in accordance with the guidelines provided by the UNFCCC (IPCC, 1997), and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). The ISO 9000 standards are also used as important input for the plan.

Reports are written for all sources of emissions that describe in detail and document the data and calculation methods used. These reports are evaluated by persons external to NERI who are experts in the area in question, but not directly involved in the inventory work. In addition, a project has been completed in which the Danish calculation methods, emission factors and uncertainties are compared with those of other countries, in order to further verify the correctness of the inventories.

For more detailed description of the QA/QC system please see the Danish National Inventory Report.

Annual reporting

NERI produces an annual report (National Inventory Report[4]) for the Climate Convention in which the results of the calculations are presented and the background data, calculation methods, plan for quality assurance and control, uncertainty and recalculations are described and documented. At the request of the Climate Convention, the report is evaluated each year by international experts. During the last few years, improvements have been made in the inventories' quality and documentation, as a result of the quality assurance and control procedures and the evaluations of national and international experts. The planned improvements can be found in the following section.

Information under Article 10(a) of the Protocol on improvements of emission inventories

A number of improvements have been made to the Danish greenhouse gas emission inventories since Denmark's Fourth National Communication to the Climate Convention (NC4). The improvements have been done either on the initiative of NERI or as a result of reviews of the inventories. The majority of improvements have been concerned with better documentation. Furthermore, overall focus will be on improving procedures for quality assurance and control and on improving documentation of the national emission factors.

3.4 NATIONAL REGISTRY

Background

Denmark's national allowances registry and other EU Memberstates national allowances registers are part of the EU emissions trading scheme, which entered into force on 1 January 2005. The 16th of October 2008 the EU ETS was included in the international emissions trading system under the Kyoto Protocol after successful connection to the International Transaction Log. Danmark's national registry is therefore set up so it works and a fullfills all requirements of both the international emissions trading system under the Kyoto Protocol as well as the EU emissions trading system (EU ETS).

Statutory basis

The national allowances registry was established pursuant to the CO_2 Allowances Act, no. 493 of 9 June 2004 as amended by Consolidated Act no. 348 of 9 May 2008 issued by the Danish Energy Agency, Ministry of Climate and Energy. The Act implements EU Directive 2003/87/EC (allowance directive). In accordance with the Act, the Minister for Climate and Energy is responsible for establishment and operation of the national CO_2 allowances registry.

Statutory Order no. 118 of 27 February 2008 and sets the amount of the fee to be paid for using the registry.

The Allowances Act was revised in May 2005 to implement EU Directive 2004/101/EC of 27 October 2004 (Linking Directive) to change the Quotas Directive so that enterprises subject to allowances can apply CO_2 credits from JI and CDM projects under the EU Quotas Directive.

Organisation and operation of the registry

Design and operation of the register must be in accordance with Commission regulation (EC) no. 994/2008 for a standardised and secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and Decision No 280/2004/EC of the European Parliament and of the Council.

Administrative set-up

A secretariat has been established in the Danish Energy Agency to manage operation and administration of the registry. Users can contact the secretariat directly by phone or email for help in using the registry.

Enterprises and users of the registry are kept informed about regulations, news etc. through regular updates from the Danish Energy Agency website, the news on the registry website and a newsletter from the allowances registry. The newsletter will be issued quarterly or as required and will explain about new regulations and opportunities as well as any planned temporary closures (for updates etc.).

Registry software

The Danish Energy Agency is currently using the EU Commision developed software known as the Community Registry (CR) software. The Centre for Corporate Management under the Danish Ministry of the Environment is responsible for technical operation of the registry software.

Further information on the national registry is in Annex A3.

3.5 Denmark's and Greenland's base year emissions, assigned amount and greenhouse gas inventories under the Kyoto Protocol

As mentioned above the GHG inventory of the Kingdom of Denmark under the Kyoto Protocol covers Denmark and Greenland. Denmark is part of the European Union while Greenland is not.

As Denmark is part of the European Union, of which 15 Member States will meet their reduction commitment jointly in accordance with Article 4 of the Kyoto Protocol, Denmark's quantified emission limitation for the 1st commitment period 2008-2012 under the protocol is 79 percent. The quantified emission limitation for Greenland is 92 percent because Greenland is not part of the European Union. Denmark's assigned amount is calculated based on the Article 4 commitment. Greenland's assigned amount is based on 92 per cent.

As reported in 2006 in the initial report under the Kyoto Protocol, Denmark's and Greenland's base year emissions (excluding LULUCF) were estimated at 69,323.34 Gg CO_2 equivalent and 654.73 Gg CO_2 equivalent, respectively.

On the basis of total base year emissions estimated at 69,978,070 tonnes, the initial review report concluded in 2007 that the the total assigned amount for Denmark and Greenland for the period 2008-2012 is 276,838,955 tonnes CO_2 equivalent. This is shown in table 3.3 together with the calculated minimum holding of 249,155,060 tonnes CO_2 equivalent in the national registry – the so-called commitment period reserve.

Table 3.3 Denmark's and Greenland's base year emissions and assigned amount for 2008-2012 under the Kyoto Protocol

Source: The Kingdom of Denmark's initial report on assigned amount, 2006 and the UNFCCC's report of the review of the initial report of Denmark, 2007.

Tonnes CO_2 equivalents	**Denmark under the EU**	**Greenland**	**Denmark and Greenland**
CO_2 (1990)*	52,712,457	629,996	53,342,453
CH_4 (1990)	5,692,000	16,155	5,708,155
N_2O (1990)*	10,593,311	8,523	10,601,834
HFCs (1995)	217,728	25	217,753
PFCs (1995)	502	0	502
SF_6 (1995)	107,338	36	107,374
Base year	**69,323,336**	**654,734**	**69,978,070**
Annual Assigned Amount in %	79%	92%	DK79%+GR92%
Annual Assigned Amount in tonnes	54,765,435	602,356	55,367,791
Total Assigned Amount 2008-12	**273,827,177**	**3,011,778**	**276,838,955**
a. 90% of AA	246,444,459	2,710,600	249,155,060
Most recently reviewed inventory (2003)*	74,007,808	634,000	74,641,808
b. Times 5 (100%)	370,039,040	3,170,000	373,209,040
*Most recently inventory (2004)**	*68,092,442*	*697,904*	*68,790,345*
c. Times 5 (100%)	*340,462,209*	*3,489,518*	*343,951,727*
CPR (lowest of a and b *or c*)	**246,444,459**	**2,710,600**	**249,155,060**

* without LULUCF

In Table 3.4, the combined greenhouse gas emissions of Denmark and Greenland are shown. The full annual inventory reporting under the Kyoto Protocol will start in 2010 for emissions and removals in 2008, which is the first year of the commitment period.

Table 3.4 Denmark's and Greenland's total emissions and removals of greenhouse gases, 1990 - 2007

Source: The National Environmental Research Institute (NERI).

GREENHOUSE GAS EMISSIONS	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	CO_2 equivalent (Gg)																	
CO_2 emissions including net CO_2 from LULUCF	53 970	62 395	56 726	59 379	62 507	59 438	73 419	63 961	58 916	56 936	55 215	54 502	52 857	57 786	53 689	51 023	57 851	52 750
CO_2 emissions excluding net CO_2 from LULUCF	53 419	64 083	58 275	60 536	64 124	61 108	74 636	65 141	60 870	58 171	53 584	55 271	54 836	60 076	54 514	50 862	58 726	53 877
CH_4 emissions including CH_4 from LULUCF	5 713	5 801	5 828	5 988	5 910	6 005	6 120	6 012	6 037	5 913	5 904	6 037	6 008	5 990	5 800	5 693	5 640	5 763
CH_4 emissions excluding CH_4 from LULUCF	5 713	5 802	5 829	5 989	5 911	6 006	6 120	6 012	6 037	5 914	5 905	6 038	6 009	5 990	5 801	5 694	5 640	5 763
N_2O emissions including N_2O from LULUCF	10 535	10 326	9 893	9 652	9 472	9 366	9 004	8 910	8 822	8 510	8 297	8 025	7 681	7 571	7 305	6 748	6 491	6 789
N_2O emissions excluding N_2O from LULUCF	10 535	10 326	9 893	9 652	9 472	9 366	9 004	8 910	8 822	8 510	8 297	8 025	7 681	7 571	7 305	6 748	6 491	6 789
HFCs	NA,NE,NO	NA,NE,NO	3	94	135	218	329	324	412	504	606	650	676	700	754	800	820	846
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0	1	2	4	9	12	18	22	22	19	16	14	16	15
SF_6	44	64	89	101	122	107	61	73	59	65	59	30	25	31	33	22	36	30
Total (including LULUCF)	**70 262**	**78 586**	**72 540**	**75 215**	**78 145**	**75 135**	**88 935**	**79 285**	**74 255**	**71 941**	**70 100**	**69 267**	**67 269**	**72 098**	**67 598**	**64 301**	**70 854**	**66 193**
Total (excluding LULUCF)	**69 711**	**80 274**	**74 089**	**76 372**	**79 763**	**76 805**	**90 153**	**80 464**	**76 210**	**73 176**	**68 469**	**70 037**	**69 248**	**74 388**	**68 423**	**64 140**	**71 729**	**67 321**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	CO_2 equivalent (Gg)																	
1. Energy	52 083	62 665	56 752	59 113	62 817	59 912	73 416	63 720	59 570	56 883	52 186	53 977	53 578	58 909	53 228	49 611	57 431	52 546
2. Industrial Processes	2 240	2 343	2 379	2 452	2 550	2 724	2 827	3 017	2 994	3 217	3 387	3 288	3 194	3 210	3 017	2 435	2 516	2 533
3. Solvent and Other Product Use	179	174	169	164	159	141	154	139	128	127	127	113	115	104	99	113	130	124
4. Agriculture	13 010	12 890	12 604	12 473	12 127	11 906	11 570	11 398	11 404	10 817	10 582	10 519	10 234	9 962	10 003	9 929	9 586	10 072
5. Land-Use Change and Forestry (LUCF)	551	-1 689	-1 549	-1 158	-1 618	-1 670	-1 218	-1 180	-1 955	-1 235	1 630	-770	-1 979	-2 291	-825	161	-875	-1 128
6. Waste	1 548	1 565	1 564	1 601	1 589	1 563	1 563	1 544	1 508	1 514	1 498	1 498	1 523	1 528	1 412	1 389	1 379	1 366
7. Other	651	637	621	569	520	559	622	645	605	619	691	643	604	675	664	663	686	679
Total (including LULUCF)	**70262**	**78586**	**72540**	**75215**	**78145**	**75135**	**88935**	**79285**	**74255**	**71941**	**70100**	**69267**	**67269**	**72098**	**67598**	**64301**	**70854**	**66193**

3.6 TRENDS IN DANISH GREENHOUSE GAS EMISSIONS FROM THE BASE YEAR UNDER THE KYOTO PROTOCOL

The developments in Danish emissions and removals of greenhouse gases from the base year under the Kyoto Protocol to 2007 (the most recent inventory year), as they are to be inventoried under the Kyoto Protocol, are shown in Table 3.5 together with a preliminary estimate for 2008.

TABLE 3.5 DANISH EMISSIONS AND REMOVALS OF GREENHOUSE GASES INVENTORIED ACCORDING TO REGULATIONS UNDER THE KYOTO PROTOCOL

Source: The UNFCCC's Report of the review of the initial report of Denmark, 2007 (base year), National Environmental Research Institute (1991-2007), Danish Energy Agency (energy statistics for 2008 on which the preliminary estimate for 2008 is based)

	Base year[1]	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Million tonnes of CO_2 equivalents	69,3	79,6	73,5	75,8	79,2	76,2	89,5	79,8	75,6	72,6	67,8	69,4	68,6	73,7	67,8	63,5	71,0	66,6	*64,4*
Index (base year=100)	100	115	106	109	114	110	129	115	109	105	98	100	99	106	98	92	102	96	*93*

[1] 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 relatively great variations in previous total emissions and removals of greenhouse gases are especially due to variations in Denmark's exchange of electricity with neighbouring countries. Furthermore, emissions of CO_2 from energy consumption vary considerably from year to year, depending on winter temperatures.

In order to facilitate the assessment of developments in CO_2 emissions associated with Denmark's own energy consumption in normal winters, the figures are shown in Table 3.6 with corrections made for exchange of electricity and variations in temperature. As it can be seen from this table there has been a 14% drop from the base year to 2007. The preliminary estimate for 2008 suggests almost the same level as in 2007 and 2006.

TABLE 3.6 DENMARK'S GREENHOUSE GAS EMISSIONS AND REMOVALS CORRECTED FOR INTER-ANNUAL VARIATIONS IN TEMPERATURES AND EXCHANGE OF ELECTRICITY

Source: As in Table 3.4 but with the Danish Energy Agency's corrections of CO_2 emissions for degree days and net electricity imports applied.

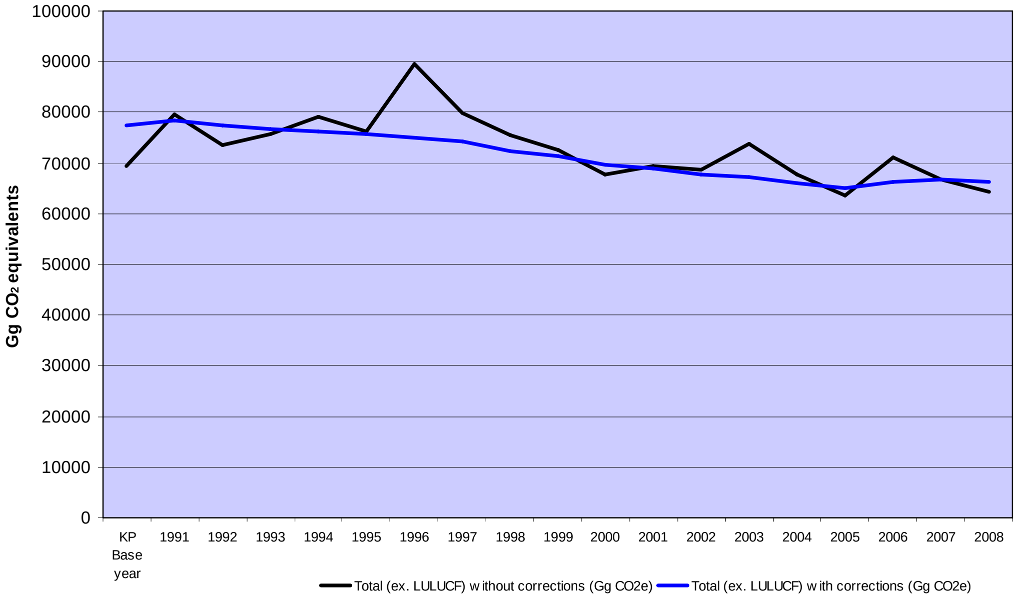
	Base year[1]	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Million tonnes of CO_2 equivalents	77,4	78,4	77,5	76,6	76,1	75,8	75,0	74,3	72,4	71,5	69,6	69,0	67,8	67,2	65,9	65,0	66,2	66,8	*66,2*
Index (base year=100)	100	101	100	99	98	98	97	96	94	92	90	89	88	87	85	84	86	86	*86*

[1] 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. Since Denmark's legal commitments under the Kyoto Protocol is to be seen in relation to figures without corrections, the figures in the table can only be used to illustrate the effects of measures taken to limit CO_2 emissions associated with Denmark's own energy consumption.

The effects of inter-annual variations in temperatures and exchange of elextricity are illustrated in Figure 3.11.

FIGURE 3.11: DENMARK'S GREENHOUSE GAS EMISSIONS AND REMOVALS 1990-2008 WITHOUT AND WITH CORRECTIONS FOR INTER-ANNUAL VARIATIONS IN TEMPERATURES AND EXCHANGE OF ELECTRICITY

Source: The UNFCCC's Report of the review of the initial report of Denmark, 2007 (base year), National Environmental Research Institute (1991-2007), Danish Energy Agency (corrections of CO_2 emissions for degree days and net electricity imports and the preliminary estimate for 2008).



4
Policies and measures

including those in accordance with Article 2 of Kyoto Protocol, and domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures

4 Policies and measures

- including those in accordance with Article 2 of the Kyoto Protocol, and domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures

4.1 Climate policy and the policy-making process

Since the Brundtland Commission's report Our Common Future from 1987, Denmark's climate policy has developed in collaboration with the different sectors of society, the international climate policy, and results from related scientific research.

Thus, since the end of the 1980s a considerable number of measures to reduce the emissions of greenhouse gases have been implemented.

Some of the measures have been implemented with reduction of greenhouse gas emissions as the main objective, others were aimed at achieving environmental improvements for society in general, e.g. by introducing environmental taxes and involving the public in the debate and decisions concerning the environment.

Since 2001, focus has also been on making efforts to reduce emissions and achieve the reduction targets under the Kyoto Protocol and the EU Burden Sharing cost-effectively. This is also the main objectives in government’s Climate Strategy from 2003.

In the follow-up on the Climate Strategy, the Danish government stated in its government platform from November 2007 that Denmark should be a green and sustainable society with a visionary climate and energy policy. This objective means that the government will work towards the realisation of a stable and secure energy supply and promote the reduction of greenhouse gas emissions.

This includes the government's long-term vision for Denmark to be independent of fossil fuels, and the setting of a series of interim targets within Danish energy policy up to the year 2025: The proportion of renewable energy must be doubled by 2025, more efficient uses of energy must be pursued, and publicly-funded research into energy technologies must be doubled.

The efforts in reducing greenhouse gas emissions in other sectors were in 2009 underpinned by new political agreements regarding transport (the Green Transport Vision), agriculture (the Green Growth Plan) and taxes (the Tax Reform). In 2010, Climate Strategy 2020 will address how the mid-term target for 2020 for sectors outside the EU Emissions Trading Scheme (ETS) will be reached. The government's strategy for reaching the long-term vision from the 2007 government platform will follow later in 2010.

Denmark's international climate targets mentioned above are described in Box 4.1.

Denmark climate policy is described in greater detail in the following sections.

Regarding climate policy-making in Denmark, Section 2.1.1 gives a short description of the general, democratic decision-making processes, to which Denmark's climate policy is also subject.

BOX 4.1 INTERNATIONAL CLIMATE TARGETS

Since 1990 Denmark has undertaken or committed itself to several targets with respect to reducing greenhouse gas emissions:

- In accordance with the Climate Convention, to reduce total emissions of greenhouse gases in Denmark, Greenland and the Faroe Islands to the 1990 level by 2000. This target was achieved for total emissions excluding the land-use sector (LULUCF).Due to windfalls total emissions including LULUCF brought the Realm to within 1% of the target.
- As a contribution to stabilisation in the EU, Denmark committed itself to reducing CO_2 emissions in 2000 by 5% compared to the corrected level for 1990. This target was fulfilled.
- In relation to the Kyoto Protocol, for the period 2008-2012 the EU has committed itself to reducing emissions of greenhouse gases on average to 8% below the level in the so-called base year; 1990 for CO_2, methane, and nitrous oxide and either 1990 or 1995 for industrial greenhouse gases. As stated in section 3.5, Denmark has committed itself to a reduction of 21% as an element of the burden-sharing agreement within the EU. In the Council's decision on the EU ratification to the Kyoto Protocol, the commitments of the different Member States are thus given as percentages compared to the base year. In 2006, preliminary emission levels were given in tonnes of CO_2 equivalents for each Member State. The Council (environment) and the Commission have, in a joint statement, agreed e.g. to show consideration for Denmark's remarks to the Council conclusions of 16-17 June 1998 concerning emissions in the base year. This statement is expected to be taken into account in the final decision on the respective emission levels in 2010.
- In relation to the period after 2012, the EU reached an agreement in December 2008 on a Climate and Energy package and on a regulation on CO_2 from new vehicles. According to this package the EU is committed to reducing its overall emissions to at least 20% below 1990 levels by 2020, and is ready to scale up this reduction to as much as 30% under a new global climate change agreement when other developed countries make comparable efforts. Under the Burden Sharing of this EU target, Denmark is committed to a 20% reduction in non-ETS emissions from 2005 to 2020. The EU is also committed to reducing its ETS emissions to 21% below 2005 levels by 2020, but the Burden Sharing on ETS emissions has not yet been decided. The EU has also set itself the target of increasing the share of renewables in energy use to 20% by 2020. Under the Burden Sharing of this EU target, Denmark is committed to reaching a 30% share of renewables in energy use.

4.1.1 National action plans

In 1988 the government of that time issued The Government's Action Plan for Environment and Development. The plan was a follow-up on the Brundtland Report and was based in principle on striving for environmentally sustainable development. One of the main messages in the plan was the need to integrate environmental considerations in decisions and administration within such sectors as transport, agriculture and energy.

In the years since then a number of ministries have prepared sector action plans in which environment is an integral element. The sector action plans thus deal with the entire development in a sector combined with solutions of environmental problems caused by the sector. The sector plans for energy, transport, forestry, agriculture, aquatic environment, waste, and development assistance are important examples.

The plans from the 1990s all contained specific environmental objectives and, usually, deadlines for achieving them. In addition, there were a number of concrete initiatives that are intended to lead to achievement of the objectives. Progress has been evaluated regularly to check whether the implementation of the plans resulted in achievement of the objectives. The results of the evaluations have been presented in political reports from the sector ministries or in special follow-up reports.

The evaluations and follow-up have often given rise to the preparation of new action plans, either because additional initiatives have been necessary in order to achieve the objectives or because the development of society or the development within the area in question has made it necessary to change both objectives and initiatives. Major sector plans that have been of importance for the reduction of greenhouse gas emissions are:

- The NPO Action Plan on pollution from livestock manure (1985)
- Action Plan for the Aquatic Environment I (1987)
- Energy 2000 (1990)
- Action plan for sustainable development in the agricultural sector (1991)
- Strategy for sustainable forest management (1994)
- Strategy 2000 - Danish strategy in the development assistance area (1995)
- Energy 21 (1996)
- Action plan for reduction of the transport sector's CO_2 emissions (1996)
- National sub-strategy for Danish environmental and energy research (1996)
- Action Plan for the Aquatic Environment II (1998)
- Action Plan II - Ecology in Development (1999)
- Waste 21 (1999)
- Action plan for reduction of industrial greenhouse gas emissions (2000)

- Reduction of the transport sector's CO_2 emissions - possibilities, policies and measures (2000)
- Reduction of the transport sector's CO_2 emissions - the government's action plan (2001)
- Denmark's national forest programme (2002)
- Denmark's National Strategy for Sustainable Development (2002)
- National Climate Strategy for Denmark (2003)
- Waste Strategy 2005-2008 (2003)
- Action Plan for the Aquatic Environment III (2004)
- 1st National Allocation Plan 2005-2007 under the EU-ETS (2004)
- Energy Strategy 2025 (2005)
- Action Plan for Strengthened Energy-saving Efforts (2005)
- 2nd National Allocation Plan 2008-2012 under the EU-ETS (2007)
- Political agreement on Energy (2008)
- Political agreement on a Green Tranport Vision for Denmark (2009)
- Political agreement on a Tax Reform (2009)
- Growth with Consideration – the government's strategy for sustainable development (2009)
- Strategy for reducing energy consumption in buildings (2009)
- Political agreement on a Green Growth Plan (2009)

The sector plans deal with different aspects of the climate problem. In the energy and transport sectors the main environmental concern has been the emissions of the greenhouse gas CO_2. The plans in these sectors were therefore to a great extent concerned with reducing CO_2.

The frameworks for the Danish energy sector, however, have changed quite significantly over a short period of time. The goal of Danish energy policy today is to create well-functioning energy markets within frameworks that secure cost-effectiveness, security of supply, environmental concerns and efficient use of energy under conditions of a fully liberalised energy sector, and electricity production from Danish power plants is controlled by market forces and traded freely across national borders.

The introduction of CO_2 quota regulation as a common EU instrument has therefore been of absolute importance to Denmark meeting its climate commitments. From 2005, quota regulation has been the key instrument to ensuring that the Danish energy sector can contribute to the reductions requisite to fulfilling Denmark's climate commitments.

The other sector plans are not primarily focused on reducing greenhouse gas emissions, in part because the sectors are battling with other major environmental problems that efforts have been made to solve through the plans. The main concern in the agricultural sector has been pollution of the aquatic environment. In the waste sector it has been reduction of the volume of waste, and in the industrial sector, reduction of emissions/discharges of harmful substances to the atmosphere/aquatic environment, the use of toxic substances, etc.

However, the implementation of the sector plans has to a great extent also resulted in reduction of greenhouse gas emissions. For example, the reduction in the agricultural sector's nitrogen emissions, which the aquatic environment plans are resulting in, is at the same time reducing the emissions of the greenhouse gas nitrous oxide. The initiatives to reduce waste quantities mean fewer landfill sites and thus less formation and emissions of methane, and the ongoing increase in forested area will mean increased removals of CO_2.

In addition, the energy and transport plans meant that changes were made in the energy and transport areas in all sectors. The initiatives in the energy area have thus resulted in reduced energy consumption despite a significant economic growth and, with that, reduced CO_2 emissions within a wide range of sectors, including the domestic sector and the business sector.

In June 2002 the government’s national strategy for sustainable development in Denmark, A SHARED FUTURE - balanced development, was adopted by the Folketing. The strategy must be seen in part as one of Denmark's responses to the challenge of Agenda 21, which was adopted at the UN General Assembly in Rio in 1992. Counteracting climate change is also an integral part of Denmark's National Strategy for Sustainable Development. The content of this strategy and the government’s 2009 follow-up “Growth with consideration” is described in Section 4.3.10.1.

On the environment policy front, Denmark has participated actively in improving environmental protection in Europe through the EU cooperation and through bilateral environmental assistance to Central and Eastern European countries. On a number of points, the EU's environmental regulation has put Europe ahead of the rest of world environmentally. There are also many examples of EU rules having helped to strengthen environmental protection in Denmark. With the adoption of the Amsterdam Treaty, sustainable development became a main objective for the EU, and integrating environmental considerations in the EU's sector policies became an obligation.

4.1.2 Denmark's Climate Policy

4.1.2.1 The 2003 Climate Strategy

The Folketing approved Denmark's present *Climate Strategy* in March 2003. The strategy lays down a framework for Denmark's future efforts on climate. The point of departure in the strategy is that Denmark is to fulfil its international climate commitments under the Kyoto Protocol and the subsequent Burden Sharing Agreement in the EU, and that effort are to be arranged cost-effectively.

In the 2003 baseline projection for Denmark's greenhouse gas emissions, which was prepared as a basis for the Climate Strategy - that is a projection which only incorporates expected effects of measures implemented prior to 2003 - it was estimated that there would be a deficit of 20-25 mill. tonnes of CO_2 equivalents annually in 2008-2012 compared to Denmark's Kyoto commitment, if no additional measures were implemented[12, 13].

The Kyoto Protocol makes it possible to plan climate action that is more flexible. The Climate Strategy from 2003 combines cost-effective domestic measures with use of the Kyoto Protocol's flexible mechanisms.

Reduction efforts are first and foremost tasks for the private sector, not least for the sectors which are subject to allowance regulation. According to the Climate Strategy, efforts from central authorities could supplement private efforts, and in the initial phase they could contribute by getting the market for CO_2 credits started. Efforts from central authorities are concentrated on the flexible mechanisms of the Kyoto Protocol which implement concrete projects to reduce greenhouse gas emissions in foreign countries. They are JI projects (joint implementation of projects in other industrialised countries) and CDM projects (projects in collaboration with developing countries on the development of cleaner technology).

Since reduction costs for possible new domestic action in the various sectors are continuously developing as a result of technological development and changing economic frameworks among other things, the strategy contemplates assessing efforts on a regular basis with the aim of ensuring that the most cost-effective measures are chosen.

In order to ensure correlation of reduction efforts across sectors and measures, the government has set a benchmark at DKK 120 per tonne of CO_2, which can constitute a basis for the implementation of domestic measures outside the sectors and businesses subject to the EU allowance scheme. The benchmark is an expression of the value of the CO_2 reduction which can be included in the assessment of concrete measures. The value of any other benefits from an initiative can be added, for example other environmental benefits.

4.1.2.2 The 2005 Effort Analysis

In March 2005 a major ex-post analysis of Denmark's efforts in 1990-2001 to reduce emissions of CO_2 and other greenhouse gases, and associated costs was finalised and published in the report "Denmark's CO_2 emissions - the effort in the period 1990-2001 and the associated costs"[14], hereafter *the Effort Analysis*.

Prior to this analysis, quantitative estimates of the effect of separate measures on greenhouse gas emissions were often limited to ex-ante estimates before the measure in question was adopted. In a few cases, the implementation of a measure was followed by an ex-post evaluation. A major reason that only a few ex-post evaluations of individual measures have been carried out is that it is often difficult to clearly attribute an observed greenhouse gas reduction to a particular measure,

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[12] Denmark's Greenhouse Gas Projection until 2012, an update including preliminary projection until 2017, December 2002, Jørgen Fenham, UNEP centre.

[13] Difference between 20 and 25 mill. tonnes of CO_2 equivalents, depending on the outcome the EU's final setting of the individual EU countries' reductions, which is to take place in 2006, including consideration for Denmark's correction to the import of electric power in the base year 1990.

[14] Denmark's CO_2 emissions - the effort in the period 1990-2001 and the associated costs, Report from the Danish EPA, No. 2, April 2005 (Main report http://www.mst.dk/udgiv/publikationer/2005/87-7614-587-5/pdf/87-7614-588-3.pdf and Annex report:http://www.mst.dk/udgiv/publikationer/2005/87-7614-589-1/html).

since many areas (sectors/sources) are affected by several measures at the same time.

In the analysis of the importance of selected, implemented measures for greenhouse gas emissions as a result of efforts in 1990-2001, the effect and cost of a number of measures were estimated - both for the year 2001 and for the period 2008-2012. Thus, the latter case is a so-called without measures projection i.e. without the effects of measures implemented since 1990, which gives estimates of the size of mean annual greenhouse gas emissions in 2008-2012, if the measures until 2001 had not been implemented.

Please note that the statistical base for *the Effort Analysis* has included the emissions inventory submitted to the EU and the UN in 2003 (covering 1990-2001) and the “with measures” baseline projection (2008-2012), i.e. without additional measures, published in February 2003 together with the Government Climate Strategy.

The *Effort Analysis* is described in greater detail in Annex B1.

4.1.2.3 The 2006 Policies and Measures Project

In 2002-2003 analyses on possible new policies and measures with regard to potential and socio-economic reduction costs were carried out prior to the Climate Strategy (see Denmark’s Third National Communication under the UNFCCC).

The results of the calculations illustrated that only relatively few domestic actions with a significant potential which did not exceed the benchmark of DKK 120 per tonne of CO_2 equivalents, would be cost-effective compared to the use of the flexible mechanisms. This must be seen in the light of the fact that Denmark has already made a massive national effort up through the 1990s, while there is a large, unexploited potential in other countries.

Due to this situation, the government’s cost-effective strategy for meeting Denmark’s reductions commitment is based to a certain extent on the use of flexible mechanisms, Emission Trading, and the project mechanisms, Joint Implementation and Clean Development Mechanism. The EU allowance scheme will constitute the framework for most of the reduction efforts. Therefore, the specific combination of efforts will depend on the extent to which the enterprises concerned choose to carry out own reduction measures or to buy allowances from abroad.

In order to up-date and investigate the possibilities of implementing additional domestic measures apart from the allowance-regulated activities, the follow-up on the Climate Strategy has also included implementation of an interdepartmental project, *the Policies and Measures Project*, in which the potential of new domestic measures has been investigated, where previous calculations have indicated relatively low reduction costs. The report from this project published in 2006 shows that only a few additional cost-effective national measures could be found. The results from this project have entered into the work on the Government’s new plans in 2007-2009, both in the National Allocation Plan under the EU ETS, the Energy Agreement, the Green Vision Transport Plan, the Tax Reform and the Green Growth Plan.

4.1.2.4 The 2007 Government platform

As regards climate issues, the new government platform from 2007 is based on the Government Climate Strategy. The 2007 government platform contains the following elements with climate-policy aspects:

<u>1) A visionary Danish climate and energy policy</u>

-with concrete initiatives such as:

More renewable energy
New integrated legislative package on renewable energy
Secure energy supply
More efficient utilisation of energy
Low-energy housing
Cost-effective development of renewable energy sources
More wind energy
More biomass and waste, and fewer fossil fuels in the central power plants
Rationalisation of the energy tax system
Transformation of the transport sector
Climate Research Centre
New and more efficient energy technologies

<u>2) An ambitious global climate strategy</u>

-with concrete initiatives such as:

UN Climate Change Conference in Copenhagen in 2009
Active climate diplomacy
Inclusion of civil society, the research community and the business community
Second generation of climate policy instruments – Climate Commission
Assistance to climate adaptation efforts in developing countries

4.1.2.5 The 2008 follow-up with agreement on Danish energy policy 2008-2011

As a follow-up on the 2003 Climate Strategy and the elements in the new government platform mentioned above, the government reached a political agreement on 21 February 2008 on Danish energy policy for the years 2008-2011.

The elements in the 2007 government platform and the 2008 follow-up are described in greater detail below.

A visionary Danish climate and energy policy
The Government's long-term target is for Denmark to be independent of fossil fuels. This vision was first formulated in a government energy strategy paper from 2007.

In the new energy policy agreement from 2008 the Government presented ambitious interim targets for Danish energy policy up to 2020:

- The Government will double the share of renewable energy, so that it reaches a minimum of 30 per cent of total energy consumption by 2020.
- The Government will ensure an even more efficient utilisation of energy, so that Denmark reduces gross energy consumption by 4% by 2020 relative to 2006.

- The Government will double the public funding for research into energy technologies, so that it reaches DKK 1 billion per year by 2010.

The targets mean that Denmark will become less dependent on fossil fuels up to 2020, and reduce the present level of energy consumption without stifling economic growth.

Concrete initiatives:

More renewable energy
The Government's objective is to double the share of renewable energy, so that it accounts for at least 30 per cent of energy consumption by 2020. As the first benchmark, the share of renewable energy is to be increased to 20 per cent by 2011.

New integrated legislative package on renewable energy
The Government wishes to bring together and focus the efforts to promote more renewable energy. To that end the parliament has adopted a bill on renewable energy with a view to coordinating the efforts and establishing the framework for developing and expanding renewable energy sources.

More biomass and waste and less fossil fuel in central heat and power generation
The allocation to the central power plants' biomass-based electricity production is increased from 0.10 to 0.15 DKK/kWh.

Wind turbines on land
The subsidy for new wind turbines is raised to 0.25 DKK/kWh for 22,000 peak load hours + 0.023 DKK/kWh in balancing costs + 0.004 DKK/kWh to a green fund.

Offshore wind turbines
Invitations to tender for two 200 MW offshore wind farms to come into operation in 2012.

Bio gas
All new and existing bio gas plants shall be subject to a fixed electricity price of 0.745 DKK per kWh or a fixed-price premium of 0.405 DKK per kWh when bio gas is used along with natural gas. The fixed electricity price and price premium shall be adjusted by 60% of the increases in the net price index.

Heat pumps for replacing individual oil burners:
A pool of 30 million DKK over two years for information campaigns, labelling of efficient pumps, limited subsidy schemes, etc. aimed at heat consumers outside of the areas with collective heat supply. This shall be implemented immediately.

Small renewable energy technologies:
25 million DKK per year for four years shall be allocated to small renewable energy technologies such as solar cells and wave power. The funding financed by PSO can, for example be used for the development of solutions integrated into construction and tender invitations for wave power, , and be implemented by the parties after further agreement.

Secure energy supply
Modern societies are heavily dependent on stable energy supplies. As part of a visionary climate and energy policy, the Government will draw up a strategy for ensuring security of energy supply in 2010.

More efficient utilisation of energy
The Government will ensure an even more efficient utilisation of energy, so that total annual energy savings are raised to 1.5% of the final energy consumption for 2006 (10.3 PJ per year), which corresponds to the combined energy consumption of about 110,000 homes.

Low-energy housing
It is the Government's aim that new buildings in 2020 should use 75 per cent less energy than today. The Government will present a strategy containing specific proposals for reducing energy consumption in new buildings, in renovated buildings and in public buildings. This could involve, for example, the introduction of new low-energy classes in the building regulations, requirements to energy saving equipment in new buildings as well as measures ensuring that public buildings become more energy efficient. The Government will also strengthen the gathering and dissemination of knowledge about energy savings by establishing a knowledge centre on energy savings. The centre will be integrated into existing knowledge and research environments.

Rationalisation of the energy tax system
The Government will rationalise energy taxes in a way that contributes to a cost-effective fulfilment of the Government's objective for renewable energy and Denmark's climate obligations. The incentive to reduce the consumption of fossil fuels and thus reduce the emission of greenhouse gases must be the same, regardless of whether the use of fossil fuels takes place inside or outside the emissions trading scheme.

Transformation of the transport sector
The Government will work to improve the efficiency of the transport sector's energy consumption and ensure that the sector in the long term makes a transition to other and more future-sustainable fuels. The aim is for the share of renewable energy sources in the transport sector to increase to 10 per cent by 2020. As a first step, a regulation will be passed requiring oil companies to ensure that 5.75 per cent of their total fuel sales stems from EU-certified bio-fuel by 2011. The Government will also exempt hydrogen-powered cars from taxes. Furthermore, the Government will extend the current tax exemption for electric cars to 2012.

Climate Research Centre
The Government wishes to strengthen research activities and the dissemination of knowledge in the climate field, also with regard to climate change adaptation. The Government will therefore set up a cross-disciplinary climate research centre. The centre will be integrated into one of the new, large universities and is to operate in close collaboration with existing research and knowledge environments in the area.

New and more efficient energy technologies
The transition to a society with significantly less consumption of fossil fuels requires development of new energy technologies. The Government will strengthen research, development and demonstration of new energy technologies by doubling public funding for these activities by 2010 to an amount reaching DKK 1 billion per year.

Second generation of climate policy instruments – Climate Commission
In connection with the Government's policy document, "A Visionary Danish Energy Policy up to 2025", the Government has appointed a broadly composed national climate commission, whose task is to present proposals for how the Government's long-term vision to make Denmark independent of fossil fuels can be realised in practice. The climate commission has been charged with the development of pro-active energy and climate policy instruments that have a global, marketing perspective. The goal will also be to establish a solid basis for implementing a long-term climate policy that can further reduce greenhouse gas emissions whilst making it possible for economic growth and prosperity to be maintained.

Assistance to climate adaptation efforts in developing countries
Within an increased development assistance framework, the Government has strengthened climate change efforts in developing countries. This is to be achieved by establishing a climate change fund that is to build up gradually from DKK 100 million in 2008 to DKK 500 million in 2012. The effort has been and will continue to be designed to help especially the world's poorest countries in the fight to adjust to and limit the man-made climate change.

4.1.2.6 The 2009 progress and follow-up on implementation of new measures

The EU directive on a common allowance scheme (the EU ETS) constitutes the framework for efforts from 1 January 2005 for a large proportion of the energy producers and some of the energy-intensive industry. The businesses subject to the allowance scheme 2008-2012 are in the process of implementing their own climate efforts. They can choose to reduce their own emissions when this is most appropriate, or they can buy allowances or credits from project-based emission reductions when this is considered most appropriate. This ensures that businesses concerned can adapt their efforts to market conditions on a regular basis. Denmark's implementation of the EU allowance directive and the second National Allocation Plan for 2008-2012 is dealt with in greater detail in Sections 4.3.1 and 4.3.4.1.1.

As mentioned, using the flexible mechanisms under the Kyoto Protocol is also part of a cost-effective Danish Climate Strategy. Progress with respect to allocation of funds and specific JI and CDM projects is reported in section 4.3.2.

Section 4.3.3 reports in greater detail on progress regarding taxes of importance to Denmark's greenhouse gas emissions. The government tax freeze eliminates tax increases, but from 2010 re-allocations will be one of the consequences of the political agreement on a General Tax Reform reached on 1 March 2009.

Within the energy sector, the political agreement reached on 21 February 2008 will enhance further energy saving and improve energy efficiency. Progress with regard to the future energy-saving efforts and the implementation of the energy agreement is reported in section 4.3.4.

In the Green Transport Vision from December 2008, further possibilities in the transport sector have been analysed, cf. section 4.3.5. In most cases, however, new measures in the transport sector demand a common effort within the EU to become sufficiently effective. On 29 January 2009 a political agreement on the Green Transport Vision was reached.

With respect to business and industry, focus will be on CO_2 reduction by way of allowance regulations as incentives enhancing energy saving and reduction in CO_2-process emissions. Since the latter is primarily associated with the production of cement and tiles, technology offers limited reduction possibilities at present. Technologically, the prospects for reducing emissions of nitrous oxide associated with the production of nitric acid in the fertilizer industry are good. As shown in section 4.3.6, this is, however, no longer an issue, since Denmark ceased to produce nitric acid in 2004. Section 4.3.6 also described Denmark's important contribution to reducing the use and emission of fluorine-containing greenhouse gases.

Certain possibilities also exist for reducing greenhouse gas emissions in the agricultural sector. The potential and possibilities of implementing cost-effective measures in this sector were analysed more closely in connection with the preparation of the Action Plan for the Aquatic Environment III, which was adopted in 2004. The plan itself only resulted in minor reductions in greenhouse gas emissions, cf. section 4.3.7. Therefore, in continuation hereof, additional concrete measures have been studied. The results of these studies are also part of the Government’s proposal for a Green Growth Plan and the political agreement reached on 16 June 2009.

Apart from the measures in the forestry sector concerning afforestation which have already been implemented and can be referred to article 3.3 of the Kyoto Protocol, also the Government’s election of activities under article 3.4 of the Protocol will make use of the cost-effective reduction potentials in connection with forests and land (forest management, cropland management, and grassland management). However, new projection estimates suggest that only cropland management and grassland management will have reduction potentials in the near future cf. Sections 4.3.7, 5.1.6 and 5.2.7.

Concerning the waste sector, it has been investigated whether there are cost-effective potentials connected to further expansion of extraction and utilisation of energy from methane from landfills, cf. section 4.3.9.

Annex B2 contains a collection of data sheets with further information on existing measures and measures no longer in place.

4.1.2.7 The government’s 2009 Climate Strategy updates for the 2008-2012

Although many important initiatives have already been implemented in order to achieve the 2008-2012 reduction target under the Kyoto Protocol and the EU Burden Sharing Agreement, new knowledge included in a preliminary update of

Denmark's energy and CO_2 emission projection (April 2009) suggested that additional initiatives had to be taken to ensure, that Denmark can live up to its very ambitious target in the sectors not covered by the ETS.

The Government in November and December 2009 therefore adopted the following additional initiatives:

- Allocation of DKK 400 mill. to support the substitution of individual oil based furnaces for modern, low-emitting heating solutions, including systems based on renewable energy such as heat pumps and solar heating

- The cancellation of reserved emission rights, which are not allocated due to closures and fewer new entrants, for fulfilling the national reduction target.

- Allocation of DKK 225 mill. in the budget for 2010 for the development of sustainable JI and CDM projects and the purchase of CO_2 credits.

The initiatives reduce emissions by 1 mill. tonnes CO_2 per year and are sufficient to ensure that Denmark fulfils its national target.

4.2 Legislative arrangements and enforcement and administrative procedures

The legal basis for the division of powers into the legislative, executive, and judicial power is the Danish Constitution, *Danmarks Riges Grundlov*[15].

The Constitution includes the legal basis for how the Regent acts on behalf of the Realm in international affairs, and he cannot act without the consent of the Folketing in any way that increases or restricts the area of the Realm, or enter into obligations requiring cooperation of the Folketing or which in some other way are of great significance to the Realm. Neither can the Regent, without the consent of the Folketing, cancel an international agreement entered into with the consent of the Folketing.

On the motion of the government, the Folketing thus gave its consent in 2002, allowing Her Majesty Queen Margrethe the Second, on behalf of the Realm and with territorial reservations for the Faroe Islands, to ratify the Kyoto Protocol. This was on 31 May 2002.

Denmark's implementation of the Kyoto Protocol is on-going and is being effectuated by following up on the national Climate Strategy, sector-policy strategies with climate considerations, and concrete initiatives, which will contribute to limiting or reducing greenhouse gas emissions, and implementation of the other parts of the Kyoto Protocol. The legislation necessary to do this has been adopted in pursuance of the Constitution regulations concerning legislative powers.

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[15] The Danish Constitution (Danmarks Riges Grundlov) (http://www.retsinfo.dk/_GETDOCI_/ACCN/A19530016930-REGL /: http://www.folketinget.dk/pdf/constitution.pdf)

Pursuant to the Constitution, the Regent is the ultimate authority, cf. paragraphs 12-14:

“**12.** Subject to the limitations laid down in this Constitutional Act, the King shall have supreme authority in all the affairs of the Realm, and shall exercise such supreme authority through the Ministers.

13. The King shall not be answerable for his actions; his person shall be sacrosanct. The Ministers shall be responsible for the conduct of government; their responsibility shall be defined by statute.

14. The King shall appoint and dismiss the Prime Minister and the other Ministers. He shall decide upon the number of Ministers and upon the distribution of the duties of government among them.The signature of the King to resolutions relating to legislation and government shall make such resolutions valid, provided that the signature of the King is accompanied by the signature or signatures of one or more Ministers. A Minister who has signed a resolution shall be responsible for the resolution.”

With this background, the Regent delegates responsibility for various functions to government ministers through Royal resolutions. This makes the various ministers for different areas responsible for, e.g. making proposals for new/amended legislation made necessary by the Kyoto Protocol, enforcement of legislation and initiation of necessary administrative procedures.

The total set of regulations can be accessed via Retsinformation[16] (online legal information system). Annex B2 contains, as far as possible, reference to the specific legal basis for each of the concrete measures dealt with in this Chapter. Legislation concerning measures of importance to Denmark's commitments under the Kyoto Protocol will be enforced pursuant to the current legal basis, including pursuant to any penalty clause. Enforcement could also involve the judicial power.

As regards the institutional arrangements for the implementation the Kyoto Protocol concerning activities in connection with participation in the mechanisms under articles 6, 12, and 17 of the Kyoto Protocol, these tasks have been delegated to the Danish Energy Agency (DEA) under the Ministry of Climate and Energy. DEA is also responsible for legislation and administration of the EU trading scheme as well as the national registry. The supplementary regulations regarding the approval and use of JI/CDM credits and the registry are now regulated in Statutory Order No. 118 dated February 28, 2008.

Among the national legislative arrangements and administrative procedures that seek to ensure that the implementation of activities under Article 3, paragraph 3, and the elected activities under Article 3, paragraph 4, also contributes to the conservation of biodiversity and sustainable use of natural resources is The Forest Act No. 945 of 24 September 2009, entering into force on 1 October 2009, and the implementation thereof by the Danish Forest and Nature Agency under the Danish Ministry of the Environment. Preservation of areas designated as forest reserve

[16] http://www.retsinfo.dk/

land and protection of natural habitats and habitats for species are among the foremost objectives of the The Forest Act.

Furthermore, activities under Article 3, paragraph 3, and the elected activities under Article 3, paragraph 4 have to be implemented in accordance with Natura 2000, which is the Sites of Community Importance (SCI) designated according to the European Union's Habitats Directive and the Special Protection Areas (SPA) designated according to the European Union's Birds Directive. The Danish Ramsar Sites are all parts of the Special Protection Areas.

The Danish Agency for Spatial and Environmental Planning under the Danish Ministry of the Environment is responsible for the implementation of the Habitats Directive and the Birds Directive. The implementation includes the designation of 254 Sites of Community Importance, 113 Special Protection Areas and 27 Ramsar Sites. The rules for the administration of the Danish Natura 2000 is set up in the Executive Order No. 477 of 7 June 2003 on the Demarcation and Administration Of International Protection Areas, as amended by the Executive Order No. 902 of 25 August 2004 into force on 14 September 2004, the Executive Order No. 1076 of 9 November 2004 into force on 24 November 2004 and the Executive Order No. 905 of 26 August 2006 into force on 9 September 2006.

4.3 Policies and measures and their effects

In this Section the individual measures relevant to Denmark's climate policy are described.

Sections 4.3.1-4.3.3 include descriptions of the cross-sectoral policies and measures Allowance regulation, the Kyoto Protocol Mechanisms and Taxes and duties followed by Section 4.3.4-4.3.9 containing descriptions of policies and measures in the following six economic sectors in Denmark: Energy, Transport, Business, Agriculture including forestry and fisheries, the Domestic sector and the Waste and sewage sector.

Table 4.1 shows how the allocation, which is to be used in connection with the annual emission inventories (the CRF/IPCC format), is aggregated into the 6 economic sectors.

Table 4.2 and Figure 4.1 show the main result of this aggregation for 1990/95[17], 2007, 2008-12, and 2015, as well as 2020 and 2025 without emissions and removals in connection with land use, land-use change and forestry (LULUCF)[18].

In accordance with the reporting guidelines the following sector sections are subdivided by gases and, as appropriate, a further subdivision of the description of measures into measures implemented, new and additional measures and measures no longer in place.

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[17] Under the Kyoto Protocol, Denmark's base year is 1990 for CO_2, methane and nitrous oxide, and 1995 for the industrial gases (HFCs, PFCs, and SF_6) cf. Article 3.8 of the Protocol from the inventory reported in 2006, and reviewed and approved in 2007.

[18] Under the Kyoto Protocol, the LULUCF category is dealt with separately under Articles 3.3 and 3.4.

Annex B2 contains a collection of data sheets with further information on existing measures and measures no longer in place.

TABLE 4.1 AGGREGATION OF SOURCES/SECTORS IN THE CRF/IPCC FORMAT INTO THE SIX MAIN ECONOMIC SECTORS IN DENMARK

Economic sector		**Sources/Sectors in the CRF/IPCC format**	
Energy	Includes extraction, conversion, and distribution.	1A1 1B	Fuel combustion activities. Fugitive emissions from fuels.
Transport	Military included.	1A3 1A5	Transport (fuel combustion) Others (fuel combustion in military transport).
Agriculture and forestry	Fisheries included.	1A4c 4 5	Fuel combustion in agriculture, forestry, and fisheries. Agriculture Land-use Changes and Forestry (LUCF).
Business	Includes production, building and construction, service and trade, as well as industrial gases and the use of organic solvents.	1A2 1A4a 2 3	Fuel combustion in production and building/construction. Fuel combustion in commerce and service. Industrial processes Use of organic solvents.
Domestic sector		1A4b	Fuel combustion in households.
Waste	Includes landfills and sewage treatment. Incineration of waste for energy recovery is included in the energy sector, cf. IPCC.	6	Waste

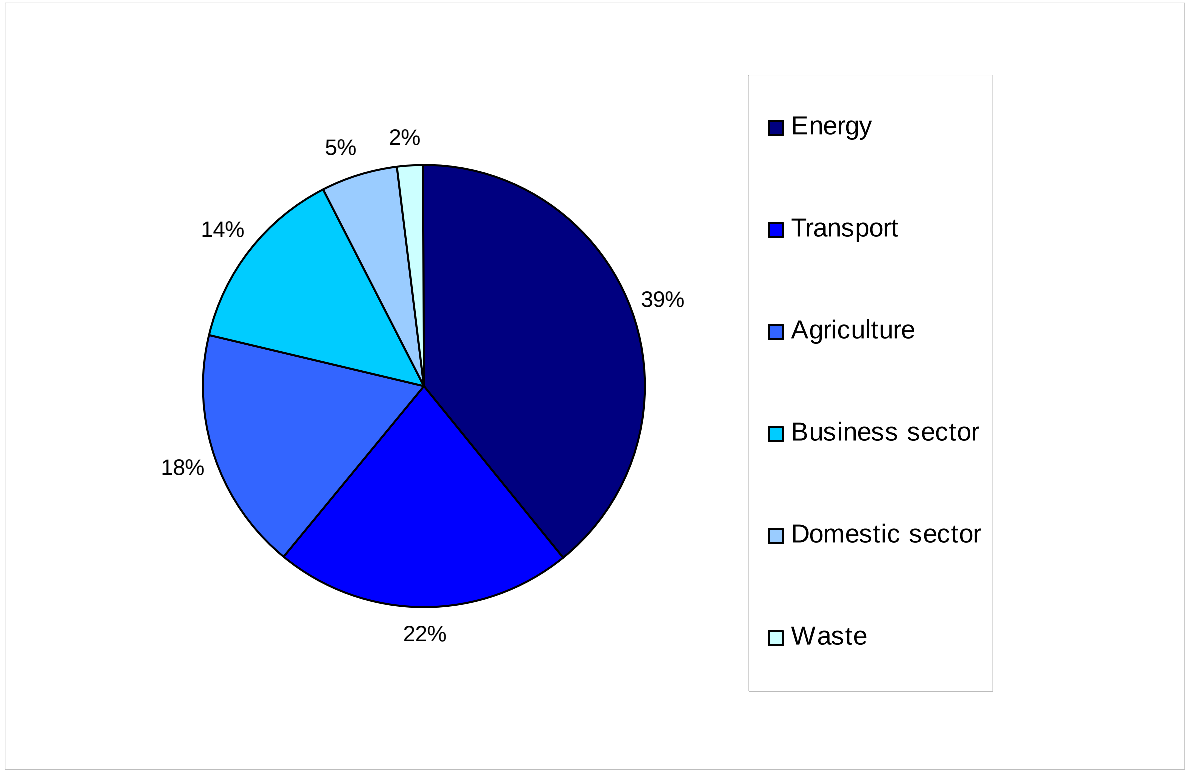
TABLE 4.2 DENMARK'S GREENHOUSE GAS EMISSIONS IN 1990/95, 2007 AND THE FEBRUARY 2009 "WITH MEASURES" PROJECTIONS UNTIL 2025 BY ECONOMIC SECTOR AND BY GAS[1]

Source: The National Environmental Research Institute (NERI) and the Ministry of Climate and Energy

	1990/95 Mt CO2 equiv. (Reported in 2006)	1990/95 %	2007 Mt CO2 equiv.	2007 %	Development in the period 1990/95 to 2007	2008-2012 Mt CO2 equiv.	2008-2012 %	Development in the period 1990/95 to 2008-2012	2015 Mt CO2 equiv.	2015 %	Development in the period 1990/95 to 2015	2020 Mt CO2 equiv.	2020 %	Development in the period 1990/95 to 2020	2025 Mt CO2 equiv.	2025 %
Energy	**26,6**	**38,4**	**26,0**	**39,0**	**-2%**	**25,9**	**39,0**	**-3%**	**21,7**	**35,8**	**-19%**	**17,7**	**32,1**	**-33%**	**16,8**	**30,7**
CO2	*26,4*	*38,2*	*25,5*	*38,3*	*-4%*	*25,4*	*38,3*	*-4%*	*21,2*	*35,1*	*-20%*	*17,3*	*31,4*	*-35%*	*16,4*	*30,0*
Methane	*0,1*	*0,1*	*0,3*	*0,5*	*410%*	*0,3*	*0,5*	*400%*	*0,3*	*0,5*	*352%*	*0,3*	*0,5*	*329%*	*0,2*	*0,5*
Nitrous oxide	*0,1*	*0,2*	*0,2*	*0,2*	*25%*	*0,2*	*0,2*	*32%*	*0,1*	*0,2*	*23%*	*0,1*	*0,3*	*19%*	*0,1*	*0,3*
Transport	**10,6**	**15,3**	**14,3**	**21,5**	**35%**	**13,9**	**21,0**	**31%**	**14,1**	**23,2**	**32%**	**14,2**	**25,7**	**34%**	**15,0**	**27,4**
CO2	*10,5*	*15,1*	*14,2*	*21,2*	*35%*	*13,7*	*20,7*	*31%*	*13,9*	*23,0*	*33%*	*14,0*	*25,5*	*34%*	*14,9*	*27,2*
Methane	*0,1*	*0,1*	*0,0*	*0,0*	*-54%*	*0,0*	*0,0*	*-62%*	*0,0*	*0,0*	*-74%*	*0,0*	*0,0*	*-81%*	*0,0*	*0,0*
Nitrous oxide	*0,1*	*0,2*	*0,1*	*0,2*	*20%*	*0,1*	*0,2*	*25%*	*0,1*	*0,2*	*18%*	*0,1*	*0,2*	*16%*	*0,1*	*0,3*
Agriculture	**15,7**	**22,7**	**12,1**	**18,2**	**-23%**	**12,2**	**18,5**	**-22%**	**12,0**	**19,9**	**-24%**	**11,8**	**21,3**	**-25%**	**11,8**	**21,6**
CO2	*2,7*	*3,9*	*2,0*	*3,0*	*-26%*	*2,3*	*3,5*	*-14%*	*2,3*	*3,8*	*-13%*	*2,3*	*4,2*	*-13%*	*2,4*	*4,3*
Methane	*4,0*	*5,8*	*3,9*	*5,8*	*-4%*	*3,8*	*5,7*	*-6%*	*3,8*	*6,3*	*-6%*	*3,8*	*6,8*	*-6%*	*3,8*	*6,9*
Nitrous oxide	*9,0*	*13,0*	*6,3*	*9,4*	*-31%*	*6,1*	*9,3*	*-32%*	*5,9*	*9,8*	*-35%*	*5,7*	*10,3*	*-37%*	*5,7*	*10,4*
Business sector	**9,5**	**13,7**	**9,2**	**13,9**	**-3%**	**9,4**	**14,1**	**-2%**	**8,7**	**14,3**	**-9%**	**8,0**	**14,5**	**-16%**	**8,0**	**14,6**
CO2	*8,1*	*11,6*	*8,2*	*12,3*	*2%*	*8,3*	*12,6*	*3%*	*7,9*	*13,0*	*-2%*	*7,6*	*13,8*	*-6%*	*7,6*	*13,9*
Methane	*0,0*	*0,0*	*0,0*	*0,1*	*97%*	*0,1*	*0,1*	*181%*	*0,0*	*0,1*	*166%*	*0,0*	*0,1*	*155%*	*0,0*	*0,1*
Nitrous oxide	*1,1*	*1,6*	*0,1*	*0,2*	*-91%*	*0,1*	*0,2*	*-90%*	*0,1*	*0,2*	*-91%*	*0,1*	*0,2*	*-91%*	*0,1*	*0,2*
Industrial gases	*0,3*	*0,5*	*0,9*	*1,3*	*172%*	*0,9*	*1,3*	*163%*	*0,6*	*1,0*	*90%*	*0,2*	*0,4*	*-33%*	*0,2*	*0,4*
Domestic sector	**5,2**	**7,5**	**3,6**	**5,4**	**-30%**	**3,5**	**5,2**	**-33%**	**2,7**	**4,5**	**-48%**	**2,1**	**3,9**	**-59%**	**1,7**	**3,2**
CO2	*5,1*	*7,3*	*3,4*	*5,1*	*-34%*	*3,2*	*4,9*	*-36%*	*2,5*	*4,1*	*-51%*	*1,9*	*3,4*	*-63%*	*1,5*	*2,7*
Methane	*0,1*	*0,1*	*0,2*	*0,3*	*177%*	*0,2*	*0,3*	*154%*	*0,2*	*0,3*	*162%*	*0,2*	*0,3*	*167%*	*0,2*	*0,3*
Nitrous oxide	*0,1*	*0,1*	*0,1*	*0,1*	*26%*	*0,1*	*0,1*	*11%*	*0,1*	*0,1*	*6%*	*0,1*	*0,1*	*1%*	*0,1*	*0,1*
Waste	**1,5**	**2,2**	**1,4**	**2,1**	**-12%**	**1,4**	**2,1**	**-10%**	**1,4**	**2,3**	**-11%**	**1,4**	**2,5**	**-11%**	**1,4**	**2,5**
Methane	*1,5*	*2,1*	*1,3*	*2,0*	*-10%*	*1,3*	*2,0*	*-8%*	*1,3*	*2,2*	*-9%*	*1,3*	*2,4*	*-9%*	*1,3*	*2,4*
Nitrous oxide	*0,1*	*0,1*	*0,0*	*0,1*	*-46%*	*0,1*	*0,1*	*-42%*	*0,1*	*0,1*	*-41%*	*0,1*	*0,1*	*-41%*	*0,1*	*0,1*
Total	**69,3**	**100**	**66,6**	**100**	**-4%**	**66,2**	**100**	**-4%**	**60,5**	**100**	**-13%**	**55,2**	**100**	**-20%**	**54,7**	**100**
CO2	*52,7*	*76*	*53,2*	*80*	*1%*	*53,0*	*80,0*	*1%*	*47,8*	*79,0*	*-9%*	*43,2*	*78,3*	*-18%*	*42,7*	*78,1*
Methane	*5,7*	*8*	*5,7*	*9*	*1%*	*5,7*	*8,6*	*0%*	*5,7*	*9,4*	*-1%*	*5,6*	*10,2*	*-2%*	*5,6*	*10,2*
Nitrous oxide	*10,5*	*15*	*6,8*	*10*	*-36%*	*6,7*	*10,1*	*-37%*	*6,4*	*10,6*	*-39%*	*6,1*	*11,1*	*-42%*	*6,2*	*11,3*
Industrial gases	*0,3*	*0*	*0,9*	*1*	*172%*	*0,9*	*1,3*	*163%*	*0,6*	*1,0*	*90%*	*0,2*	*0,4*	*-33%*	*0,2*	*0,4*

[1] Trends in GHG emissions by gas and by sector can also be seen in Figure 5.1 in Chapter 5.

FIGURE 4.1 DENMARK'S GRENHOUSE GAS EMISSIONS IN 2007 BY SECTOR.
Source: The National Environmental Research Institute (NERI) and the Ministry of Climate and Energy



4.3.1 Allowance regulation

Directive 2003/87/EC on trading in CO_2 allowances (the EU ETS Directive) in 2005 introduced a greenhouse gas emissions allowance trading scheme in the EU. The objective of the allowance scheme is to reduce emissions of greenhouse gases so that the EU and its Member States can meet their reductions commitments under the Kyoto Protocol and the EU Burden-Sharing Agreement.

According to the EU ETS Directive, each Member State had to prepare a national allocation plan before trading period 2008-12.

The European Commission approved the Danish National Allocation Plan (NAP2) in 2007. The NAP contains a detailed plan for the reduction efforts and ensures that Denmark reaches its goal for the Kyoto Period. In the NAP, the gap between the emission target and emission under business as usual amounted to 13 million tonnes pr. year. Of this gap, 5.2 million tonnes are covered by efforts in the emission trading sector, while the remaining 7.8 million tonnes are covered by efforts in the non-emission trading sector using various instruments, including the use of CDM-credits, sinks and additional domestic efforts. The NAP also ensures that Denmark honours the supplementarity principle.

Via the national allocation plan, the present allowance regulation in Denmark includes individual emission limits 2008-2012 for CO_2 emissions from several sectors, which together produce approx. half of Denmark's total greenhouse gas emissions. Denmark has allocated a total of 125 million CO_2 emission allowances during the five years of the scheme. Of these, 2.5 million allocated to new production units and major expansions. The rest are allocated free of charge to those production units covered by the trading scheme in 2007.

In the following, only the principles and general figures for Denmark's implementation of the EU ETS directive via the national allocation plan (NAP2) will be described.

From the 1st of January 2008 the first Kyoto Commitment Period (CP1) commenced. In practice the EU ETS has not changed for the Danish operators under the EU ETS. Even after the Community Independent Transaction Log and the registries under the EU ETS connected to the International Transaction Log under the UN the 28th of October 2008, as the registry already was ready to work in the international emissions trading system.

Relevant key figures in the proposed national allocation plan for Denmark for the period 2008 – 2012 are shown in Table 4.3.

TABLE 4.3: KEY FIGURES IN THE PROPOSAL FOR DENMARK'S NATIONAL ALLOCATION PLAN 2008-12 FROM 2007

	2003 emissions	Projected emissions 2008-12	Quota allocation 2008-12	Quota allocation 2005-07
	Million tonnes CO_2 equivalents per year			
Sectors subject to allowances, in total	**36.6**	**29.7**	**24.5**	**33.5**
- electricity & heat production	28.1	20.5	15.8	21.7
- other sectors subject to allowances, incl. offshore industries-	8.5	9.2	8.2	7.1
- auction			0	1.7
- new installations			0.5	1
Sectors not subject to allowances	*37.8*[1]	*38.1*		
Total	**74.4**	**67.8**		

[1] On the basis of the European Commission's broad definition of enterprises covered.

Denmark is committed to reducing its national greenhouse gas emissions by 21 per cent in 2008-12, compared to 1990/1995 level. This means that emissions must be reduced to an average 54.8 million tonnes of CO_2 equivalents annually for the period.

In NAP2, the deficit between expected Danish emissions of CO_2 and the target Denmark is committed to achieving was expected to be 13 million tonnes for the period 2008-12 if no further initiatives were implemented. The allocation plan documents how this deficit will be reduced to zero. As stated in NAP2, Denmark will meet its commitment through a combination of domestic and foreign environmental and energy measures by the government and by Danish enterprises with CO_2 emissions.

Denmark has had an active, environmentally oriented energy policy since the 1970s, and since 1990 this has been supplemented by a climate policy as such, which, on an international scale, has entailed a major strain - economically and/or via administrative regulations - on most of the greenhouse gas emissions, especially from businesses and sectors not subject to allowances.

Denmark's national allowance registry

Denmark's national allowance registry – (DK ETR – Emission Trading Registry[19]) has been operating since the 1 January 2005. The DK ETR is used to allocate allowances to production facilities subject to allowances and enables trade in allowances among the allowance holders found in the registry The DK ETR is constructed so it also fulfils all Kyoto requirements.

The DK ETR has also been prepared to contribute to Denmark's implementation of the Kyoto Protocol in such a way that Denmark's EU allowance registry is now also functioning as the national registry under the Kyoto Protocol. The establishment of a functioning DK ETR pursuant to the Kyoto Protocol is a

[19] https://www.kvoteregister.dk

prerequisite for the application of the Kyoto mechanisms. Section 3.4 contains a more detailed description of the national registry.

4.3.2 The Kyoto Protocol mechanisms

The starting point in the Government Climate Strategy is that efforts aimed at fulfilling the international climate commitment under the Kyoto Protocol and the subsequent EU Burden Sharing Agreement are organised cost-effectively.

The flexible Kyoto Protocol mechanisms are, therefore, important elements of the Government Climate Strategy, supplementing domestic reduction measures. The purchasing of CO_2 credits is primarily a task for the private businesses under the regulations of the EU allowance directive. By involvement in project development, the government has contributed to "start up" the market for CO_2 credits earlier than would otherwise have been the case. The buying of credits will also contribute to the fulfilment of Denmark's international climate commitment, just as the climate projects will entail a number of additional environmental benefits such as reduced pollution of air and water.

On this basis the government has allocated approximately DKK 1.7 billion for the development of JI and CDM projects and purchase of credits in 2003-2009. The allocated funds should correspond to 3.7 million tonnes of CO_2 annually from 2008-2012. The implementation of specific JI and CDM projects is described in more detail in the following. In accordance with the reporting guidelines and the Annotated Outline, information on how the use of the Kyoto Protocol mechanisms is supplemental to domestic action is included in section 5.3.

JI projects

In order to have a well-functioning market for CO_2 credits, it is important that the host countries have the necessary institutions and procedures for approval of climate projects in place. This is best ensured if the Danish state as purchaser of CO_2, becomes directly involved in the development of specific climate projects. The involvement of the Danish state to secure a well-functioning market is especially important in the present financial crisis, where good projects lack funding to be implemented.

By building on experience and network contacts gained from the well-established environmental assistance programme, the Danish state can further strengthen the market to help get the necessary approvals in place.

On this basis, Denmark has selected a number of promising climate projects in collaboration with countries in Eastern Europe. Contracts for the acquisition of approx. 10.2 mill. tonnes CO_2 credits from twenty one projects have been entered into. The assessment is that the contracts entered into, and negotiations about other projects, have been directly influential in enabling national authorities to build administrative capacity to manage JI projects.

The projects display good environmental and social profiles. Thus, it shows how climate projects benefit the country buying the CO_2 reductions as well as the host country. Annex C contains further information on three examples of the Danish JI/CDM projects.

Besides the direct project development, two contracts are currently active with suppliers of indirect CO_2 credits. These are: the Testing Ground Facility (TGF) under the Nordic Environment Finance Corporation (NEFCO) and the World Bank. The TGF is open for investments from private investors, whereas the Danish state's contract with the World Bank was entered into in collaboration with the private companies Dong Energy, Aalborg Portland, Nordjysk Elhandel and Maersk Olie & Gas. The contract entered into with the World Bank represent the first time large private Danish actors have invested in CO_2 reductions in developing countries and Eastern Europe and has a total capital of DKK 200 mill.

It should be noted that to the extent the JI projects lead to reductions in the greenhouse gas emissions of the host country, also before 1 January 2008, the reductions in question can, in accordance with the contracts entered into, be transferred to the Danish states holding as parts of the assigned amounts of the host country, if the conditions of the Kyoto Protocol have been met. This procedure is called "early crediting" and will in practice be registered as allowance trading in the host country and in the DK ETR.

CDM projects

Denmark wishes to create better interaction between environmental assistance and Denmark's other initiatives to protect the global environment, including through climate efforts under the Kyoto Protocol of the Climate Convention. This will be realised through collaborating with developing countries on development of projects that reduce the emission of greenhouse gases.

CDM collaboration with developing countries is also being managed by the Ministry of Climate and Energy. The goal is to ensure the greatest possible synergy between CDM collaboration and Denmark's international effort within development assistance. The climate effort must contribute:

- to fulfilling the targets in the Government Climate Strategy to meet Denmark's reduction commitment in a cost-effective way, and

- to establishing sustainable, environmental and social development in the developing countries Denmark is collaborating with.

In the beginning Denmark chose to commence with the implementation of the CDM effort by collaborating with countries that have been covered by the special environment assistance (previously MIFRESTA) for a number of years. In this way, Denmark is building on collaboration projects on capacity building and planning which have been operating for a number of years. Furthermore, the countries must have a large emission of greenhouse gases, and thus a large reduction potential and potential for purchasing CO_2 credits. Therefore, Denmark started working together with Malaysia, South Africa, and Thailand, since these countries lived up to the conditions mentioned. Later, the effort expanded to include Indonesia, Armenia, Cyprus, China and Egypt.

So far the Danish efforts in the selected CDM countries have consisted of some or all of the elements below:

• Entering into collaboration agreements which commit Denmark and the partner country to cooperate on efforts and help with the transfer of CO_2 credits between countries.

• Providing support to the countries with regard to establishing an administration system in relation to CDM and with regard to setting out national criteria for approval of CDM projects.

• Identifying eligible project ideas and elaborating these, so that they may be approved according to Kyoto Protocol rules. Denmark will subsequently buy all, or part, of the CO_2 credits resulting from the projects.

In addition to the CDM collaboration with the five countries mentioned above, general agreements have been entered into with Chile, Nicaragua, and Argentina with a view to paving the way for possible CDM credits trades between these countries and Denmark. An agreement has also been entered into with Mexico and India.

Purchases of CDM credits can be bilateral, especially purchases from projects that Denmark has participated in the development of, or they can be indirect, through purchases of credits from CO_2 investment funds or similar. The Ministry of Climate and Energy has until today 30 contracts on credit purchase from CDM projects.

Funds for purchasing credits from CDM projects are part of the Danish Ministry of Climate and Energy's budget and are separate from development assistance, which is administered by the Danish Ministry of Foreign Affairs. The purchase of credits will thus not be at the cost of funds for development assistance.

Technology transfer in the CDM collaboration

The framework and work on CDM projects include broad collaboration aimed at promoting efficient methods for developing, applying, and disseminating environment-friendly technologies, know how, and procedures and processes that can influence climate change; and at promoting sustainable development in the developing countries. Also within CDM collaboration work, such technology transfer covers both soft technologies, such as capacity building, information network, training, and research, as well as hard technologies, such as equipment for controlling and reducing greenhouse gas emissions.

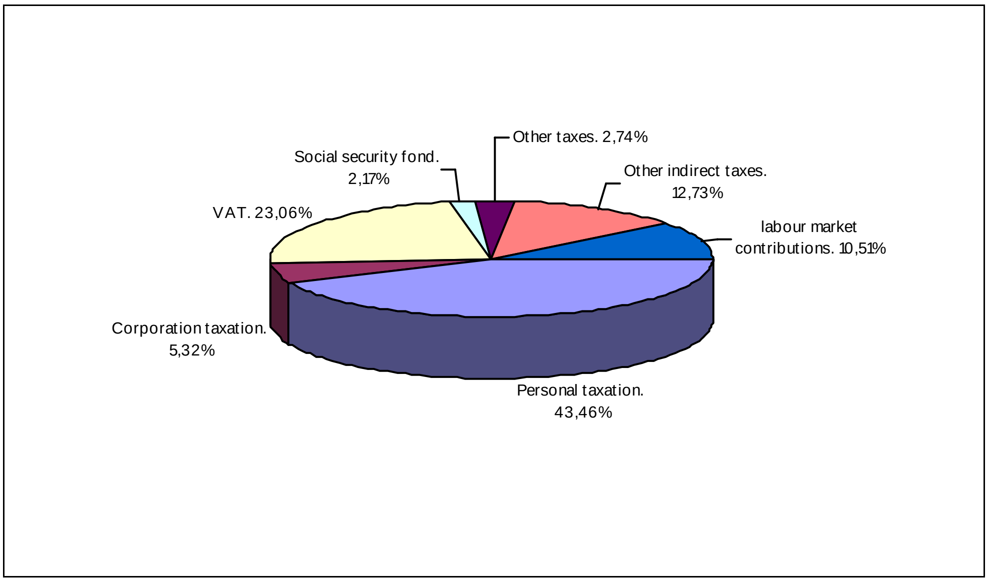
4.3.3 Taxes and duties

In Denmark, taxes and duties collected make up a total of approx. 48% of the GDP. The public sector provides childcare, education, unemployment benefits, health and disability benefits, old-age pensions, and many other services.

The personal income tax is the most important tax, making up more than half (52%) of total tax revenues. Other taxes are VAT, duties, corporation taxes, and labour market contributions. The Danish VAT is relatively high, 25%, and there are no differentiated rates. There are a considerable number of additional consumption taxes and environmental taxes. The corporation tax rate is 25%.

Total revenue from all taxes and duties is expected to amount to DKK 824 billion in 2009. The relative distribution is shown in Figure 4.2.

FIGURE 4.2 RELATIVE DISTRIBUTION OF TAXES AND DUTIES 2009
Source: Ministry of Taxation



Taxes that influence Denmark's greenhouse gas emissions

Retail prices on products that influence Danish greenhouse gas emissions are, in most cases, the decisive factor determining the degree to which they are consumed. Energy prices influence the composition and total size of energy consumption. Therefore extra taxes and duties put on products influence the consumption of these products and the size of greenhouse gas emissions associated with the use of the products.

Denmark has special taxes on motor vehicles, energy products, alcohol, tobacco, and a number of other products. During the 1990s a number of new environmental taxes were introduced. These taxes were placed on consumer goods that caused pollution or were scarce (water, energy products such as such as oil, petrol, electricity, etc.) or on discharges of polluting substances (CO_2, HFCs, PVC, SF_6, SO_2, and sewage). Taxes are imposed on mineral oil, tobacco, and alcohol in accordance with EU legislation.

The introduction of CO_2 taxes and the increase in the rates of individual energy taxes since 1990 have had an effect on the consumption of a number of energy products and have therefore reduced the CO_2 emissions associated with consumption of these products.

The *Effort Analysis*[3] from 1 April 2005 made an estimate of the effects of the measures implemented in the period 1990-2001. The report's calculations show that the total effect of the introduction of CO_2 taxes and raised energy taxes meant a reduction in annual emissions of about 1.5 mill. tonnes of CO_2 equivalents in 2001. The socio-economic reduction costs were estimated at DKK 325/tonne. The expected average reduction in emissions for the years 2008-12 is the same as for 2001, namely about 1.5 mill. tonnes of CO_2 equivalents.

The increased fuel taxes have led to an annual reduction of about 1.2 mill. tonnes of CO_2 equivalents in 2001 with a socio-economic reduction cost of DKK 775/tonne. The average for 2008-12 is expected to be at the 2001 level.

In 2001, the introduction of the green owner tax meant an approx. 2% reduction in CO_2 emissions from cars, corresponding to 0.158 mill. tonnes of CO_2 equivalents. The average for 2008-12 is expected to be around 7% (0.540 mill. tonnes of CO_2 equivalents).

Taxes influencing Denmark's greenhouse gas emissions are described in more detail in the following. Data sheets for these measures are in Annex B2, which includes e.g. references to the legal basis for implementation of the measures.

4.3.3.1 Implemented taxes and duties relevant to CO_2, CH_4, and N_2O emissions

4.3.3.1.1 Energy

Denmark has had taxes on energy for many years[20]. Since the first oil crisis in the early 1970s, the rates of the taxes has been aimed at reducing consumption and promoting the instigation of more energy-saving measures. Lesser energy consumption will reduce the emissions of both CO_2, methane (CH_4), and nitrous oxide (N_2O) associated with combustion of fossil fuels. Energy taxes from recent years are stated in Table 4.4 below.

TABLE 4.4 ENERGY TAXES 1999-2009

Source: Ministry of Taxation

		Unit	1999	2000	2001	2002-2004	2005-2007	2008[1]	2009
Coal		*DKK/toe*	1,884	1,968	2,051	2,135	2,173	2,211	2,252
Natural gas		*DKK/toe*	1,536	1,672	2,048	2,111	2,134	2,173	2,211
Natural gas		*DKK/m³*	1.47	1.60	1.96	2.02	2.042	2.079	2.116
Oil products:	**Diesel**	*DKK/toe*	2,030	2,255	2,255	2,432	2,439	2,439	2,547
	Fuel oil	*DKK/toe*	1,967	2,008	2,060	2,122	2,155	2,194	2,233
Electricity:	**For heating**	*DKK/kWh*	0.42	0.47	0.486	0.501	0.511	0.52	0.529
	Other	*DKK/kWh*	0.48	0.54	0.551	0.566	0.576	0.587	0.596
Waste:	**Heating from waste**	*DKK/toe*	209	335	427	540	540	548	561
Other compostable biomass		*DKK/toe*	0	0	0	0	0	0	0

[1] As from 1 January 2008 the taxrates are following a yearly regulation of 1,8% in the period 2008-2015.

Danish Energy taxes are laid down in the four Danish tax acts on mineral-oil, gas, coal, and electricity, respectively (Mineralolieafgiftsloven, Gasafgiftsloven, Kulafgiftsloven, and Elafgiftsloven). As from 1 January 2008 the taxrates set in these four tax acts are following a yearly regulation of 1,8% in the period 2008-2015. The indexation was estimated to lead to a reduction in emissions of 0,14 mill. tonnes CO_2 in 2008 and 0,98 mill. tonnes CO_2 in 2015.

[20] Energy taxation in Denmark is described in detail in the report Energy policies of IEA Countries – Denmark 2002 (pp. 27-33) published by the IEA (International Energy Agency) in 2002.

The mineral-oil tax act entered into force on 1 January 1993. Before that time the tax on petrol was regulated via the petrol tax act, which entered into force on 1 January 1983, and the act on taxation of gas oil and diesel oil, heating oil, heating tar, and crude oil was regulated via the act on taxation of certain oil products, which entered into force on 3 October 1977. In the period 1 January 1988 – 14 May 1992 the tax rate for gas and diesel oil used as motor fuel was DKK 1.76/litre, for fuel oil the rate was DKK 1.98/litre and for auto gas the rate was DKK 1.24/litre. Tax rates from recent years are shown in Table 4.5.

TABLE 4.5 TREND IN TAXES 1996-2009 UNDER THE MINERAL-OIL TAX ACT, STATED IN DKK/LITRE

Source: Ministry of Taxation

DKK per litre	1.1.96-31.12.96	1.1.97-30.06.98	1.7.98-31.5.99	1.6.99-31.12.99	1.1.00-31.12.00	1.1.01-31.3.01	1.4.01-31.12.01	1.1.02-31.12.04	01.01.05-31.12.07	01.01.08-31.12.08[1]	01.01.09-31.12.09
Gas oil and diesel oil used as motor fuels	2.02	2.12	2.12	2.12	2.35	2.58	2.58	2.76	2.787	2.837	2.888
Light diesel oil	1.92	2.02	2.02	2.25	2,48	2.48	2.48	2.66	2.687	2.735	2.785
Diesel low in sulphur content	-	-	-	2.07	2.30	2.30	2.48	2.48	2.507	2.552	2.598
Diesel without sulphur	-	-	-	-	-	-	-	-	2.487	2.487	2.598
Fuel oil	1.66	1.66	1.91	1.91	1.95	2.00	2.00	2.06	2.092	2.130	2.168
Auto gas	1.36	1.43	1.45	1.45	1.61	1.73	1.73	1.73	1.746	1.777	1.809

[1] As from 1 January 2008 the taxrates are following a yearly regulation of 1,8% in the period 2008-2015.

The increase per 1 July 2004 was part of a reorganisation of the taxes, and the total tax burden on the products did not change; the only thing that changed is the relative distribution between energy taxes and CO_2 taxes.

The purpose of introducing a tax differentiation from 1 June 1999 between light diesel and diesel low in sulphur was to encourage the use of diesel low in sulphur, which is less contaminant than light diesel. This was accomplished and a change took place soon after to the effect that almost all diesels sold were low in sulphur. The purpose of further differentiation from 1 January 2005 favouring sulphur-free diesel was likewise to encourage the use of this type of diesel in favour of diesel low in sulphur which has been succesfull.

In addition, tax differentiation has been introduced in order to achieve environmental goals other than the direct reduction of greenhouse gas emissions. Thus tax differentiation has been introduced with a view to phasing out lead in petrol and collecting petrol vapours at filling stations. The rates of taxes to achieve these environmental goals are shown in Table 4.6.

TABLE 4.6 TREND IN TAXES ON DIFFERENT TYPES OF PETROL, STATED IN DKK/LITRE

Source: Ministry of Taxation

Type of petrol:	1.10.95-31.12.95	1.1.96-31.12.96	1.1.97-31.12.97	01.01.98-31.12.98	01.01.99-31.12.99	01.01.00-31.12.00	01.01.01-31.12.01	01.01.02-31.12.04	01.01.05-31.12.7	1.1.08-18.6.08[3]	19.6.08-31.12.08	1.1.09-31.12.09
With lead[1]	3.65	3.92	3.97	4.02	4.42	4.52	4.62	4.72	4.50	4.581	4.55	4.632
Lead-free	3.00	3.27	3.32	3.37	3.77	3.87	3.97	4.07	3.85	3.919	3.889	3.959
With lead[1] & vap.rec.[2]	-	3.89	3.94	3.99	4.39	4.49	4.59	4.69	4.47	4.55[4]	-	-
Lead-free & vap.rec.[2]	-	3.24	3.29	3.34	3.74	3.84	3.94	4.04	3.82	3.889[4]	-	-

[1] The term has been kept even though petrol companies in Denmark ceased using lead for octane improvement in 1994.
[2] When sold from filling stations with vapour recovery.
[3] As from 1 January 2008 the taxrates are following a yearly regulation of 1,8% in the period 2008-2015.
[4] As of 18.6.08 the differentiation between petrol sold from filling stations with vapour recovery has been revoked.

The gas tax on natural and town gas was introduced in its current form on 1 January 1996 with a rate for both natural and town gas at DKK 0.01/Nm^3. There has been taxation on gas, however, since 1 January 1979, when the tax on town gas and LPG was introduced. The tax on town gas was cancelled again in June 1983 and regulation of the tax on LPG was transferred to the mineral-gas tax act when this act entered into force. The tax rates on gas are shown in Table 4.7.

TABLE 4.7 TAXES ON GAS 1998-2009, DKK PER NM^3

Source: Ministry of Taxation

DKK per Nm^3	1.7.98-31.8.98	1.9.98-31.12.99	1.1.00-31.12.00	1.1.01-31.12.01	1.1.02-31.12.02	1.1.03-31.12.03	1.1.04-31.12.04	1.1.05-31.12.05	01.01.06-31.12.07	1.1.08-31.12.08[1]	1.1.09-31.12.09
Natural gas	0.25	1.47	1.60	1.96	2.02	2.02	2.02	2.042	2.042	2.079	2.116
Town gas	0.25	0.25	0.38	0.68	0.99	1.25	1.50	1.77	2.042	2.079	2.116

[1] As from 1 January 2008 the taxrates are following a yearly regulation of 1,8% in the period 2008-2015.

The coal tax was introduced on 1 July 1982 and constituted DKK 127/tonne for hard coal and DKK 91/tonne for lignite and lignite briquettes on the day of entry into force. In the period 1 January 1989 - 15 May 1992 the tax rate was DKK 765/tonne hard coal and DKK 500/tonne lignite. The rates have since then developed as shown in Table 4.8.

TABLE 4.8 TREND IN COAL TAXES SINCE 1997, DKK PER TONNE

Source: Ministry of Taxation

DKK per tonne	1.1.97-31.12.97	1.1.98-30.6.98	1.7.98-31.12.98	1.1.99-31.12.99	1.1.00-31.12.00	1.1.01-31.12.01	1.1.02-31.12.04	01.01.05-31.12.07	1.1.08-31.12.08[1]	1.1.09-31.12.09
Hard coal	950	1040	1150	1250	1300	1350	1425	1449.2	1475.3	1501.8
Lignite	700	764	840	910	950	990	1030	1047.8	1066.7	1085.9

[1] As from 1 January 2008 the taxrates are following a yearly regulation of 1,8% in the period 2008-2015.

The electricity tax was introduced on 1 April 1977. From 1 June 1989 to 14 May 1992 the tax rate was DKK 0.295/kWh for consumption of electricity and DKK 0.33/kWh for other electricity.. Table 4.9 shows the development in electricity tax rates since 1997.

TABLE 4.9 TREND IN ELECTRICITY TAXES SINCE 1997, DKK PER KWH

Source: Ministry of Taxation

DKK per kWh	1.1.97-31.12.97	1.1.98-31.12.98	1.1.99-30.6.99	1.7.99-31.12.99	1.1.00-31.12.00	01.01.01-31.12.01	01.01.02-31.12.04	01.01.05-31.12.07	01.01.08-31.12.08[1]	01.01.09-31.12.09
Consumption of electricity, exceeding 4,000 kWh in all-year residences heated by electricity	0.365	0.401	0.416	0.456	0.471	0.486	0.501	0.511	0.520	0.529
Other electricity	0.40	0.466	0.481	0.521	0.536	0.551	0.566	0.577	0.587	0.596

[1] As from 1 January 2008 the taxrates are following a yearly regulation of 1,8% in the period 2008-2015.

The CO_2 tax on energy products was introduced on 1 March 1992. CO_2 tax is placed on different types of energy products relative to their CO_2 emissions, cf. Table 4.10.

TABLE 4.10 CO_2 TAX RATES, 2000-2009, STATED IN DKK PER TONNE OF CO_2

Source: Ministry of Taxation

	2000	2001	2002	2003	2004	2005	2006	2007	2008[1 2]	2009[2]
Basic rate										
Heating in industry	100	100	100	100	100	90	*90*	*90*	*90*	*90*
Light industrial processes										
Basic rate	90	90	90	90	90	90	90	90	90	90
With a voluntary agreement	68	68	68	68	68	68	68	68	68	68
Resulting subsidy	22	22	22	22	22	22	22	22	22	22
Heavy industrial processes										
Basic rate	25	25	25	25	25	25	25	25	25	25
With a voluntary agreement	3	3	3	3	3	3	3	3	3	3
Resulting subsidy	22	22	22	22	22	22	22	22	22	22

[1] As from 1 January 2008 the tax rates are following a yearly regulation of 1,8% in the period 2008-2015.
[2] With the implementation of an amendment of the energy taxes, which is currently pending approval by the European Commission, only subsidies regarding CO_2 tax on electricity to firms with a voluntary agreement will be given.

Table 4.11 shows examples of the different types of CO_2 taxes converted into consumer units.

TABLE 4.11 EXAMPLES OF CO_2 TAXES

Source: Ministry of Taxation

	Unit	15.5.1992-31.12.2004	1.1.2005-31.12.2007	1.1.2008-31.12.2008[1]	1.1.2009-31.12.09
Gas oil and diesel oil	*DKK/litre*	0.27	0.243	0.247	0.252
Fuel oil	*DKK/kg*	0.32	0.288	0.293	0.298
Electricity	*DKK/kWh*	0.10	0.09	0.088	0.089
Lignite	*DKK/tonne*	242	217.8	221.7	225.7
Natural gas and town gas	*DKK/Nm^3*	0.22	0.198	0.202	0.205
Petrol	*DKK/litre*	-	0.22	0.224	0.228

[1] As from 1 January 2008 the tax rates are following a yearly regulation of 1,8% in the period 2008-2015.

In addition to this, there are CO_2 taxes on heating tar, crude oil, coke, crude oil coke, lignite briquettes and lignite, LPG, and other gases. As evident from Table 4.11, the CO_2 taxes were reduced from 1 July 2004. This reduction, however, does not mean a reduction in the tax burden and resulting increased CO_2 emissions. The tax reductions were part of a reorganisation of the energy taxes to make them more transparent, and the energy taxes on the different energy products have been raised correspondingly, so that the overall tax on the individual product is the same. As part of the reorganisation of the taxes, from 1 January 2005 a tax was placed on petrol and the energy tax on petrol was reduced correspondingly, so that the total tax burden on petrol remains unchanged. This reorganisation was introduced in order to make it possible to exempt biofuels from CO_2 tax. As from 1 January 2008 the CO_2 taxes is following a yearly regulation of 1.8% in the period 2008-2015 similarly to the energy taxes.

In connection with the implementation of the CO_2 allowance scheme in 2005 a decision was made to pay back the CO_2 taxes paid for fuels and heating used in industrial processes that are directly allowance-regulated in industrial enterprises covered by the allowance regulations. This amendment is still pending approval by the European Commission and has therefore not yet entered into force.

4.3.3.1.2 Transport

In the transport sector, the number of cars in Denmark and the use of motorised vehicles are influenced by the tax on cars and fuel. The latter has been described above.

Since 1 July 1997 the annual tax on motor vehicles has been based on energy consumption (the green owner tax) measured in accordance with EU Directive 93/116/EC. Before this date, the taxation was based on weight. 24 classes of energy consumption have been defined for both petrol-driven and diesel-driven vehicles. Examples of classes from 2009 are shown in Table 4.12.

TABLE 4.12 EXAMPLES FROM THE DANISH STRUCTURE OF TAX INCENTIVES BASED ON ANNUAL TAXES ON MOTOR VEHICLES (2008-09), DKK/YEAR

Source: Ministry of Taxation

Class of motor vehicle		**Fuel consumption (km/l)**	**Annual tax (DKK/year)**
Petrol	**1**	**> 20.0**	520
	11	**10.0 – 10.5**	5,500
	24	**< 4.5**	18,460
Diesel	**1**	**25> 22.5**	1,960
	12	**10.2 – 11.3**	9,620
	24	**< 5.1**	25,060

From 1 January 2000, three new classes were defined for diesel-driven private cars. The annual tax is given in Table 4.13.

TABLE 4.13 ANNUAL TAX FOR DIESEL-DRIVEN PRIVATE CARS, DKK/YEAR

Source: Ministry of Taxation

DKK/year	**2000**	**2001**	**2002-2009**
> 32.1 km/l	140	200	160
28.1-32.1 km/l	700	780	740
25-28.1 km/l	1,280	1,380	1,320

The reason for the fall from 2002 and onwards is a reduction in the green owner tax as a consequence of rising fuel taxes. With effect from 1 January 2002, there was an increase in the tax on diesel.

The registration tax for passenger cars and vans has from 15 June 2007 been reduced or increased according to the fuel efficiency of the vehicle. Petrol (diesel) driven passenger cars and vans receive a tax reduction of DKK 4,000 for each kilometre in excess of 16 kilometres (18 kilometres) the vehicles run per litre petrol (diesel). Similarly, a tax increase of DKK 1,000 for each kilometre less than 16 kilometres (18 kilometres) the vehicles run per litre petrol (diesel) is received. This is expected to lead to a yearly emission reduction of 0.05 mill. tonnes CO_2.

This incentive replaces a reduction in the registration tax for highly energy-efficient private cars, which was introduced 1 January 2000.

As the EURO3 and EURO4 standards have become obligatory, the reductions of annual taxes for light commercial vehicles (LCVs) as an incentive to buy vehicles which fulfils these standards are no longer relevant. From 1 January 2007, a reduction of DKK 4.000 in the tax base for the registration tax was implemented for diesel driven personal cars and LCVs fulfilling the standards for emission of particles set out in EU Council's directive 70/220/EØF, dated 20 march 1970.

4.3.3.1.3 The domestic sector

For the domestic sector, the taxes levied on consumption of electricity and heat affect consumption figures, since with the introduction of taxes these products become more expensive.

4.3.3.2 Implemented taxes and duties relevant to consumption and emissions of HFCs, PFCs, and SF_6

Since 1 March 2001, imports of industrial gases HFCs, PFCs, and SF_6 (F-gases) in the industry/business sector have been subject to taxation. The tax is based on the Danish CO_2 tax correlated with the GWP up to a maximum of DKK 400/kg, cf. the examples in Table 4.14.

TABLE 4.14 EXAMPLES OF TAXES ON F-GASES

Source: Ministry of Taxation

Substance	GWP	Tax in DKK per kg
HFC-134a	**1300**	130
R404a (a combination of 3 HFCs)	**3780**	378
SF_6	**23900**	400

Regarding the effect of taxes on the consumption of HFCs, PFCs, and SF_6 on emissions of greenhouse gases, the *Effort Analysis* has estimated that the tax on the industrial gases HFCs, PFCs, and SF_6, in combination with the effect of regulation adopted and introduced, led to a reduction of 49,000 tonnes CO_2

equivalents in 2001. In 2005, reduction was expected to be somewhere around 150,000 tonnes of CO_2 equivalents, increasing to around 370,000 tonnes in 2010. The socio-economic reduction cost is estimated at about DKK 200/tonne CO_2. Please note that it has not been possible to calculate the effects and costs of taxes and regulation separately.

4.3.3.3 New and additional measures

The Danish government implemented an overall tax freeze from 2002 stipulating no tax increases, which means that no fixed rates in Danish kroner or in per cent may be increased.

As part of an agreement on Danish energy policy the CO_2 tax rate will be raised to DKK 150 per tonne of CO_2 reflecting the expected price on CO_2 quotas. The energy taxes will be reduced correspondingly so as to leave the total tax burden unchanged. The higher CO_2 tax rate is expected to bring about a reduction of 0.69 mill. tonnes CO_2. The implementation of this tax change is pending approval by the European Commission.

On 1 March 2009 a political agreement was reached about a coming tax-reform. The tax-reform will be implemented gradually towards 2019 and will lower the tax on work income and finance this partly by green taxes.

The tax reform includes a general raise of the energy taxes, the imposition of energy taxes on energy products used by industries in manufacturing and an extension of the indexation of energy taxes by 1.8 pct. per year beyond 2015. Furthermore several smaller adjustments will be made to the energy taxes.

The reform will also raise the tax on consumption of HFCs, PFCs, and SF_6 so as to equate the new CO_2 tax rate of DKK 150 per tonne. In addition to this, taxes are imposed on other greenhouse gasses than CO_2 in relation to use of energy. The tax rates on these greenhouse gasses will likewise equate the new CO_2 tax rate.

In the transport sector a higher annual tax will be imposed on LCVs and the registration tax on taxis will be reorganized. These changes will increase the incentive to buy more energy efficient vehicles.

The total reduction of greenhouse gasses as an effect of the reform is estimated to be approximately 0.5 million tonnes of CO_2-equivalents.

4.3.3.4 Measures no longer in place and measures increasing greenhouse gases

Besides the changes mentioned above there has been no cancellation of taxes and duties relevant to greenhouse gas emissions since *Denmark's Fourth National Communication* to the Climate Convention in 2005.

4.3.4 Energy

The energy sector's extraction, conversion and distribution of energy led to greenhouse gas emissions which in 2007 made up 39 % of Denmark's total emissions, of which CO_2 was the primary emission. 98% of the emissions from the energy sector are CO_2. 1.5% is methane (CH_4), and the remaining 0,5% is nitrous oxide (N_2O).

4.3.4.1 CO_2

Energy production and energy consuming activities in the transport sector and industry are main contributors to the total emissions of CO_2 due to use of large quantities of coal, oil and natural gas. The energy sector is, therefore, centrally placed in the efforts to reduce the emissions of CO_2.

Many initiatives have been taken over the years to reduce the emissions, and work is still going on to find the best and most cost-effective measures with the objective to fulfil Denmark's international climate obligations. Danish experience shows that through persistent and active energy policy focus on enhanced energy efficiency, it is possible to sustain high economic growth and at the same time reduce fossil fuel dependency and protect the environment. More information on "The Danish example – the way to an energy efficient and energy friendly economy" is available in Annex D (sub-section 5),

The energy sector is fully liberalised. Today, electricity production from Danish power plants is controlled by market forces. Danish electricity generation is traded freely across national borders on the Nordic and the north-German electricity markets. There is thus a significant extent of integration in the Northern European electricity market on an arm's length basis. This entails, for example, that increased use of renewable energy in the Danish electricity system or enhanced efforts to save electricity do not automatically mean that generation at coal-fired power plants is reduced correspondingly during the first commitment period of the Kyoto Protocol 2008-2012.

The introduction of the CO_2 allowance regulations as a common EU instrument has been pivotal for Denmark's possibilities to comply with the climate commitments. The allowance regulations constitute a central instrument in ensuring that the Danish energy sector is enabled to provide the reductions required if Denmark is to comply with the climate obligations. At the same time, the allowance scheme permits significant improvements to the cost-effectiveness of Denmark's climate effort.

The Government's long-term objective is to become a nation with an energy supply solely based on renewable energy sources and thus independent of fossil fuels. To address potential means to fulfil this objective, the Government has established the Danish Commission on Climate Change and Climate Change Policy. The Commission will report to the Government in 2010.

The objective of the Danish energy policy today is security of supply, environmental concerns, energy savings and well-functioning energy markets within frameworks that secure cost effectiveness. Several initiatives often meet more than one of the purposes mentioned at the same time. Efforts concerning climate change should thus be seen in a broader context than CO_2 alone, not least when it comes to the purpose and calculation of effects.

The costs to Denmark of meeting climate obligations are less than they could have been. Denmark gave priority to renewable energy sources and energy efficiency early on. Most of the public support schemes and regulations have prioritised energy efficiency and RE. In this respect the development in Denmark has been quite different from other IEA countries, which have invested in new energy supply – notably nuclear energy.

Danish public support programmes have instigated competition amongst private companies. Most public support for energy research and development in Denmark has been open for competing applicants. Similarly, all procurement of energy technologies induced by public schemes has followed EU rules requiring open tenders or left it to competitive markets in general.

The focus of this section is energy production and energy supply. The energy consuming activities and the possibilities for energy savings in the different sectors of society are dealt with in greater detail in the subsequent sections.

A large number of policies and measures have been implemented over the years to meet the various energy-policy objectives cf. Table 4.15.

4.3.4.1.1 The allowance regulation relevant to the energy sector

A key instrument for reaching the goals for emission reductions is the EU Emission Trading Scheme (EU ETS), which is a CO_2 allowance scheme for energy production and energy-intensive industries as described in section 4.3.1. The EU Member States have devised this trading scheme for greenhouse gas emissions in order to fulfil the international climate commitments set out in the Kyoto Protocol in particular with the aim of reducing CO_2 emissions from energy production and energy-intensive industries.

The allowance scheme entered into force on 1 January 2005. The 2005-2007-period was used as a testing phase. It was replaced by the Kyoto allowance trading period on 1. January 2008. This period lasts until end of 2012.

The allowance allocation for 2008-12 was determined in the national allocation plan, submitted the EU Commission July 2006. The allowance scheme is one of the most important measures in Denmark's fulfilment of its climate obligations under the Kyoto Protocol. The scheme aligns well with the liberalisation of the energy markets and management of environment efforts by the market being implemented by the government for the energy area. The allowance scheme permits significant improvements to the cost-effectiveness of Denmark's climate policies and measures and forms a main element of the Danish government's Climate Strategy.

Annex A3 contains overviews of the installations covered and their allowances for 2008-2012. The installations subject to the allowance regulations, account for a little less than half of Danish emissions of greenhouse gases. Almost all major Danish installations with considerable emissions are covered by the ETS. Most of these are generators of power and heat, the rest are industrial enterprises plus a few production units within the offshore sector.

Both the statutory and the administrative basis for the scheme have been established. The necessary legal basis was adopted by the Folketing in June 2004 and the 2008-2012 national allocation plan was approved by the EU Commission on 31 August 2007.

According to the national allocation plan for the period 2008-2012 an average annual allowance of 24.5 million tonnes CO_2 has been allocated. This corresponds to a drop in annual emissions of about 5 million tonnes per year in 2008-2012, or a reduction of about 17% compared with expected emissions for the period. This level was set by balancing environmental considerations against competitiveness and jobs:

- Electricity and heat producers were allocated about 15.8 mill. EAU's. The allowance for electricity generation is allocated as "per kWh", while for heat production allowances are allocated according to emissions in the base years 1998-2004.

- The other 133 installations (industry and offshore) have been allocated allowances corresponding to emissions in the base years 1998-2004. A total of 8.2 mill. tonnes per year have been allocated to industry and offshore.

- A special reserve of 0.5 mill. tonnes per year has been allocated with free allowances for new installations and significant extensions to existing units.

Allowances not allocated by the end of the commitment period or returned due to closures have been earmarked for fulfilling the national reduction targets – alternatively for sale by auction or similar.

The new EU Climate and Energy Agreement from December 2008 extended the ETS system to 2013-2020 in order for EU to reduce CO_2-emissions by 20 per cent in 2020. At the same time allocation is centralised and auctioning is used more extensively from 2013.

4.3.4.1.2 Energy and CO_2 taxes

Taxes have also been used for many years as an instrument for reducing the CO_2 emissions from the energy sector, since fuels used for heat production are subject to energy and CO_2 taxes. The main objective is general GHG reductions and the promotion of the use of fuels with lower CO_2 emissions, mainly biomass. Energy and CO_2 taxes are described in detail in section 4.3.3.

4.3.4.1.3 Research and development

Danish support for new energy technologies has been comprehensive and relatively stable. A long list of direct and indirect support schemes and policies have, combined, created a domestic market which has given Danish companies a boost. This boost has enabled many companies to become international market leaders. Danish companies continue to enjoy commercial success within the energy related marketplace.

R&D activities include energy savings, more efficient energy conversion and renewable energy technologies. Research in the energy area is described in more detail in section 8.2.6.

TABLE 4.15 INITIATIVES AND MEASURES IN THE ENERGY SECTOR
Source: Danish Energy Agency

Name of measure or initiative	Objective	GHG affected	Type of instrument	Status for implementation	Implementing entity/ player
The energy sector					
EU-CO_2-allowances for electricity and district heating production (including Business)	CO_2-reduction	CO_2	Economic (financial)	Implemented	State authorities, energy producers, energy-intensive enterprises
Biomass Agreement	R&D, demonstration, CO_2 reduction	CO_2	Economic (financial)	Implemented	State authorities, energy producers
Price supplement and subsidies for environmentally friendly electricity	Energy efficiency, technology development, CO_2 reduction	CO_2	Economic	Implemented	State authorities, energy producers
Tenders for offshore wind turbines	Energy efficiency, technology development, CO_2 reduction	CO_2	Regulatory (administrative)/ economic (financial)	Implemented	State authorities, electricity producers
Scrapping scheme for old wind turbines	Other environ-mental improvements	CO_2	Economic, financial	Implemented	Local/ regional authorities, interest organisations, energy producers, state authorities
Energy research	R&D	CO_2	R&D	Implemented but regularly adjusted	State authorities, research institutions

4.3.4.1.4 Combined heat and power

Increased use of CHP and enlarged district heating areas has been main elements of the Danish strategy to promote RE and the efficient use of energy resources since the end of the 1970s. Effective heat supply planning has ensured the highest share of district heating and CHP in the Western Hemisphere. This has secured early markets for district heating technologies and a cheap avenue for the use if many renewable energy sources like straw, municipal waste, wood waste and geothermal energy. More than half of Denmark's domestic electricity consumption is co-generated with heat at CHP plants, and the potential for further use of CHP is limited. For this reason, only a small increase in CHP production is expected in the future. CHP has been promoted partly by the tax system, partly by electricity production grants for small-scale CHP plants and, lastly, by prioritising electricity from small-scale CHP plants.

4.3.4.1.5 Renewable energy

The increasing use of renewable energy sources is reducing the emissions of CO_2 from fossil fuels. The proportion of Denmark's gross energy consumption covered by renewable energy increased from 6.7 % in 1990 to 17 % in 2007. The political energy agreement concluded by the Government and a broad majority in the Parliament in February 2008 sets the goal that 20 % of the gross energy consumption in 2011 should be based on RE. By 2025, the Danish Government has the target to increase the amount of RE to at least 30 % of the gross energy consumption.

Renewable energy sources are promoted with economic measures, including the tax system, price supplements and subsidies.

4.3.4.1.6 Fuel conversion from coal to natural gas

Substitution of natural gas for coal or oil reduces the emissions of CO_2. The first Danish natural gas was landed from the Danish sector of the North Sea in 1984, and since then consumption of natural gas has increased to 191 PJ in 2003, covering 23.1% of gross energy consumption. In future years it is expected that use of natural gas will decrease. This development will follow as a consequence of energy savings and conversion from natural gas to renewable energy sources.

4.3.4.1.7 Energy savings

The Danish Energy Agency is responsible for authority tasks throughout the energy-savings area. In addition to legislation and regulation, the area includes the further negotiations within the EU on implementation and control of EU Directives, for example on labelling and standards, as well as a number of operational tasks such as energy labelling of buildings. Agency tasks include setting the framework for and administrating the saving activities of the grid and distribution companies and cooperating with the Electricity Saving Trust (from 1 March 2010: Centre for Energy Savings), and the Agency manages tasks in connection with the agreement scheme with business.

The National Agency for Enterprise and Construction carries out a number of energy-related authority tasks in the building area. Tasks include energy provisions in building regulations, rules on individual metering of electricity, gas, water and heating, as well as rules on the efficiency of heating plant.

The Electricity Saving Trust was established in 1996 with the primary tasks of supporting conversion from electrical heating to CHP and promotion of efficient electrical appliances etc. in households and the public sector. For conversion to CHP the Trust grants subsidies and negotiates pricing agreements etc. In regards to promotion of efficient electrical appliances the Trust carries out campaigns, influences markets, and encourages voluntary agreements as well as making electricity consumption more visible. Effective from March 1st The Electricity Saving Fund will be replaced by The Centre for Energy Savings, which will attend to the development and implementation of campaigns, market impact activities, etc. The program will cover energy savings in all sectors except the transport sector.

<u>Grid and distribution companies (electricity, natural gas, oil and heating).</u> As a part of the 2005 political agreement grid and distribution companies in the electricity, natural-gas, district-heating and oil sectors are obligated to realise savings in the final energy consumption at end-users. Furthermore the companies are obligated to provide information to their own costumers on energy consumption and provide advices for energy savings. The companies have a high degree of freedom regarding methodology.

The obligations are implemented as a voluntary agreement between the minister for climate and energy and trade associations representing the electricity-grid, natural-gas, district heating, and oil companies.

In the 2008 political agreement the companies' obligation to deliver energy savings was increased by more than 80% from 2.95 PJ to 5.4 PJ. The elevated obligation of 5.4 PJ will entry in to force from January 1st 2010. .

Electricity companies have worked with energy savings since the early 1990s. Natural gas and district heating companies' activities have only been formalised in the past years. Today costs are in principal financed through energy prices.

4.3.4.1.8 Support for environmentally friendly electricity

Since the amendment of the Electricity Supply Act entered into force on 1 January 2005, all environmentally friendly electricity, i.e. electricity from wind turbines and other renewable energy (RE) plants, decentralised cogeneration of heating and power etc, has been sold on market conditions. The previous support for environmentally friendly electricity, where consumers had an obligation to take the electricity at a fixed settlement price, was converted to financial support in the form of a price supplement on the electricity market price.

In order to reduce the environmental impact of electricity production, support is granted in the form of a price supplements and subsidies for environmentally friendly electricity from wind turbines and other RE plants (straw, woodchips, biogas, solar energy, hydro power etc.) and decentralised cogeneration of heating and power. Due to the energy agreement from February 2008 all price supplements were increased as a measure for meeting the RE goals. The RE legislation was gathered in the Renewable Energy Law adopted by the Parliament in December 2008.

The most recent figures are for 2007, and they show that the proportion of Danish electricity consumption from RE was 28 %, of which wind turbines accounted for 20 % of total electricity consumption. The proportion of biomass (straw, wood and biodegradable waste) was 69 % in 2007.

4.3.4.1.9 Denmark's long-term energy policy 2008 – 2011

The earlier mentioned energy agreement from February 2008 sets the main agenda for the Danish energy policy for the years 2008 – 2011 together with the framework of the common European goals for 2020 set by the European Union.

The agreement sets the goal that 20 % of the primary energy supply in 2011 should be based on renewable energy resources. By 2025, the Danish government has set a target to increase the amount of renewable energy to at least 30 % of the total energy consumption – i.e. twice as much as today. These goals will be met by using more wind power – including offshore – and more biomass and waste for central heating and power generation.

Another key ambition is to further improve energy efficiency and energy savings. It has been agreed that the level of energy consumption be reduced by 4 % before 2020 (compared to the level of consumption in 2006).

The government intends to double investments in research, development and demonstration of a broad spectre of innovative energy and climate adaptation technologies.

An important instrument to achieve these goals is the market. Since the mid 1990's the energy market in the European Union has become more liberalized.

The Government's long term objective is to become a nation with an energy supply solely based on renewable energy sources and thus entirely independent from fossil fuels. To map potential means to fulfil this objective, the government has established an independent Climate Commission, which will present its findings at the end of 2010.

4.3.4.1.10 Government energy savings plan

The government platform states that the government will promote energy saving initiatives so that Denmark can continue to lead in energy efficiency.
On June 10th 2005 the government made a broad political agreement to significantly strengthen energy-saving efforts. The agreement is ambitious, and sets the framework for efficient and increased energy-saving efforts in the coming years.

The 2005 agreement included a target of reduction of the overall energy consumption (excluding transport). Strengthened efforts will be made to reach specific and verifiable energy savings in the end-use consumption corresponding to 7.5 PJ per year on average in the period 2006-2013.

On February 21st a new broad political agreement was passed in the Danish parliament. The overall targets of the agreement are; reducing the climate impact, improving security of supply, and ensuring economic growth through transition to a green economy.

The 2008 agreement on Danish energy policy for the years 2008-2011 strenghtened the targets for energy savings set in the 2005 agreement.

The goal is that total gross energy consumption (including transport) should be reduced by 2% in 2011 and 4% by 2020 compared to consumption in 2006. This corresponds to a decrease from 863 PJ in 2006 to 846 PJ in 2011. Furthermore, the target of reduction in final consumption was increased to 1.5 % corresponding to annual savings of 10.3 PJ. This represents a strengthening of the saving efforts since 1980, in which large energy savings and a high degree of efficiency have been attained through an increase in combined heat and power production, among other things.

A very significant portion of further energy savings at end users will be obtained by the earlier mentioned increase in the energy companies' overall saving obligations from about 2.95 PJ/year today to 5.4 PJ/year from 1 January 2010.

4.3.4.1.11 Green technology and bio-fuels

The Government has decided that an overall catalogue of possible initiatives in the transport area should be drawn up. CO_2 emissions by the transport sector have grown constantly for many years now as they have in all the other EU countries, and hitherto assessments of reduction potentials and costs for transport and farming have often been that the costs are too high. The Energy Agreement of February 2008 supports a broad spectrum of renewable energy resources within the transport sector.

The Government's goal is that biofuels and other forms of renewable energies in transport (including electricity for electric vehicles, plug-in hybrid vehicles, etc.) should constitute 5.75% of total fuel use in land transport by 2010 and 10% by 2020. This corresponds to the goals set by the EU. It is an absolute precondition backed by a broad majority in the Danish Parliament that biofuels must meet the EU sustainability criteria in order to count towards the target.

According to the Energy Agreement hydrogen fuelled cars will be tax-free, as will electric cars, provisionally up until 2012. Moreover, a pool of DKK 35 million is to be set aside to fund research into electric cars up until 2012.

The future investment plan for the transport infrastructure must also be viewed in the light of CO_2 emissions. This includes considerations concerning a comprehensive expansion of a more efficient and modern public transport system with a view to a larger share of future transport needs being met by public transport with regard for accessibility, climate and the environment alike. To attain these goals the Government presented a comprehensive plan for improved sustainable transport and infrastructure in December 2008 including investments in public transport and intelligent transport systems.

The overall objective of the wave energy strategy is to enable Danish wave energy plants to contribute to cost-effective, sustainable electricity supply in Denmark, and to enable Danish enterprises to supply competitive wave energy products etc. in Denmark and abroad.

4.3.4.2 Methane, CH_4

Many small sources contribute to the energy sector's methane emissions. The biggest single contribution comes from gas-fired CHP plants, which emit unburnt natural gas. With a view to minimising the emissions, a statutory order now limits the emissions from new plants, corresponding to about 3% of fuel consumption. The emissions limit value for existing plants will be reduced by 5% from 2006 pursuant to Statutory Order no. 720 on limitations of emissions of nitrogen oxides, unburnt carbon hydrides and carbon monoxide etc. of 1998. The emissions limit value for unburned hydro carbons – including methane – now applying to all gas motors is 1500 mg UHC per normal cubic meter and will be checked through measurements. All else being equal, it is expected that total emissions from these plants will be reduced by 5% from 2006.

4.3.4.3 New and additional measures

The new EU Climate and Energy Agreement from December 2008 strengthened the ETS system by making it more flexible and cost efficient in order to reach the reduction goals for 2013 – 2020. The emission quotas are no longer distributed by country but by sector. This secures a fair competition. The post 2012 EU ETS system will continue to primarily address CO_2 emissions in the energy sector and energy intensive industries.

The EU Climate and Energy Agreement contain ambitious reduction obligations for Denmark until 2020. For the sectors *not* covered by the ETS in Denmark, including the non-ETS activities in the energy sector, Denmark has taken on a challenging 20 per cent reduction target.

4.3.4.4 Measures no longer in place and measures increasing greenhouse gases

Regarding measures no longer in place Table 4.16 and Annex B2 contains information on discontinued measures in the energy sector.

TABLE 4.16 REPLACED AND DISCONTINUED INITIATIVES AND MEASURES IN THE ENERGY AREA

Source: Danish Energy Authority and Danish CO_2 emissions - the effort in the period 1990-2001 and the associated costs

Name of replaced or discontinued measure or initiative	***Name of replacement measure , cf. Table 4.15***	***GHG affected***	***Type of instrument***	***Status for implementation***	***Implementing entity/ player***	***CO_2-reduction in 2001[4]***	***Average annual CO_2 reduction for 2008-2012[1]***
The energy sector						Mill. tonnes CO_2	Mill. tonnes CO_2
National CO_2-allowance scheme for electricity producers	EU CO_2 allowance scheme entered into force 1/1 2005	(CO_2)	Economic (financial)	National allowance scheme in force 15/6 2000 to 31/12 2004	State authorities, energy producers. EU CO_2 allowance scheme also covers energy-intensive enterprises		
Subsidy to electricity generation (RE)	Price supple-ment for environment friendly elec[2]	(CO_2)	Economic (financial)	Reorganised 1/1 2005	State authorities, energy producers		
Subsidies for electricity generation (wind turbines)	Price supple-ment for environment friendly elec[2]	(CO_2)	Economic (financial)	Reorganised 1/1 2005	State authorities, energy producers		
Priority for electricity from CHP plants	Price supple-ment for environment friendly	(CO_2)	Economic (financial)	Reorganised 1/1 2005	State authorities, energy producers		
Requirement for offshore wind turbines	Tenders for offshore turbines[3]	(CO_2)	Regulatory (admin.), economic (financial)	Replaced by tenders	State authorities, energy producers		
Scrapping scheme for old, badly located wind turbines	Scrapping scheme for old wind turbines[4]	(CO_2)	Economic (financial)	Old scheme stopped end of 2003	Local/ regional authorities, interest organisations, energy producers, state authorities		
Renewable energy Island	(Finished as state initiative)	CO_2	Economic (financial), R&D	Continued locally, see www.veo.dk	Consumers, supply companies, interest organisations, local/ regional authorities, research institutions, state authorities		
Construction subsidy for renewable energy	(Scheme discontinued)		Economic (financial)		State authorities, enterprises		
Subsidy for investment in energy savings by industry	(Scheme discontinued)	CO_2	Economic (financial)	Scheme discontinued end of 2001	State authorities, enterprises		
Subsidy for conversion of old housing to coal CHP	(Scheme discontinued)		Economic (financial)		State authorities, enterprises		
Subsidy to promote connection to coal CHP	(Scheme discontinued)		Economic (financial)		State authorities, enterprises		
State subsidy for energy savings measures in housing for pensioners	(Scheme discontinued)	CO_2	Economic (financial)	Scheme discontinued end of 2003	Local and state authorities, consumers		

[1] Effects of some of these measures are included in the Effort Analysis.
[2] The amendment to the Electricity Supply Act, which entered into force on 1 January 2005, means that all environmentally friendly electricity, i.e. electricity from wind turbines and other renewable energy (RE) plant, small CHP plants etc., is now sold under market conditions. The previous support for environmentally friendly electricity, where consumers were obliged

to take electricity at a fixed settlement price has also been transferred to financial support as a price supplement added to the market price.
[3] In accordance with the energy policy agreement of 29 March 2004 two offshore wind turbine farms will be established, each of 200 MW, one at Horns Rev, and one at Rødsand.. The offshore wind farms should be in operation in 2008/2009. There are currently no plans for further development of offshore wind farms. Any further development will depend on the initiatives taken in the Energy Strategy 2025, with a view to providing the basis for future extension based on market conditions.
[4] The energy policy agreement of 29 March 2004 introduced a scrapping scheme where an extra price supplement is granted to new land-based wind turbines, provided that the owner has a scrapping certificate for a turbine with output of 450 kW or less, scrapped in the period from 15/12 2004 to 15/12 2009. The supplement is granted for brand new wind turbines linked to the grid from 1/1 2005 to 31/12 2009.

4.3.5 Transport

In 2007, the transport sector was responsible for 22% of Denmark's total greenhouse gas emissions. The emissions from the transport sector are primarily CO_2. 14.2 mill. tonnes of CO_2 equivalent corresponded to 98.8 of emissions in 2007. Nitrous oxide made up 1.0% or 0.14 mill. tonnes CO_2 equivalents, and methane about 0.2% or 0.03 mill. tonnes CO_2 equivalents.

In 2007, the transport sector's energy consumption - primarily oil products - made up 32.8% of total energy consumption in Denmark. The consumption of energy to transport has increased nearly 32% since 1990. Road and air transport are growing faster than the other transport means. The most recent reference prognosis from 2008 predicts continued growth in the sector's CO_2 emissions.

However in the beginning of 2009 the Danish Government made an agreement with most parties in the parliament to change Danish transport policy into a new greener direction. This change will have important impact on future CO_2-emissions from transport. With the introduction of number of new measures the Danish Government expects CO_2-emissions from transport to peak around 2010.

4.3.5.1 CO_2

Efforts to turn the upward trend in emissions of greenhouse gases in the transport sector have so far not been successful in terms of total emission of CO_2 from the transportsector, partly because a long period of sustained economic growth has increased transport demand and partly due to the fact that a number of effective measures to reduce CO_2 emissions from cars are extremely difficult without international initiatives, mainly on the EU-level.

As shown in Table 4.1, the greenhouse gas emissions from fuel for vehicles, ships and aircraft are included under transport. It should be noted that air transport will be included under the EU ETS from 2011. The contribution from the armed forces consists mainly of CO_2 and accounts for just less than 1% of the inventory for the transport sector. The proportion of fuel consumption for multilateral military operations, which is therefore kept out of the total national inventory, is at present regarded as minimal.

In 2007, working on the basis of the previous trends in passenger and freight traffic, Denmark's Technical University carried out a long term projection of road traffic. The projection indicates that road traffic will continue to grow. With the chosen assumptions it is estimated that road traffic will grow by 38 % in the 20 years periode from 2005 to 2025 i.e. 1,8 % per year.

A large part of total freight and passenger transport is by road and is expected to increase. The trend in freight and passenger transport by road will therefore determine the transport sector's energy consumption and thus its CO_2 emissions.

Table 4.17 shows the existing policies and measures within the transport sector. A number of important steps have been taken by the European Union e.g. EU has emphasised its measeres toward the car industry in order for it to live up to an overall target of attaining a mean CO_2 emission from new passenger cars of 120 g of CO_2.

Measures at the EU-level and new Danish measures described under the new measures section below will help to turn the previous upward trend for the transport sector's CO_2 emissions into a new phase where mobility is sustained and CO_2-emisssons from the sector will be reduced throughout the next decade.

The national environmentally-motivated measures for the transport sector, which have also influenced CO_2 emissions, are usually characterised by aiming at limiting environmental impacts in general. The measures ”Changing the registration tax to a green owner tax” and ”increased fuel taxes” are both assessed to have had considerable effects and were, furthermore, implemented with reduction of CO_2 emissions as one of the primary targets.

A great number of additional initiatives aiming directly or indirectly at reducing CO_2 emissions have been implemented within various areas. Characteristic for all these initiatives are information campaigns or subsidy schemes, while no initiatives have been established using direct regulation such as requirements or bans. The effects of these initiatives is hard to quantify and in themselves they are not considered to have contributed significantly to CO_2 reductions

As transport in itself has a number of side-effects in addition to contributing to the greenhouse effect through higher CO_2 emissions, for example air pollution causing poor air quality or acidification, noise, accidents and congestion, it is important to note that the various initiatives implemented in the transport area typically address many of these aspects and can thus not only be considered in relation to CO_2 emissions. In general the increasing traffic intensity has caused increased CO_2 emissions, while other air pollution has fallen significantly. Other negative effects of transport have also been reduced, e.g. the number of injuries and fatalities in accidents fell by 37 % and 31 % respectively from 1990 to 2007.

4.3.5.2 Methane, CH_4

The transport sector's emissions of methane account for about 0.2% of the sector's greenhouse gas emissions, corresponding to about 0.03 mill. tonnes CO_2 equivalents.

4.3.5.3 Nitrous oxide, N_2O

Nitrous oxide accounts for just less than 1%, or 0.14 mill. tonnes CO_2 equivalents, of the transport sector's total greenhouse gas emissions. Emissions of nitrous oxide have increased considerably since the introduction of new cars with catalytic converters in 1990. As the half-life of cars from that time is approaching, it is expected that the rate of increase will fall until all cars have catalytic converters. This saturation point is expected to be reached around 2010-2012, with annual emissions of around 0.8 mill. tonnes CO_2 equivalents.

TABLE 4.17 MEASURES TO LIMIT CO_2 EMISSIONS FROM THE TRANSPORT SECTOR

Source: Ministry of Transport and Denmark's CO_2 emissions - the effort in the period 1990-2001 and the associated costs

Name of measure or initiative	*Objective*	*GHG affected*	*Type of instrument*	*Status for implementation*	*Implementing entity/ player*	*CO_2 reduction in 2001*	*Average annual CO_2 reduction for 2008-2012*
The transport sector						Mill. tonnes CO_2	Mill. tonnes CO_2
Higher fuel taxes[2]					Ministry of Taxation	1.2	1.2
Green owner tax on motor vehicles	More efficient energy consumption, CO_2 reduction	CO_2	Economic	Implemented	Ministry of Taxation	[1]	[1]
Information campaign on fuel consumption of new cars	More efficient energy consumption, CO_2 reduction	CO_2	Information	Implemented and completed	Road Safety and Transport Agency		
Energy-correct driving technique	More efficient energy consumption CO_2 reduction	CO_2	Information	Included in driving courses	Ministry of Justice		
Initiative on enforcing speed limits	More efficient energy consumption, CO_2 reduction	CO_2	Information, economic	Implemented	Ministry of Justice		
Establishment of intermodal installations	More efficient energy consumption, CO_2 reduction	CO_2	Economic (financial)	Ongoing implementation	Ministry of Transport, counties, municipalities, HUR, DSB		
Promotion of environmentally friendly goods transport	More efficient energy consumption, CO_2 reduction	CO_2	Economic (financial), information	Implemented	EPA, haulage contractors		
Reduced travel times for public transport	More efficient energy consumption, CO_2 reduction	CO_2	Regulatory (Administrative)	Ongoing implementation	Ministry of Transport, counties, DSB		
Spatial planning	Limitation of transport, CO_2 reduction	CO_2	Regulatory (Administrative)	Ongoing implementation	Counties, munici-palities		

[1] The effect of the various initiatives to improve the energy efficiency of cars, which in addition to the voluntary agreement with the motor industry includes the green car owner tax, information campaigns, energy labelling etc. was estimated in the Effort Analysis at 0.2 mill. tonnes CO_2 in 2001 and 0.6 mill. tonnes CO_2 per year in 2008-2012 cf. Annex B1.

[2] The reduction from the increased taxes on energy products such as fuel has been estimated for 2001. The reduction for 2008-12 is based on taxes on fuel remaining unchanged in real terms and demand not changing.

4.3.5.4 New and additional measures

In 2008 the government made an energy agreement with the majority of the parliament for the period 2008 to 2011. As to energy consumption and cost reductions the aim is a 4 per cent reduction toward 2020 compared to 2006. For the transport sector the government's aim is that biofuels should make a total of 5.75 per cent by 2010. In the energy extrapolation biofuel is implemented in the period 2008 to 2010 (1,5 per cent in 2008 and 3 per cent in 2009). Only biofuel can be used for meeting the goals of the agreement in that biofuel meets the demands formulated by the EU as to the future sustainability criteria.

The CO_2 emissions of the transport sector are expected to increase in the period, however not in the period 2009 to 2010, since the energy agreement determines that there should be a blending of 5.75 per cent biofuels in petrol and diesel. The use of biofuels in the transport sector gets a full impact on the transport sector's CO_2 emission.

Hydrogen cars are exempted from charges until 2012. The exemption from charges as for electric cars is extended until 2012. A test arrangement for electric cars has been established with an appropriation of DKK 10 million yearly in 2008-09, followed by DKK 5 million yearly in 2010-12.

In January 2009 the government reached a green transport agreement with the majority of the parliament with an overall aim to reduce the CO_2-emissions of the transport sector. Green Transport Vision Denmark is a long-term vision aiming at creating a green transport system that rests on a three-legged base being able to effectively reduce greenhouse gas emissions and at the same time maintain mobility in society.

The focus of Green Transport Vision Denmark is an environment friendly renewal of car taxes, more and better public transport plus new sustainable technologies. The long-term effort is a combination of a concrete endeavour to diffuse and mature for market new technologies through a comprehensive trial and a markedly strengthening of research into sustainable technologies on the transport area.

Denmark will become a laboratory so to speak for the development of sustainable technologies within the field of transport. With the establishment of Centre for Green Transport, Denmark is pacing up the development of sustainable technologies. Foreign partners are to think of Denmark as an attractive place to test new technologies. Funds worth DKK 200 million have been allocated for spreading and maturing for market new technologies, including large-scale trials with electric cars. A number of initiatives to reduce greenhouse gas emissions will be taken already in 2009 as a means to support increased energy effectiveness in the transport sector in the short term.

The following initiatives will be started in 2009:

- DKK 28 million has been allocated to campaigns to promote energy efficient driving. Experience shows that most people are able to save between 5 and 15 per cent fuel by adapting a special driving style.

- Recommendation and counselling with public purchase of energy efficient and environment friendly cars should promote the opportunity for a more energy efficient and environment friendly car fleet.

- Introduction of a certifications system for “green transport companies” and “green Cities” should promote the use of energy efficient cars and better use of the existing car fleet.

- Mid 2009 the taxi law will be changed so that new taxies have to be at least energy class C. Furthermore, particle filters will be required from 2011. Taxi law changes will have impact as of September 2009.

- Optimising of trucks’ aerodynamics (spoilers and strings) should be promoted through campaigns and best practice plus funds of DKK 42 million in the period 2009-12.

- In 2008 Denmark launched a trial with ”mega lorries”. This test will be considered expanded after the test period is finished.

- DKK 14 million has been allocated for energy labelling of vans in order to disclose how energy efficient vans are.

Environment friendly and energy efficient public transport will be promoted through a gradual phasing in of energy efficient transport solutions, which, among other things, can be supported by tests with energy efficient busses or busses driven by other propellants.

Denmark needs to become independent of conventional propellants at the expense of environment friendly propellants. The vision is to develop efficient electric cars within a reasonable time frame. As part of the government’s work concerning renewal of car taxes it will be examined how a system of taxation can be arranged in a way that promotes transport technologies such as electric cars and plug-in hybrids.

4.3.5.5 Measures no longer in place and measures increasing greenhouse gas emissions

Since *Denmark’s Fourth National Communication* to the Climate Convention in 2005, there have been no great changes in measures for transport.

4.3.6 Business sector

The business sector covers industry, building and construction and public and private service.

In 2007, the greenhouse gas emissions from the business sector decreased by 3 per cent from 9.5 million tonnes CO_2 equivalents in 1990/1995 to 9.2 million tonnes CO_2 equivalents in 2007 primarily due to the ceased production of nitric acid, although CO_2 constitutes the major part of greenhouse gas emissions in this sector. The sector is the only source of emissions of industrial gases. According to the February 2009 projection, the expected emission from the business sector is an average of 9.4 million tonnes CO_2 equivalents in 2008-2012.

The ongoing initiatives to reduce the emissions from the business sector include both promotion of energy savings and energy efficiency improvements, conversion of energy production to cleaner fuels and initiatives to reduce the emissions of industrial gases. Certain energy intensive businesses are also subject to allowance regulation as a consequence of the EU allowance directive.

Analyses have shown that there is a big potential for profitable energy efficiency improvements within the business sector, so improving energy efficiency is a vital area of action.

The measures implemented in the business sector are shown in Table 4.18.

4.3.6.1 CO_2

4.3.6.1.1 Industry, building and construction, trade and private service

Industry is responsible for most of the sectors' emissions of CO_2. The emissions come mainly from energy consuming activities in industry. Cement and brick production also contributes especially high levels of CO_2, due to the raw materials used.

The main instrument to reduce CO_2 emissions in energy-intensive industry is EU’s emission allowance scheme, covering about 120 industry installations.

Business and industry not covered by the emission allowance scheme are subject to a higher CO2 tax corresponding to the expected CO2 allowance cost.

Business and industry have introduced major energy efficiencies over the past 15 years. This is mainly due to a green tax package for the business sector, which was firstly introduced in 1995. The package contained a combination of taxes and rebates to enterprises. The package led to a higher CO_2 tax and the introduction of a space-heating tax for businesses.

In 1996, a scheme was introduced in which companies with high energy consumption have the possibility of gaining a discount on the taxes in return for entering into an agreement on energy efficiency improvements. In order to become eligible to entering an agreement, companies have to commit themselves to introduce energy management and carry out special investigations on specific areas of their primary production processes. In addition, they have to undertake energy flow screenings and implement investments improving energy efficiency with a simple economic payback time of less than four years. Danish experience shows, that introduction of energy management alone contributes to a 10-15 % reduction in the companies’ energy consumption. The combination of taxes and return of the proceeds was intended to ensure a marked reduction of businesses' CO_2 emissions without affecting their international competitiveness.

TABLE 4.18 MEASURES WITHIN THE BUSINESS SECTOR

Source: Danish Energy Agency and the Danish Environmental Protection Agency

Name of measure or initiative	*Objective*	*GHG affected*	*Type of instrument*	*Status for implementation*	*Implementing entity/ Player*
Business					
EU-CO_2 allowances (see under Energy)	CO_2 reduction	CO_2	Economic (financial)	Implemented amendment to implement the Linking Directive adopted by the Folketing May 2005	State authorities, energy producers, energy intensive enterprises
Revised CO_2-tax	CO_2 reduction Tax on non EU-ETS business	CO_2	Economic (financial)	Expected to be implemented by January 1, 2010	State authorities, energy intensive enterprises
Agreements on energy efficiency with business	Energy efficiency at energy intensive enterprises	CO_2	Voluntary agreements, economic (financial)	Implemented As of January 1, 2010, the scheme does not cover CO_2 any longer.	State authorities, business enterprises
Savings activities by elec. grid, gas and district heating companies (including for the domestic and public sectors)	Energy savings and efficiency, environmental effects including CO_2 reduction	CO_2	Information (advice, education, campaigns)	Implemented	State authorities, supply companies, enterprises
Tax on HFCs, PFCs and SF_6	Reduction of emissions of industrial gases	HFCs, PFCs, SF_6	Economic	Implemented	State authorities, enterprises
Regulation of use of HFCs, PFCs and SF_6	Reduction of emissions of industrial gases	HFCs, PFCs and SF_6	Regulation (admin.)	Implemented	State authorities, enterprises
Enterprise scheme on HFCs	To reduce use and thus emissions of HFCs in the refrigeration sector	HFCs	Economic (subsidies)	Initiated spring 2005	State authorities
Public service					
Circular on energy-efficiency in state institutions	Energy savings, technology promotion, environmental effects incl. CO_2 reduction	CO_2	Regulation (admin.)	Implemented	State authorities
Electricity Saving Trust – campaigns and A club to promote efficient appliances (incl. elec. Heating conversion and efficient appliances in households)	Energy savings, technology promotion, environmental effects incl. CO_2 reduction,	CO_2	Information (market influence), economic (subsidies – primarily to elec. heating conversion)	Implemented	Institutions, producers

The potential for better energy efficiency in the business sector is still great. Analyses from the Danish Energy Agency show a potential of 25 % in energy savings in the industry. For the transport sector and offshore activities, the potential is up to 35 %.

The action plan for a renewed energy saving effort from 2005 contains a number of initiatives with the objective to save energy in the business sector:

- Efficiency consultancy and information efforts, including more focus on realising the savings assigned.
- Promotion of sales of energy services. Efforts for business and industry is organised so that energy services are promoted. Information campaigns are still running to give the market a push.
- Promotion of energy management, energy-conscious planning, energy-correct procurement and bench-marking of energy consumption.
- Promotion of exploitation of surplus heat.

The action plan was evaluated in December 2008. New political measures will be adopted during 2009 in order to organise the energy saving effort more effectively and to implement new energy saving measures. December 15th 2010 a broad majority of the Danish parliament passed a bill on the establishment of an energy saving program with ten year duration (2010 to 2020). The aim of the program is to strengthen the energy saving efforts as a total in order to achieve a more coherent and efficient approach. In order to do so a reorganisation of the efforts is needed. Resultantly, The Electricity Saving Fund will be replaced by The Centre for Energy Savings, which will attend to the development and implementation of campaigns, market impact activities, etc. The program will cover energy savings in all sectors except the transport sector.

In addition, the Energy Saving Council is established to aid the Danish Energy Agency to improved coordination of the total Danish energy saving efforts.

Finally, the program aims to consolidate and fortify the minister's and the Danish Energy Agency's regulatory assignments concerning energy savings.

4.3.6.1.2 Cement

Cement production results in big emissions of CO_2. The production process itself is very energy-intensive, and a large quantity of CO_2 is emitted in connection with the production process.

Cement production in Denmark is concentrated in a single company. About half of the emissions come from the company's energy consumption and the other half from chalk, which is one of the raw materials used in the process. A lot has been done within the cement industry. For example, in the last 20 years the Danish cement producer has significantly reduced its CO_2 emissions per tonne cement produced. In the February 2009 projection, the CO_2 emissions are assumed to be constant at an average of 2004, 2005 2006 level for the years 2007-2025. The company's long-term target is substitution of 40% of the fossil fuel.

Since 2005, all CO_2 emissions from cement production in Denmark are subject to the EU ETS.

4.3.6.1.3 Public service

Work to improve energy efficiency in the public sector has been going on for many years, and considerable savings have been achieved. However, there are still economically viable possibilities for savings. This is illustrated by the fact that there is a very big difference in consumption (per m^2) between comparable institutions.

Data on energy consumption in the public sector have been collected for some years as a means of rendering the sector's energy consumption visible. There are complete inventories of energy consumption in municipalities and state institutions.

The action plan for a renewed energy saving effort from 2005 also contains a number of initiatives with the objective to save energy in the public sector. The main initiatives in this respect are:

- A circular on energy-efficiency in state institutions (including implementation of profitable energy savings, energy-efficient behaviour and operation and energy-efficient procurement).
- Guidelines for procurement in the public sector, e.g. through preparation of environmental guidelines for large buyers in the public sector.
- Energy labelling and energy-checking of large properties.
- A-club for public institutions, introduced by the Electricity Saving Trust. The members of the club undertake only to buy energy efficient appliances that meet specific requirements given in guidelines for procurement and in a positive list.
- Campaigns by the Electricity Saving Trust on energy efficient lighting, ventilation and office equipment, etc.
- Consultancy by supply companies for institutions.

As mentioned above, the action plan was evaluated in December 2008. New political measures will be adopted during 2009 in order to achieve further energy savings in the public sector.

Public institutions are encouraged to sign a Curve Breaker Agreement with the Danish Electricity Saving Trust. In September 2008, the Danish Minister for Climate and Energy agreed to reduce the energy consumption in her department by 15 % in three years. Also the Prime Minister’s Office signed a Curve Breaker Agreement with the Danish Electricity Saving Trust in June 2008. Under the terms of the agreement the Prime Minister’s Office will reduce electricity consumption by 13% in 2011.

4.3.6.2 N_2O, nitrous oxide

4.3.6.2.1 N_2O from the production of nitric acid

The emission of nitrous oxide (N_2O) from the production of nitric acid in connection with the production of fertilizer in Denmark has only been included in Danish emissions inventories in recent years, even though production from the single plant in Denmark, with associated emissions, has taken place for many years, including 1990, Denmark’s basis year for emissions of nitrous oxide.

In summer 2004, however, the owner decided to stop production of fertilizer and so production of nitric acid in Denmark. Emissions of nitrous oxide from production of nitric acid in 2003 corresponded to 0.9 mill. tonnes CO_2

equivalents. In 2004 emissions will be about one-half of this, and from 2005 they will cease entirely, and probably also in 2008-2012 cf. market conditions for production of fertilizer in Europe.

4.3.6.3 HFCs, PFCs and SF_6

The industrial sector is the only sector which in practice emits the industrial gases HFCs, PFCs, and SF_6 according to the emission inventories. These gases are used for several purposes including as cooling and foaming agents, etc. (HFCs), cooling agents (PFCs), and insulator gas in high-tension contacts (SF_6).

The Danish regulation of emissions of the industrial greenhouse gases (HFCs, PFCs, and SF_6) is 2-phased, since there is a consumer tax on the use of the substances and also a statutory order on the phasing out of use of the gases in new facilities and products.

4.3.6.3.1 Taxes on HFCs, PFCs and SF_6

Taxes corresponding to their GWP have been imposed on each of the greenhouse gases from March 2001 in combination with the Danish CO_2 tax of DKK 0.1 per kg CO_2 as described in section 4.3.3. This means that HFC-134a is subject to a tax of DKK 130/kg, as it has a GWP of 1,300. There is a ceiling of DKK 400/kg so although SF_6 has a GWP of 23,900, the tax is only DKK 400/kg and not DKK 2,390/kg.

The tax is imposed on the substances on importation because none of them is produced in Denmark. The tax is payable whether the substances are imported as pure substances or are part of imported products. If the content in the products is not known, the tax is based on a fixed tariff.

The tax is payable on a wide range of products, including:

- Refrigerating and freezing plants
- Air-conditioning plants
- PUR foam for cooling plant, district heating pipes, insulated gates and doors, panels for refrigeration and freezer rooms, extruded polystyrene for insulation (XPS foam), jointing foam
- Spray canisters
- Insulation gas

The tax is also payable on service on existing and new installations/products.

4.3.6.3.2 Regulation of HFCs, PFCs and SF_6

On 15 July 2002, a statutory order on the regulation of certain industrial greenhouse gases came into force.

This order includes a general ban on the use of industrial greenhouse gases in a great number of new facilities and products from 1 January 2006, including household cooling and freezing appliances, PUR foam, etc. There are, however, certain exceptions to the general phase-out date. For example, the ban will only apply to new commercial cooling plants, air-conditioning plants, etc. from 1

January 2007. Other exceptions are new sound-insulating windows, in which SF_6 has been banned since 1 January 2003, and PFCs, on which there has been a general ban since September 2002. However, some products and applications are exempted from the ban. This applies, for example, to service on existing plants, mobile cooling plants, including mobile air conditioning plants, the use of HFCs in cooling and air conditioning plants with fillings between 0.150 and 10 kg HFC, SF_6 in high voltage plants, etc.

To ensure the best possible implementation of the phase-out dates for the refrigeration sector, a total of DKK 12 mill. was reserved for the period 2005-2007 for development of alternatives and for subsidies for implementation of the alternatives developed in the previous years. A knowledge centre for HFC-free cooling has been established. This centre disseminates knowledge and offers technical assistance.

4.3.6.4 New and additional measures

Although many important initiatives have already been implemented in order to achieve the 2008-2012 reduction target under the Kyoto Protocol and the EU Burden Sharing Agreement, new knowledge included in a preliminary update of Denmark's energy and CO_2 emission projection (April 2009) suggested, that additional initiatives had to be taken to ensure that Denmark can live up to it very ambitious target. The Government in November and December 2009 therefore adopted additional initiatives, including the decision to allocate DKK 400 mill. to support the substitution of individual oil based furnaces for modern, efficient, low-carbon emitting heating solutions, including systems based on renewable energy such as heat pumps and solar heating".

The EU Climate and Energy Agreement from December 2008 contain ambitious reduction obligations for Denmark until 2020. For the sectors *not* covered by the ETS in Denmark, including the non-ETS activities in the business sector, Denmark has taken on a challenging 20 per cent reduction target.

In 2010, the government will present a new Climate Strategy for the period 2013-2020, focusing on possible further cost effective actions until 2020 for the purpose of achieving Denmark's 2020 reduction target outside the EU ETS. This may also entail additional measures in the business sector outside the EU ETS.

4.3.6.5 Measures no longer in place and measures increasing greenhouse gases

Apart from the above mentioned changes, no significant changes in the measures for the business and industry sector have taken place since *Denmark's Fourth National Communication* to the Climate Convention in 2005.

4.3.7 Agriculture, forestry and fisheries

The primary occupational sectors agriculture, forestry and fisheries are generally considered as one single economic sector in Denmark. However, the importance of the individual sectors differs greatly with respect to Denmark's emissions and uptake of greenhouse gases. Agricultural farms have emissions of methane and nitrous oxide. The net uptake of CO_2 in Denmark's forests is included under

Forestry. However, CO_2 emissions from energy use in all three sectors are considered under one heading because there is no breakdown of these in the annual energy statistics. Table 4.19 shows measures for emission reductions within agriculture and forestry.

TABLE 4.19 MEASURES WITHIN AGRICULTURE, FORESTRY AND FISHERIES TO LIMIT EMISSIONS OF GREENHOUSE GASES

Source: Ministry of Food, Agriculture and Fisheries, Danish Institute of Agricultural Sciences, Danish Forest and Nature Agency, Forest and Landscape Denmark and *Denmark's CO_2 emissions - the effort in the period 1990-2001 and the associated costs*

Name of measure or initiative	***Objective***	***GHG affected***	***Type of instrument***	***Status for implementation***	***Implementing entity/ player***	***CO_2 reduction in 2001***	***Emissions reduction 2010***
Agriculture						mill. tonnes CO_2 eq.	mill. tonnes CO_2 eq.
Action Plan for the Aquatic Environment I+II and Action Plan for Sustainable Agriculture	Reduction of N run-off from agriculture by 100,000 t N/year	N_2O	Regulation (order), economic, information	Implemented (1987, 1991, 1998)	State and county authorities	1.6	2.2
Action Plan for the Aquatic Environment III	Further reduction of N and P losses from agriculture	N_2O	Regulation (order), economic	Implemented (2004)	State and county authorities		0.2[1]
Ban on burning straw on fields	Less air pollution	N_2O	Regulation (order)	Implemented (1989)	State and county authorities		
Ammonia action plan and the new statutory order on manure	Reduced emissions of ammonia	N_2O	Regulation (order)	Implemented (2001)	State and county authorities		0.03
Planting of windbreaks	Binding of CO_2	CO_2	Economic (subsidies)	Implemented (1960s)	State		0.14
Biogas plant	Reduced CO_2 and methane emissions and better exploitation of manure	CO_2, N_2O and CH_4	Economic (subsidies)	Implemented (1987)	State	0.2	0.036
Forestry							
Subsidies scheme for private afforestation on agricultural land	Forest area increased by 450,000-500,000 ha in 100 years.[2]	CO_2	Economic	Implemented (through the Forestry Act)	Danish Forest and Nature Agency	0.021	0.116 [3] (0.120 for “2010”)
Public afforestation (state, counties and municipalities)	Forest area increased by 450,000-500,000 ha in 100 years.[2]	CO_2	State: regulation/ counties and municip.: voluntary	Implemented	Danish Forest and Nature Agency, counties and municipalities	0.027	0.069 [3] (0,068 for “2010”)

[1] In addition to the effect stated of Action Plan III, it is estimated that the effect under Action Plan III of the general structural development will be a reduction of 170,000 tonnes CO_2 equivalents/year, and that the effect of the CAP reform will be an additional reduction of 230,000 tonnes CO_2 equivalents/year. All the estimated effects are in the new baseline projection ”with measures” The mid term evaluation of Action Plan III revealed that the expected effects for reduction af N leaching will be difficult to reach .

[2] Currently, only about 1850 ha forest are planted each year (average 1990-2004), the objective requires 4,500 ha- 5,000 ha. per year

[3] Calculation on the basis of actual afforestation 1990- 2004, which has been too small.

In 2007, agriculture was responsible for 18% of Denmark's total greenhouse gas emissions and is the most important sector regarding the emissions of N_2O and CH_4. In 2007, the contribution of N_2O and CH_4 from agriculture to the total emission of these gases was 92 % and 67 %, respectively. The N_2O emission decreased by 31 % and the CH_4 emission by 4 % from 1990 to 2007 (*Nielsen et al., 2009a*). The greenhouse gas emissions from agriculture consisted of approx. 84% from methane and nitrous oxide and 16% of CO_2 from the burning of fuel.

Measures that are used in the agricultural sector and that have affected or will affect the sector's greenhouse gas emissions include:

- Ban on burning of straw on fields
- Action Plans for the Aquatic Environment I and II and Action Plan for Sustainable Agriculture
- Action Plan for the Aquatic Environment III
- Ammonia Action Plan
- Action Plan for Joint Biogas Plants and subsequent follow-up programmes
- Environmental Approval Act for Livestock Holdings
- New Energy Policy Agreement, supporting biogas
- Agreement on Green Growth 2009: Reduction of the agricultural sector's emissions of greenhouse gasses by an anticipated 800,000 tonnes of CO_2-eq annually as a consequence of the energy, nature and environment initiatives.

4.3.7.1 Methane, CH_4

Methane comes mainly from the agricultural sector, contributing with 67% of total Danish CH_4 emissions in 2007. The emissions in 2007 were 182.60 Gg, corresponding to 3.84 mill. tonnes CO_2 equivalents (*Nielsen et al., 2009a*). The methane is formed through enteric fermentation in farm animals and from conversion of carbohydrates in manure.

Agriculture's biggest contribution to the methane emissions comes from dairy cows.

In the digestion process, methane is a by-product of the fermentation of feed in the rumen, primarily from grass and green fodder. In addition, methane is formed during conversion of manure under anaerobic conditions if the temperature is sufficiently high. These conditions normally occur in manure stores and housing systems with liquid manure or deep litter.

The emission of methane from agriculture has declined in the period from 2003 to 2006, but methane emission is expected to increase slightly in the near future, as was the case in 2007, due to that the number of dairy cows in the future is not reduced as previously assumed. The main reason is the currently planned increase in the Danish milk quota, which will, except in 2009 and 2010, reduce the number of cows, but only at a low pace. In the long term a steady milk production is expected to lead to a decline in the methane emission, primarily due to improved efficiency in cattle farming.

4.3.7.2 Nitrous oxide, N_2O

Agriculture is the biggest source of nitrous oxide emissions in Denmark. Of the total N_2O emissions of 21.870 Gg in 2007, 92% or 20.122 Gg, corresponding to more than 6.24 mill. tonnes of CO_2 equivalents, came from agriculture (*Nielsen et al., 2009a*). Nitrous oxide may be emitted during microbial decomposition of organic matter. The process occurs in some types of manure stores and during conversion of minerally and organically bound nitrogen (e.g. manure and applied wastewater sludge) in the soil. Some of the leached nitrogen is also converted into nitrous oxide. Nitrogen entering the soil with fertiliser and manure and in plant residues is the main cause of nitrous gas emissions. Ammonia volatilisation contributes to the greenhouse effect because some of the ammonia nitrate ends up as nitrous oxide in the atmosphere. Ammonia volatilisation into the atmosphere comes almost exclusively from agriculture. In 2006 the ammonia emissions from agriculture were 58,977 tonnes NH3-N (updated value December 2009), with a nitrous oxide contribution corresponding to 5.4 % of agriculture's nitrous oxide emissions. Ammonia volatilises from manure, fertiliser, sludge, crops and treatment of straw with ammonia. The emissions particularly occur during handling of manure in animal housing, during storage of manure, during transport of manure, and from grazing animals[21] (Nielsen et al., 2009a).

The main reason for the drop in the emissions of N_2O in the agricultural sector of 31% from 1990 to 2007 is legislation to improve the utilisation of nitrogen manure. The legislation has resulted in less nitrogen excreted per unit livestock produced and a considerable reduction in the use of mineral fertilisers. The basis for the N_2O is then reduced (*Nielsen et al., 2009a*). Implementation of the Action Plan for the Aquatic Environment II and III contribute the most to this reduction[22,23].

4.3.7.2.1 Action Plans for the Aquatic Environment I and II and Action Plan for Sustainable Agriculture

One of the main purposes of the Action Plans for the Aquatic Environment and the Action Plan for Sustainable Agriculture was to reduce agriculture's emissions of nitrogen to the aquatic environment.

The action plans have been implemented as regulation of farmers' behaviour. The Action Plan for the Aquatic Environment I was initiated in 1987 and the Action Plan for Sustainable Agriculture in 1991. These action plans included particularly requirements concerning winter green fields and better utilisation of manure. The Action Plan for the Aquatic Environment II from 1998 contained a number of additional measures, including re-establishment of wetlands, afforestation, agreements on environment friendly agricultural measures, organic farming on an additional 170,000 ha, improved use of fodder, reduced animal density, use of catch crops, reduced fertilisation norms and stricter requirements concerning the

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[21] Mikkelsen et al., 2005: Mikkelsen, M.H., Gyldenkærne, S., Poulsen, H.D., Olesen, J.E. & Sommer, S.G. (2005). Opgørelse og beregningsmetode for landbrugets emissioner af ammoniak og drivhusgasser 1985-2002. Arbejdsrapport fra DMU Nr. 204. (in Danish).

[22] Olesen et al., 2004: Olesen, J.E., Petersen, S.O., Gyldenkærne, S., Mikkelsen, M.H., Jacobsen, B.H., Vesterdal, L., Jørgensen, A.M.K., Christensen, B.T., Abildtrup, J., Heidmann, T. & Rubæk, G. (2004). Jordbrug og klimaændringer - samspil til vandmiljøplaner. DJF rapport Markbrug nr. 109. (in Danish).

[23] Olesen, 2005: Olesen, J.E. (2005). Muligheder for reduktion af drivhusgasemissioner i jordbruget. I: Olesen, J.E. (red). Drivhusgasser fra jordbruget - reduktionsmuligheder. DJF rapport Markbrug nr. 113, s. 12-32. (in Danish).

use of nitrogen in manure. The aim, which has now been reached, was to reduce nitrogen leaching by 100,000 tonnes N/year up to the year 2003[24].

These action plans have, in particular, reduced the emissions of nitrous oxide. There have presumably also been small effects on methane emissions from manure stores, particularly as a consequence of increased use of anaerobic fermentation of manure in biogas plants. The increased use of catch crops, larger areas with organic farming and re-establishment of wetlands must also be expected to lead to increased storage of carbon in the soil.

Most of the changes in nitrous oxide emissions from agriculture in the period since 1990 can be attributed to these action plans. However, it has been calculated that even without the action plans there would have been a reduction in emissions, although to a much lesser extent. The effect of these action plans on emissions of nitrous oxide has been calculated at about 2.2 mill. tonnes CO_2 equivalents/year[19]. There are no estimates of the effect of the Action Plans I and II for the Aquatic Environment and the Action Plan for Sustainable Agriculture on carbon storage in the soil.

4.3.7.2.2 Action Plan for the Aquatic Environment III

With the political agreement on the Action Plan for the Aquatic Environment III of 2 April 2004, a number of measures were implemented to follow up on the results attained via the previous plans. This third action plan contains targets with respect to nitrogen, phosphorus, sensitive natural areas, and slurry odour. This is a 10-year agreement, and in evaluations in 2008 and 2011 initiatives will also be combined with the Water Framework Directive and the Habitats Directive. Special emphasis is on the use of catch crops, stricter requirements for use of manure as well as afforestation and agro-environmental measures. In addition, the agreement includes research initiatives aimed at slurry odours and reduction of emissions of nutrients, e.g. research into technology to manage slurry, ammonia etc. The effect of the action plan in 2008-12 is estimated at 0.2 mill. tonnes CO_2 equivalents/year[25].

At the midterm evaluation of the Aquatic Plan for the Environment III 2008 covering the years 2004-2007 no reductions in the production of animal manure has been recorded, nor for a further decrease in the use of mineral fertilizers. Furthermore, no significant reduction in nitrogen leaching has been proved for the investigated period (Waage Petersen et al., 2008). Thus, no change in the key parameters that provided reduction in the emissions of greenhouse gasses in the earlier action plans for the aquatic environment have happened so far, so it may be difficult to reach the above mentioned target.

4.3.7.2.3 Environmental Approval Act for Livestock Holdings

The Environmental Approval Act for Livestock Holdings was implemented January 1st, 2007 providing national minimum requirements for environmental

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[24] Grant et al., 2000: Grant, R., Blicher-Mathiesen, G., Jørgensen, V., Kyllingsbæk, A., Poulsen, H.D., Børsting, C., Jørgensen, J.O., Schou, J.S., Kristensen, E.S., Waagepetersen, J. & Mikkelsen, H.E. (2000). Vandmiljøplan II - midtvejsevaluering. Miljø- og Energiministeriet, Danmarks Miljøundersøgelser, Silkeborg, Denmark. 65 pp (in Danish).

[25] Olesen et al., 2001: Olesen, J.E., Andersen, J.M., Jacobsen, B.H., Hvelplund, T., Jørgensen, U., Schou, J.S., Graversen, J., Dalgaard, T. & Fenhann, J. (2001). Kvantificering af tre tiltag til reduktion af landbrugets udledning af drivhusgasser. DJF-rapport Markbrug 48. (in Danish).

protection (odour, ammonia, nitrate, phosphorous, landscape, etc.) when livestock holdings above 75 Livestock Units (LU) are established, expanded or changed. The purpose of the act is to ensure the use of best available techniques (BAT). The measures covered by the Environmental Approval Act for Livestock Holdings are:

- 300 m buffer zones around ammonia sensitive areas where no extension of livestock farms can take place if such an extension would lead to increased ammonia deposition in natural areas vulnerable to ammonia.
- Demand for reduction of ammonia emissions relative to production facility with lowest ammonia emission norm: 2007: 15%, 2008: 20%, 2009: 25%
- Demands for injection of animal slurry on black soil and grass within buffer zones (1 km from vulnerable natural areas).
- Demand for fixed cover on most new containers for solid manure and slurry tanks (depending on distance to neighbours and vulnerable natural areas).
- Reduced number of LU/ha when in Nitrate vulnerable areas with low denitrification capacity
- Regulation of phosphorous surplus on manure spreading areas

The effect of these measures on green house gas emissions has not yet been quantified.

4.3.7.2.4 The Ammonia Action Plan

Ammonia emitted from agriculture will stimulate emissions of nitrous oxide when it is deposited in other ecosystems. Reducing ammonia evaporation will therefore also result in a reduction of nitrous oxide emissions. An Ammonia Action Plan which was adopted in 2001 will, together with the Action Plan for the Aquatic Environment I and II, reduce ammonia emissions by 15-20,000 tonnes of nitrogen annually. Hereby ammonia evaporation from agriculture should be reduced from 90,000 tonnes of nitrogen in the mid 1990s to approx. 60,000 tonnes of nitrogen in 2004.

The measures covered by the Ammonia Action Plan are:

1) Optimisation of manure handling during housing for cattle, pigs, poultry and fur animals.
2) Rules on covering storage facilities for solid manure and slurry tanks.
3) Ban on surface spreading and reduction of the time from field application of manure to incorporation.
4) Ban on ammonia treatment of straw.

These measures are estimated to lead to a reduction in emissions of nitrous oxide corresponding to 34,000 tonnes of CO_2 equivalents annually by 2010. A shorter period of exposure for spread manure has the greatest effect of 13,000 tonnes of CO_2 equivalents annually[20].

4.3.7.2.5 Ban on burning of straw

The purpose of the ban has been to reduce air pollution from burning of straw.

The ban has resulted in greater return of carbon to the soil and increased use of straw as a fuel. Both uses will result in a net reduction in CO_2 emissions. Not burning straw prevents the methane and nitrous oxide emissions associated with the burning. On the other hand, there are some emissions of nitrous oxide in connection with the return of nitrogen to the soil when the straw is mulched.

The measure works by regulating behaviour, and the ban was introduced from 1990. The measure was implemented in the form of a statutory order under the Environmental Protection Act, and compliance is monitored by the local authorities.

The initiative has also caused increased carbon storage in the soil, but this has not been quantified separately so far.

4.3.7.3 CO_2

Implemented measures

4.3.7.3.1 Energy consumption by agriculture

The green tax package and the grant scheme for energy savings in the business sector are resulting in energy savings and thus a reduction in CO_2 emissions from use of energy in agriculture.

4.3.7.3.2 Biogas

Biogas from digestion of manure and organic wastes has a number of advantages when used to substitute fossil energy: reductions in emissions of greenhouse gases, better exploitation of manure as fertiliser, recycling and use of organic wastes for energy and fertiliser purposes etc.

In order to ensure renewed growth the politically fixed subsidy on the sales price of electricity production based on biogas was adjusted by the Energy Policy Agreement of 21 February 2008. The agreement resulted in the Law on Promotion of Renewable Energy of 27 December 2008. Consequently the latest projection from the Danish Energy Agency expects an increase in the biogas production from 4 PJ in 2007 to 12 PJ in 2020. This is expected to imply a five to six fold increase in the volume of manure digested meaning that close to 30 percent of all manure shall be used for biogas generation before 2020.

The increase is expected to result in annual emissions of methane and nitrous oxide from agriculture being additionally reduced by approx. about 0.2 mill. tonnes of CO_2 equivalents by 2020. An additional reduction of 0.4 mill. tonnes of CO_2 in greenhouse gas emissions from the energy sector is expected by 2020 due to reduced CO_2 emissions from substitution of fossil fuels, primarily natural gas, with the increased production of biogas.

4.3.7.3.3 Planting of windbreaks

The objective of planting windbreaks is to reduce wind erosion and ensure greater biodiversity. Planting of windbreaks is supported under conditions described in the Statutory Order on subsidies for planting windbreaks and biotope-improving measures (Statutory Order no. 1101 of 12/12/2002). Support is granted under the EU Rural Districts Programme. Since the end of the 1960s about 1,000 km of tree-lined windbreaks have been planted with government subsidies. It is also estimated that about 30% more has been planted without subsidies. Estimates indicate that planting of windbreaks leads to CO_2 sequestration in woody biomass of about 130,000 tonnes CO_2/year[26].

4.3.7.3.4 Forestry

Forestry is important due to its CO_2 and emissions being a consequence of trees growing, respiring and decomposing. An average Danish forest contains a considerable store of CO_2 absorbed from the atmosphere. When new forests are established, new CO_2 stores are created. Afforestation is therefore a useful climate policy instrument.

Calculating the total CO_2 accumulation in forests is complicated. Almost all existing forests are established for wood production, e.g. logs and timber. Whether there are net emissions or net sequestration of CO_2 from an existing forest depends on many factors, including its age and species distribution, and the management regime applied.

Compared with other sectors, forestry has very low energy consumption. Green accounting and environmental management are being developed in the sector, partly with a view to determining whether the use of fossil fuels can be reduced.

The national forest programme includes evaluation of the possibilities offered by the Kyoto Protocol for economically viable CO_2 sequestration in forests. Such measures should be implemented without undermining the Protocol's environmental integrity or counteracting established measures in support of sustainable forest management. The same should also apply to forest projects in connection with CDM and JI. The forests are managed with a view to multiple-use and sustainability, and carbon sequestration is one of several objectives.

The political measure to increase carbon sequestration is the declaration of intent from 1989 to double the forested area in Denmark within 100 years. This measure relates to Article 3.3. of the Kyoto Protocol.

Various measures have been taken towards achieving this goal. For instance, a government grant scheme has been established as an incentive for afforestation on private agricultural land. Also, the state itself establishes new forests, and some private individuals choose to establish forests on agricultural land without a government grant.

Primarily the CO_2 balance is affected by these measures. Forests raised on agricultural land accumulate far more biomass than the previous agricultural land-use. The forest biomass contains about 50% carbon, which is absorbed as CO_2 through photosynthesis. Probably, additional carbon is stored in the organic matter in the soil due to a larger supply of dead organic matter and the absence of soil preparation. Denmark has so far reported on sequestration in litter (forest floors) developing after conversion from agriculture to forestry. Previous studies have not indicated any consistent change in mineral soilC stocks (Vesterdal et al., 2002,

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[26] Gyldenkærne et al, 2005: Gyldenkærne, S., Münier, B., Olesen, J.E., Olesen, S.E., Petersen, B.M. & Christensen, B.T. (2005). Opgørelse af CO_2-emissioner fra arealanvendelse og ændringer i arealanvendelse. Arbejdsrapport fra DMU (under preparation,, in Danish).

2007). The effect of afforestation on other greenhouse gases, such as nitrous oxide and methane has not been properly clarified. However, the acidification of nitrogen-rich former agricultural land may stimulate the formation of nitrous oxide, and blocking of drains after afforestation and the resulting water stagnation could increase methane emissions. Increased methane and nitrous oxide emissions could counteract the positive effect of afforestation on CO_2 sequestration. However, since sufficient information is still unavailable on changes in the methane and nitrous oxide emissions, analyses of the consequences are only carried out for CO_2.

The Danish Forest and Nature Agency is responsible for policies on afforestation on private agricultural land and on state-owned land.

Afforestation on 18,000 hectares of privately owned farmland, corresponding to additional binding of 323,000 tonnes of CO_2, was subsidised in 1990-2007.

The state, counties, and municipalities have contributed approx. 7,200 hectares of new forest since 1990. Only little is known about private afforestation without subsidies. It is assumed that about 600 ha are planted annually. An ongoing project on satellite imagery will substantially improve the knowledge on the total afforested area since 1990.

The annual quantities of CO_2 sequestrated as a consequence of subsidised private afforestation, public afforestation and the total afforestation are summed up in Table 4.20.

TABLE 4.20 AREA OF AFFORESTATION AND CO_2 SEQUESTRATION IN WOODY BIOMASS AND FOREST FLOORS (LITTER) SINCE 1990

Source: 1990-2007: The National Inventory Report (NIR), NERI April 2009.

CO_2 sequestration in Gg	**1990**	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Private afforestation with subsidies, ha	0	178	1764	1288	1497	1534	463	2454	3061	0
CO_2 seq. (Gg)	0	-1.0	-16	-21	-26	-34	-40	-56	-71	-84
Public afforestation, ha	119	537	378	234	235	383	251	276	164	425
CO_2 seq., Gg	0	-6.0	-23	-27	-31	-36	-40	-44	-47	-50
Total afforestation including private afforestation without subsidies, ha	**730**	**1326**	**2753**	**2133**	**2343**	**2528**	**1325**	**3341**	**3836**	**1036**
Total CO_2 seq. Gg	**0**	**-15**	**-70**	**-86**	**-102**	**-123**	**-140**	**-158**	**-184**	**-209**

Carbon sequestration in trees after afforestation is calculated by a simple model. Sequestration is obtained as the planted area multiplied by the carbon absorption for the age class of the trees. The absorption is calculated by using Danish increment Tables for Norway spruce, as representative of conifers, and oak, as representative of deciduous trees[27].

The areas in Table 4.20 for the period 1990-2001 are based on the evaluation of the afforestation programme carried out in the period[28] together with a national forest inventory carried out recently[29]. The areas for 2005-2020 are based on a slightly revised projection[30]. Afforested areas do not include plantations of Norman Christmas trees in short rotation on agricultural land.

The quantities of carbon are obtained by estimating the carbon content of the woody biomass using relevant conversion factors. The stem biomass for conifers and the total above-ground woody biomass for deciduous trees are converted into total above-ground and below-ground biomass by multiplying with an expansion factor. An expansion factor of 2 is used, which is somewhat higher than the expansion factors used for forests planted before 1990 - 1.8 for conifers and 1.2 for deciduous trees. The reason for this is that the expansion factor depends on age.

The stem biomass thus constitutes a very small part of the total biomass in entirely young trees. The expansion factor therefore decreases exponentially towards a value between 1 and 2 as the trees grow older[31].

Since there are neither Danish expansion factors nor age-dependent expansion functions, the expansion factor of 2 is being used until better methodologies are available. The total biomass is subsequently converted into tonnes dry matter using the conversion factors 0.38 tonnes dry matter m^{-3} for conifers and 0.56 tonnes dry matter m^{-3} for deciduous trees[32]. The quantity of carbon is calculated by multiplying with the conversion factor 0.5 tonnes C/tonne dry matter. Carbon sequestration in products can be included in the calculations, but the figures presented represent only the quantity of carbon that is sequestered in the forest ecosystem. This quantity of carbon is stored in the total living biomass (incl. roots) of the trees and in slash. The quantity of sequestered carbon is summed by the model for the different year classes of afforested areas since 1990, providing the total carbon sequestration for the differently aged stands in specific years. Studies of soils in a time series of afforested stands have shown that, compared with the biomass carbon pool, there is no great change in the soil carbon pool during the first 30 years after afforestation[33]. It is assumed in the models that the growth of the trees corresponds to site index 2 (on a scale decreasing from 1 to 4), and that there is a ratio of 1 to 3 between the area afforested with conifers and deciduous trees[34].

Afforestation offers many other benefits in addition to CO_2 sequestration. Besides being valuable for outdoor recreation it provides valuable groundwater protection and protection of habitats for fauna and flora. Forest is also a highly valued type

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[27] Møller, 1933
[28] Forest and Nature Agency, 2000
[29] Larsen and Johannsen, 2002
[30] Danish Energy Authority, 2001
[31] Schöne and Schulte, 1999
[32] Moltesen, 1988
[33] Vesterdal et al., 2002
[34] More information on the methods can be obtained from the Danish Energy Authority, 2001, and Vesterdal, 2000.

of nature in terms of cultural values and landscape amenity. In addition to carbon sequestration, afforestation thus contributes to a wide range of values. The continued growth of new forests will provide for carbon sequestration on a long-term basis. If the objective of doubling the Danish forested area within 100 years is achieved, the new forests will sequester about 250 mill. tonnes of CO_2 over the next approximately 120 years. Owing to the legal protection of forest land use, the sequestration is expected to be permanent. If the objective of doubling the forest area is to be achieved, however, an enhanced rate of planting will be needed.

Danish forest policy is moving towards more near-to-nature forest management. It is not certain what this change in management will mean for storage of carbon in the existing forested area in the future. Some near-to-nature forest management such as longer rotation and more permanent forest cover aid more CO_2 storage, while grazing and more open areas have the opposite effect. For state-owned forests (about. 25% of the forested area) it has been decided to introduce near-to-nature forest management. The Forestry Act of 2004 also provides for better opportunities for private forest owners to move in this direction. However, at the moment it is uncertain how far and how quickly this will happen.

Another initiative related to forestry concerns Denmark's election of article 3.4 under the Kyoto Protocol, i.e. the sequestration of C in forests existing by 1 January 1990.

In forests remaining forests, net C sequestration is calculated from the net annual increment (gross wood increment minus harvested wood) following conversion from m3 of total woody biomass to C. Net C sequestration in forests remaining forests is the result of relatively low harvest intensity, especially for conifers. The harvesting intensity for broadleaves has also been decreasing since the late 90'ies. The high net C sequestration is also partly a result of an uneven age class distribution with relatively many young stands. The time series for forests remaining forests is given in Table 4.21. Carbon sequestration in other forest C pools has not been addressed until now. However, the new National Forest Inventory will enable to report on dead wood. For litter and soil C, Denmark will apply the non-source principle, i.e. Denmark will document by repeated sampling of forest plots sampled in 1990 and 2008-9 that forest soils are not net sources of CO_2.

For the period 2008-12 it must be noted that only 183 Gg CO_2 yr^{-1} can be accounted for under Article 3.4 of the Kyoto Protocol either as credits up to an annual amount of (-)183 Gg if the forest is a net sink or as debits up to an annual amount of (+)183 Gg if the forest is a net source.

TABLE 4.21 THE REMOVALS OF CO_2 IN FORESTS REMAINING FORESTS 1990
Source: 1990-2007: The National Inventory Report (NIR), NERI April 2009.

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007
Gross uptake of CO_2 (Gg yr^{-1})	-5742	-5742	-6083	-6083	-6083	-6083	-6083	-6083	-6083	-6594
Loss of CO_2 in harvested wood (Gg yr^{-1})	2911	2765	5489	2618	2358	2658	2757	4411	3509	3824
Net annual sink for CO_2(Gg yr^{-1})	**-2831**	**-2977**	**-594**	**-3465**	**-3725**	**-3424**	**-3326**	**-1672**	**-2574**	**-2770**

Carbon sequestration in forests remaining forests is currently based on the so-called "default method", i.e. the difference between annual growth rates of forests and drains by harvesting. The estimated gross wood increment for the period 2000–2006 is based on the most recent questionnaire-based Forestry Census of 2000 and for 2007 it is based on the new plot-based National Forest Inventory. Data on the annually harvested amount of wood are obtained from Statistics Denmark. Commercial harvesting was used in the calculations for broadleaved species as wood from thinning operations in young stands is sold as fuel wood and therefore appears in the statistics. For conifers, non-commercial thinning operations are more common. In order to account for this, 20% were added to the figures for commercial harvests of coniferous wood.

Expansion factors are needed to convert stem volumes for conifers and total aboveground biomass for the broadleaves to total biomass. There is currently no information on applicable expansion factors for Danish conditions; however, a couple of studies will supply valuable national information within a few years. At present, stem wood volumes for conifers are converted to total biomass by an expansion factor of 1.8 based on Schöne and Schulte (1999), and aboveground biomass for broadleaves are converted to total biomass by an expansion factor of 1.2 based on Vande Walle et al. (2001) and Nihlgård and Lindgren (1977). A current project is working on establishing specific expansion functions for the main Danish tree species Norway spruce, beech and oak. More information on calculations can be found in The National Inventory Report 2009.

4.3.7.3.5 Activities under Articles 3.3 and 3.4 of the Kyoto Protocol

Article 3.3

In accordance with Article 3.3 of the Kyoto Protocol emissions and removals from afforestation, reforestation and deforestation (ARD) activities will be included in the accounting of Removal Units (RMUs) in the 1st commitment period 2008-2012 under the protocol. Quantitative estimates of the projected anthropogenic greenhouse gas emissions and removals from forestry activities under Article 3.3 of the Kyoto Protocol during the commitment period were included in the latest GHG projection published with Denmark's Fourth National Communication on Climate Change in 2005.

Average annual afforestation in the period 1990-2003 was 1,900 ha per year. In the March 2009 projection it was assumed that afforestation will continue at the same pace in the period 2004-2014 and that activities under Article 3.3 of the Kyoto Protocol during the first commitment period would be a sink. In the March 2009 projection, the sink was estimated at 288 Gg CO_2 per year in the period 2008-12 due to afforestation including carbon pools in aboveground and belowground biomass.

New projections from August 2009 suggests that only 224 Gg CO_2 per year in the period 2008-12 can be expected if no further deforestation will take place. However, with the additional deforestation foreseen due to the establishment of a test centre for wind turbines, this figure may drop even further down to 193 Gg CO_2 per year in the period 2008-12.

Article 3.4

In accordance with Article 3.4 of the Kyoto Protocol emissions and removals from forest management (FM), cropland management (CM) and grazing land management (GM) activities have been elected to be included in the accounting of RMUs in the 1st commitment period 2008-2012 under the protocol.

Article 3.4 - Forest Management

In March 2009, the contribution from managed forestry was estimated at 2.8 Mt CO_2 (or 0.8 Mt C) in average for the 10-year period 1997-2006 (*Nielsen et al., 2009a*). The included carbon pools were aboveground and belowground biomass. This estimate was much higher than the specified maximum of credits as removal units for Denmark at 0.183 Mt CO_2 (0.05 Mt C) annually 2008-12.

However, according to new estimates from August 2009, the Danish forests are expected to be a source in 2008-2012 with an average annual net emission of 0.490 Mt CO_2. This estimate is much higher than the specified maximum of debits at 0.183 Mt CO_2 (0.05 Mt C) annually 2008-12.

Article 3.4 - Cropland management and Grazing land management:

The government has decided to include removals of CO_2 by soils (Article 3.4 of the Kyoto Protocol) in the calculation of Denmark's climate accounts for 2008-12, corresponding to about 1.7 million tonnes of CO_2 annually.

Contributions to the Kyoto Protocol under Article 3.4 concern changes to vegetation and soil carbon stocks. Under the Kyoto Protocol, the flows of carbon to and from biomass and soils must be stated according to a net-net principle by which the change in net emissions is calculated as the rate of change for the carbon stock in the statement period (2008-12) less the rate of change for the carbon stock in the reference year (1990). The rate of change can be calculated in different ways, however the method must be the same in the statement period as in the reference year. For agriculture, the following potential sources of CO_2 emissions and CO_2 sequestration have been included:

1. Net change in the content of carbon in mineral soils in connection with changed land use and cultivation.
2. Net change in the soil's carbon stock in connection with drainage and cultivation of organic soils or re-establishment of wetlands.
3. Change in the carbon content of wood biomass in wind breaks and fruit farms.
4. Emissions of CO_2 from application of limestone to farm land.
5. Consumption of organic soil-improvement agents, peat and sphagnum.

The projections of the changes in the carbon stock in mineral soils include a number of assumptions about future land use and future changes in temperatures. As climate regime, the Danish average climate for the period 1961-1990 has been used as reference. Since this normal climate period, the climate in Denmark and large parts of the rest of the world has, however, developed toward a warmer climate. This change amounts to about 0.3 ˚C per decade.

With a scenario of a continued temperature increase of 0.3 ˚C per decade, the baseline projection of land use shows a reduction in emissions from land use by agriculture of about 1.9 mill. tonnes CO_2 per year, see the National Environmental Research Institute of Denmark and the Danish Institute of Agricultural Sciences (2006) . A temperature increase of 0.3 ˚C per decade corresponds to the scenarios for climate change that are central parts of Denmark's efforts concerning adapting to climate change, and which are based on core scenarios defined in the IPCC Third Assessment Report.

Both future weather conditions and changes in agricultural practices and land use occasion considerable uncertainty about the effect of including Article 3.4 for soils. These uncertainties may however go both ways, since an increased area of permanent grassland and catch crops, greater crop yield, and setting aside organic soils, will increase CO_2 sequestration, while reduced grassland area, removal of straw from fields, and burning slurry and solid manure will reduce CO_2 sequestration. An overall effect of CO_2 sequestration by soils of 1.7 million tonnes per year on average in 2008-12 has been included in calculations, which is assessed to be a conservative estimate, however about which there is considerable uncertainty.

Uncertainties

Although the projections have been updated with the latest knowledge, they are, as all other forecasts, associated with considerable uncertainty.

Total from activities under Article 3.3 and 3.4

The total amount of credits in the period 2008-2012 from activities under Article 3.3 and 3.4 is estimated at 8.55 million tonnes of CO_2 for the period or as the average per year 1.71 million tonnes of CO_2 – with:

0,193 Mt from afforestation under Article 3.3,

- 0,183 Mt from forest management under Article 3.4 and

1,7 Mt from cropland management and grassland management under Article 3.4.

In 2007, a monitoring programme for the monitoring and reporting of activities under Articles 3.3 and 3.4 was decided with a total budget of DKK 72 mill. The results from this programme will be included in the annual reporting of greenhouse gas inventories under the UNFCCC and the Kyoto Protocol from April 2010.

4.3.7.3.6 Fisheries

The inventories of the total emissions and removals of greenhouse gases include the emissions of greenhouse gases from fuel sold for fishing vessels. The fishing vessels' contribution to greenhouse gas emissions consist primarily of CO_2. The EU has as a part of the European Fisheries Fund increased EFF aid-intensity for fuel-saving equipment, expertise in relation to energy audits and restructuring plans, and promoting research on fuel-saving technologies. These project are primarily aimed at reducing energy consumption for vessels.

4.3.7.4 New and additional measures

As a consequence of the energy, nature and environment initiatives in the Green Growth plan from 2009, a further 800,000 tonnes reduction of CO2-eq. annually of the agricultural sector's greenhouse gas emissions is anticipated.

4.3.7.5 Measures no longer in place and measures increasing greenhouse gases

Since *Denmark's Fourth National Communication* to the Climate Convention in 2005, no measures limiting greenhouse gases have been discontinued, nor have any measures increasing greenhouse gases been introduced within agriculture, forestry and fisheries. However, the abandon of the EU set-a-side rules in 2008 is expected to level out the previously projected continuation of the decrease in the agricultural area due to urbanisation of agricultural land. Since there is a national cap on the total amount of manure and fertiliser N applied in agriculture, this change in agricultural area is not expected to have any significant effects on nitrous oxide emissions. Furthermore, it should be noted that although it is positive to increase use of straw as a fuel for energy supplies in substitution for fossil energy, the amount of carbon returned and stored in the soil will be reduced at the same time. Removal of straw for energy purposes also seems to have negative effects for the fertility of soil[35]. Use of straw for energy increased from 0.9 mill. tonnes in 1990 to 1.3 mill. tonnes in 2007.

4.3.8 The domestic sector

In 2007, the domestic sector contributed to Denmark's total national greenhouse gas emissions with 3.6 mill. tonnes of CO_2 equivalents corresponding to a share of 5.5 %. Approximately 93% of greenhouse gas emissions from households in 2007 consisted of CO_2. There are also small emissions of methane and even smaller emissions of nitrous oxide.

To this can be added primarily CO_2 emissions as a result of consumption of electricity and district heating. These CO_2 emissions are included in the figures for producers and therefore they are also subject to quota regulation in the energy sector.

4.3.8.1 CO_2

The consumption of energy by households, including electricity and district heating, is responsible for almost 30% of the total energy consumption in Denmark.

The largest part of the energy consumption is used for heating homes, where burning of oil and natural gas results in a CO_2 emissions. A large part of the space heating is in the form of district heating (32.2% in 2007), which results in CO_2 emissions in connection with the production of district heat. When district heat is produced at CHP plants or with CO_2-friendly fuels, particularly renewable energy, there are big CO_2 savings overall from use of district heating instead of individual heating based on, for example, oil-fired boilers.

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[35] Christensen, 2002

Danish households also have a substantial consumption of electricity. Most of the household consumption of electricity goes to household appliances and light sources, whereas a decreasing amount of electricity goes to electric heating. Consumption for electric heating has been decreasing in recent years as a consequence of the work of the Electricity Saving Trust, which has resulted in considerable conversion from electric heating to district heating and natural gas heating.

Households' disposal of waste also contributes to emissions of methane from landfill sites.

The action being taken on households' waste and transport consumption is described in the sections on waste and transport. This section therefore concentrates on the possibilities of reducing the CO_2 emissions through savings in electricity and heating in households and the possibilities for conversion to more environment-friendly forms of heating. The possibilities for reduction in the public energy supply system are described in the section on the energy sector.

In 2007, the domestic sector used 166.3 PJ of energy for heating (climate-corrected) and 34 PJ of electricity for appliances, etc. Consumption for heating has been quite constant for a number of years in spite of an increase in the number of households and in the area heated. The consumption of electricity for appliances, etc. has risen steadily since 1996. The increase in the consumption of electricity has, however, not been nearly as great as the increase in the number of appliances, since these have become steadily more energy efficient.

With a view to reducing energy consumption and environmental impacts from the domestic sector, a wide range of initiatives have been launched, as described in Table 4.22 in order to promote:

- Electricity savings,
- Savings in energy consumption in space heating, and
- Fuel conversion (from electric heating and the use of oil to district heating and the use of renewable energy).

Several concrete measures and incentives already implemented are described below.

4.3.8.1.1 Energy taxes

All energy consumption for space heating as well as other energy consumption in households and the public sector, as well as non-VAT-registered businesses is subject to energy taxes. Throughout the 1990s CO_2 and energy taxes have steadily increased, but since 2002 it has been almost stable. The increases have mainly affected households, helping to reduce their energy consumption.

4.3.8.1.2 CO_2 taxes

All energy consumption in households is subject to CO_2 taxes. The CO_2 tax is further described in section 4.3.3.

4.3.8.1.3 Energy labelling of buildings

Denmark has a long experience with energy efficiency and energy savings in buildings. Since 1980 energy consumption for heating has been reduced with 27 % per m^2. The goal is to reduce energy consumption in new buildings by 75 % by 2020. The benefits of reducing energy consumption are tangible: less fossil fuel is consumed and the environment has improved substantially. Strict and progressively tightened building regulations since 1977 have ensured a stable demand for energy efficient building technologies.

4.3.8.1.4 Energy labelling of buildings when built, sold or rented

Energy labelling of buildings must be implemented after finishing the construction of a building and on the sale or rental of the building - primarily heating consumption. This applies in principle for all buildings indifferent of size, apart from production facilities, factories etc.

4.3.8.1.5 Regular Energy labelling of large buildings and public buildings

Energy labels and an energy plan must be prepared regularly every five years for all large buildings over 1,500 m2 (1000 m^2 at July 2009) and for all public buildings over 60 m^2 - primarily heating consumption and air conditioning systems.

4.3.8.1.6 Energy labelling of appliances

Energy labelling (A-G) of white goods, lighting etc. is compulsory. There are also voluntary labelling schemes (Energy Star, Energy Arrow, windows, boilers, electric motors, and ventilators) for a number of products. Danish authorities play an active role in securing compliance to the compulsory requirements. The Danish Electricity Saving Trust runs a comprehensive programme in order to promote energy efficient appliances and products. March 1st The Electricity Saving Fund will be replaced by The Centre for Energy Savings, which will attend to the development and implementation of campaigns, market impact activities, etc.

4.3.8.1.7 The Danish Electricity Saving Trust - conversion of electricity/heating

Sets up requirements for energy companies, negotiates and markets fixed-price agreements, advises customers, and grants subsidies. March 1st The Electricity Saving Fund will be replaced by The Centre for Energy Savings, which will attend to the development and implementation of campaigns, market impact activities, etc.

4.3.8.1.8 The Danish Electricity Saving Trust - efficient appliances

Prepares market analyses and campaigns focusing on the price and efficiency of energy appliances. Makes it simple, safe, and cheap to trade in an energy-appropriate manner. March 1st The Electricity Saving Fund will be replaced by The Centre for Energy Savings, which will attend to the development and implementation of campaigns, market impact activities, etc.

4.3.8.1.9 Support for the substitution of individual oil based furnaces

In November/December 2009, the Parliament decided to allocate DKK 400 mill. to support the substitution of individual oil based furnaces for modern, low-emitting heating solutions, including systems based on renewable energy such as heat pumps and solar heating. Implementation of a program of subsidies is projected to start 1 March 2010.

TABLE 4.22 MEASURES WITHIN THE DOMESTIC SECTOR TO REDUCE EMISSIONS OF GREENHOUSE GASES

Source: Danish Energy Agency

Name of measure or initiative	*Objective*	*GHG affected*	*Type of instrument*	*Status for implementation*	*Implementing entity/ Player*
Domestic sector					
EU-CO_2-quotas on electric and district heating production could influence consumption by households (see under Energy)	CO_2 reduction	CO_2	Economic (financial)	Implemented Amendment to implement the Linking Directive adopted by the Folketing May 2005	State authorities, energy producers, energy-intensive enterprises
Energy labelling of small and large buildings (incl. public sector and business)	Savings in energy water and environmental impacts including CO_2 reductions	CO_2	Information	Implemented	Consumers, others
Energy labelling of electric appliances	Energy savings and more efficiency, promote technology env. impacts including CO_2 reductions	CO_2	Information	Implemented	Consumers, others
Substition of individual oil based furnaces	The promotion of modern, low-emitting heating solutions, including systems based on renewable energy such as heat pumps and solar heating"	CO2	Subsidy	Under implementation beginning of 2010	Consumers,

1) There are no estimates of the effects of these initiatives.

In February 2008 the Danish Government and a broad majority in Parliament concluded a comprehensive Energy Agreement. The agreement sets the main agenda for the Danish energy policy for the years 2008 to 2011 together with the framework of the common European goals for 2020 set by the European Union. One of the key ambitions in the agreement is to further improve energy efficiency and energy savings. It is agreed to reduce the level for energy consumption by 4 % before 2020 (compared to the level for consumption in 2006).

4.3.8.2 New and additional measures

The EU Climate and Energy Agreement from December 2008 contain ambitious reduction obligations for Denmark until 2020. For the sectors *not* covered by the ETS in Denmark, including the non-ETS activities in the domestic sector, Denmark has taken on a challenging 20 per cent reduction target.

In 2010, the government will present a new Climate Strategy for the period 2013-2020, focusing on possible further cost effective actions until 2020 for the purpose of achieving Denmark's 2020 reduction target outside the EU ETS. This could also entail measures in the domestic sector.

4.3.8.3 Measures no longer in place and measures increasing greenhouse gases

Table 4.16 presents the national CO_2 allowance scheme, as well as other measures that have been discontinued and changed.

Other than the changes mentioned above, there have been no great changes in measures for the domestic sector since *Denmark's Fourth National Communication* to the Climate Convention in 2005.

4.3.9 Waste and sewage

The contribution of the waste sector to greenhouse gas emissions consists primarily of methane from the decomposition of organic waste that takes place at landfill sites. Greenhouse gas emissions from wastewater treatment include both methane (81%) and nitrous oxide (19%). Of total greenhouse gas emissions from the waste sector of 1.4 mill. tonnes CO_2 equivalents in 2007 – corresponding to 2.1% of total Danish greenhouse gas emissions – the proportion from landfills was 78%, and the proportion from wastewater was 22%.

Please note that all incineration of waste in Denmark is associated with energy utilisation, which is why the emission of CO_2 from the incineration of plastic waste is included under the energy sector.

4.3.9.1 Methane, CH_4

In previous years, efforts within the waste sector have been based on the Action plan for waste and recycling 1993-97, which included targets on waste treatment to the year 2000. The plan did not relate directly to the waste sector's contribution to methane emissions (CH_4), but included a number of initiatives that are of relevance to waste products containing industrial gases (HFCs and SF_6), besides an objective concerning stopping landfilling combustible waste.

The previous government's waste plan, Waste 21, which covers the period 1998-2004, does not relate directly either to the waste sector's possibilities for contributing to solution of the problem of greenhouse gas emissions. The plan aimed at stabilising the total quantities of waste in 2004, and increasing recycling and reducing the environmental burden from the environmentally harmful substances in waste, including the industrial gases. With respect to waste incineration, the objective was to adjust incineration capacity to what was absolutely necessary, to ensure best possible energy utilisation, maximum CO_2 displacement and regional self-sufficiency. The plan thus contributed indirectly to reduction of greenhouse gas emissions.

The objective in Waste 21 was for 64% of all waste to be recycled, 24% to be incinerated and not more than 12% landfilled.

That objective was already reached in the year 2000, and according to the Danish Environmental Protection Agency's Waste Statistics 2000 (ISAG). Total waste in that year amounted to about 12.8 mill. tonnes.

The current government's waste plan, the Waste Strategy 2005-08, was issued in September 2003. The current Waste Strategy aims at decoupling growth in waste amounts from economic growth. The Strategy also aims at preventing the loss of resources in waste and environmental impacts from waste, as well as better quality waste treatment and an efficient waste sector. Finally, the government has aimed at reducing waste amounts sent to landfill to 9% in 2008 and increasing recycling to 65% of all waste.

The most important initiatives regarding greenhouse gases in the Strategy are improvement of landfills and increased collection of plastic packaging for recycling.

The first part of the Waste Strategy 2009-12 was issued in March 2009 and a draft sec ond part of the Waste Strategy 2009-12 was sent in public hearing in October 2009. The recycling target for all waste is still 65%, and the target for overall waste amount sent to landfills is reduced to 6%.

The latest figures for waste in Denmark are in the Danish EPA Waste Statistics 2006. Total waste in 2006 was 15,459,000 tonnes, of which 70% was recycled, 23% incinerated, and 6% landfilled.

The waste sector's contribution to reduction of greenhouse gas emissions consists mainly in:

- reducing landfilling of organic waste,
- utilising gas from discontinued/existing landfill sites,
- promoting oxidation of gas in landfill coverings,
- increasing recycling of plastics, and
- using waste as an energy source.

An overview of the concrete measures implemented in the pursuance of these objectives is given in Table 4.23.

The emission of methane from Danish landfills is calculated to have been 71,100 tonnes gross in 1990, increasing to a maximum of 76,500 tonnes in 1996, corresponding to 1.6 mill. tonnes of CO_2 equivalents.

As a consequence of the ban on landfilling waste suitable for combustion, from 1 January 1997, methane emissions from Danish landfill sites will fall in the years ahead. The annual emission of methane in 2008-2012 is, thus, calculated to be 63,000 tonnes, corresponding to approx. 82% of the maximum in 1996.

According to the Danish Energy Authority's inventory Biogas, Production, Forecast and Target Figures, there were in all 25 landfill gas plants in Denmark in the autumn of 2002. These installations produced 10,000 tonnes of methane annually, compared to approx. 1,700 tonnes in 1993. In 2004, methane recovery from landfills amounted to 7,700 tonnes methane[36]. The same study shows that, through optimising existing plants, a further 1,800 tonnes methane per year could be recovered over the next five years. Furthermore, the establishment of new gas-collection equipment at five landfills could contribute an additional 1,300 tonnes methane per year over the next five years.

Optimisation of existing plant and establishment of new gas plants will, however, probably require subsidies. The previous subsidy scheme to promote gas collection at landfills was discontinued at the end of 2001. In 2007 subsidies were given for establishing methane recovery and test pumping at 11 landfill sites. Data from these projects has not been compiled yet.

As a consequence of the new landfilling strategy, only a few landfill gas plants are expected to be established in the future. The maximum quantity of methane recovered peaked in 1998 at about 13,200 tonnes. The quantity of methane recovered will continue to fall gradually over many years.

On the basis of the above, net emissions of methane (methane produced less methane recovered) from Danish landfill sites have been calculated at 63,600 tonnes in 1990, rising to 65,900 tonnes in 1993, and then falling steadily to 51,800 tonnes in 2012. The average annual net methane emissions in 2008-2012 correspond to about 1.1 mill. tonnes CO_2 equivalents.

The total quantity of waste incinerated rose from 2,216,000 tonnes in 1994 to 3,489,000 tonnes in 2006, i.e. an approximately 57% increase. The energy produced from the incineration plants is included as part of the renewable energy production in the Danish energy statistics. The international greenhouse gas inventories include greenhouse gases from incineration of the content of oil-based products, such as plastics in waste.

In accordance with the targets in the Waste Strategies, waste incineration plants are designed so as to optimise energy utilisation.

Besides the direct effect of waste management on greenhouse gas emissions, the emissions are also affected indirectly through recycling of paper, cardboard, plastic, metals, etc. which means less energy consumption and thus less CO_2 emissions during production of raw materials and new products.

[36] Willumsen, 2004

TABLE 4.23 MEASURES WITHIN THE WASTE SECTOR TO REDUCE EMSSIONS OF GREENHOUSE GASES.

Source (on effects): Danish EPA and Denmark's CO_2 emissions - the effort in the period 1990-2001 and the associated costs

Name of measure or initiative	***Objective***	***GHG affected***	***Type of instrument***	***Status for implementation***	***Implementing entity/player***	***CO_2 reduction in mill. tonnes CO_2***		
Waste sector						in 2001	in "2010"	in 2020
Obligation to send combustible waste to incineration (in practice a ban on landfilling).	Reduce landfilling, energy production, greater recycling, CH_4 reduction	CH_4	Regulation (admin.)	Implemented	State and local authorities	0.02	0.3	
The waste tax	Greater recycling, least possible landfilling	CH_4	Economic	Implemented	State authorities /waste plants			
Weight-and-volume-based packaging taxes	Waste reduction	CH_4, CO_2	Economic	Implemented	State authorities			
Subsidy programme – Enterprise Scheme (special scheme for businesses)	Reduce environmental impacts from waste	CO_2 and CH_4	Financial	Implemented	State authorities			
Increased recycling of waste plastic packaging	22,5% recycling of waste plastic packaging in 2008 onwards	CO_2	Regulation	Implemented	State and local authorities/ enterprises and the public		0.005	
Implementation of the EU landfill directive	More focus on gas in environmental approvals, less waste to landfills	CH_4	Regulation	Implemented	State and local authorities			
Support for (construction of facilities for) gas recovery at landfill sites	Increase CH_4 recovery at landfills	CH_4	Financial	Discontinued	State authorities	0.2	0,10	
Subsidy programme for cleaner products	Waste reduction, pollutants out of waste	CH_4	Financial	Discontinued	State authorities			
The waste tax on incineration of waste	Greater recycling, least possible landfilling	CH_4	Economic	Discontinued	State authorities /waste plants			
Energy and CO_2 tax on waste incineration	To increase cost-effectiveness of waste incineration and improve the structure of tax on waste incineration	CO_2	Economic	Implemented	State authorities/ waste plants			

The implementation of national waste plans and fulfilment of targets has necessitated the implementation of a wide range of measures.

In 1996 the Statutory Order on Waste was amended to introduce a municipal obligation to assign combustible waste to incineration (corresponding to a ban on deposition of combustible waste). As a result of this, large quantities of combustible waste that used to go to landfill sites are now either recycled or used as fuel in Denmark's incineration plants.

Besides the traditional regulation via legislation, statutory orders, and circulars, the waste sector is regulated by means of a range of policies and measures, including taxes and charges, grant schemes and agreements.

A tax on landfilling and incinerating waste was introduced in 1987. Since 1993 the tax has been differentiated to reflect the prioritisation of the different forms of treatment. It thus costs most to deposit waste, less to incinerate it and nothing in tax to recycle it. The waste tax has been increased several times and it is now DKK 375 per tonne waste for landfilling and DKK 330 per tonne waste for incineration. The size of the tax thus provides an incentive to recycle as much of the waste produced as possible and to use non-recyclable, combustible waste as fuel in energy production instead of depositing it at a landfill site.

Weight-and-volume-based taxes (e.g. on various packaging, carrier bags and PVC film) encourage a reduction in packaging consumption and thus the quantities of waste. The weight-based tax is based on an index that reflects the environmental burden of the materials used.

Under the grant programme Programme for Cleaner Products etc., grants were made for projects that reduce the environmental burden in connection with development, production, sale and use of products or in connection with the management of the waste generated during the product's entire lifecycle. Furthermore, support could be granted to waste projects aiming at reducing the problems of waste disposal. A total of about DKK 100 mill. was allocated for the 5-year period 1999 to 2003 for the part of the Programme related to waste.

In 2005 the Programme for Cleaner Products etc. was replaced by the Enterprise Scheme which refunds CO_2 taxes to business. The waste part of the new programme is aimed exclusively at enterprises. A total of DKK 33 mill. for the five-year period from 2004 to 2008 has been earmarked for the waste part of the scheme. The subsidies were to be used to reduce the environmental impact of waste. In 2007 methane recovery from 11 landfill sites and establishment of “biocover” for methane oxidation in the cover layer of a landfill were supported by this scheme.

The Danish EPA has also supported initiation of a development project aiming at documenting the oxidation of methane in landfill coverings. By ensuring optimal oxidation, methane emissions from landfills can be reduced, and if this can be documented it can be credited to the CO_2 accounts. This biocover project was carried out by the Technical University of Denmark with funding from the EU LIFE Programme. The Biocover project has established a viable methodology for documentation of the gained reduction of greenhouse gas emission by installation of a biocover system on a landfill. The methodology consists of a logical order of tasks using well documented measuring technologies. The demonstration project also proved that there may exist several obstacles on landfills which can jeopardize an efficient greenhouse gas reduction, and the project has obtained understanding of which precautions should be taken. Most important obstacles are: a) Ability to control point gas releases, b) Ability to distribute the landfill gas to active parts of biocover system, and c) Ability to obtain a spatial even gas distribution to active parts of biocover system. Due to the obstacles the goal of reaching a 90% reduction of methane emission was not reached; the obtained reduction was in the 20-30% range. Future developments of biocover systems on other landfills should focus on overcoming the mentioned obstacles.

From 2009 onwards the subsidy scheme is expected to continue, but the target areas of the Enterprise Scheme has not yet been decided and the budget for waste projects is not known yet.

As a result of the EU Packaging Directive, collection of plastic packaging waste for recycling has been increased to 22.5%, corresponding to an increase in recycling of about 11,000 tonnes plastic per year from 2008, through an amendment to the Statutory Order on Waste requiring municipalities to improve the possibilities of people and enterprises to separate and deliver plastic packaging waste for recycling.

Furthermore, new producer responsibility obligations have been introduced concerning waste of electrical and electronic equipment and batteries due to new EU Directives resulting in higher collection and recycling rates of these used products. The aim is to increase recycling of metals significantly resulting in energy savings compared to extraction and refining of virgin materials.

On the basis of the EU Landfill Directive, demands on the establishment and operation of landfills have been tightened with Statutory Orders No. 650 of 29 June 2001 and No. 252 of 31 March 2009 on landfills. According to the new regulation, methane in landfills for mixed waste must be monitored. From landfills where insignificant amounts of biodegradable waste are landfilled, methane must be managed in an environmentally-sound way or be used to produce electricity or for heating purposes.

An amendment to the Statutory Order on Waste in 2000 means that municipalities must now assign non-recyclable waste PVC and impregnated wood to landfill. The objective is to avoid adding PVC and impregnated wood to incineration with the consequential pollution of flue gas and slag. Moreover, landfills will receive more organic waste, and in the long term this will form methane during decomposition. Work is being carried out to develop new treatment methods in order to utilise the resources in waste. When these methods have been developed and new plants established, it is expected that the Statutory Order on Waste will be amended so that PVC and impregnated wood is assigned to these plants and landfilling is avoided.

It is not possible to make a quantitative estimate of the effects of the various measures for the waste area. The objectives in the national waste plans are related to waste amounts and their treatment. The developments are monitored through the annual waste statistics. However, changes in the treatment of waste cannot immediately be converted into changes in emissions of greenhouse gases.

4.3.9.2 New and additional measures

The government has revoked the waste tax on incineration and instead introduced an energy tax related to the energy content of the waste and a CO_2 tax on emissions from waste incineration, which are expected to give an incentive to increase recycling of waste plastic.

4.3.9.3 Measures no longer in place and measures increasing greenhouse gases

As stated in Table 4.23 the subsidy programme for gas retrieval at landfill sites and the subsidy programme for cleaner products have been discontinued.

The requirement to assign impregnated wood to landfilling will lead to an increase in the amount of biodegradable waste going to landfills and therefore increased emissions of methane. Additional contributions from this source will, however, be modest in relation to the overall amount of methane from landfills.

4.3.10 Policies and measures in accordance with Article 2, of the Kyoto Protocol

4.3.10.1 Denmark's climate efforts – a step on the way to sustainable development

As mentioned above, the government's National Strategy for Sustainable Development in Denmark, A SHARED FUTURE - balanced development was adopted by the Folketing in June 2002.

In this strategy, the government lists eight objectives and principles for creating sustainable development:

1. The welfare society must be developed and economic growth must be decoupled from environmental impacts.
2. There must be a safe and healthy environment for everyone, and we must maintain a high level of protection.
3. We must secure a high degree of bio-diversity and protect ecosystems.
4. Resources must be used more efficiently.
5. We must take action at an international level.
6. Environmental considerations must be taken into account in all sectors.
7. The market must support sustainable development.
8. Sustainable development is a shared responsibility and we must measure progress.

The strategy is built up with a number of sectors: food production, forestry, industry, transport, energy, urban and housing development, and cross-cutting issues: climate change, biodiversity, environment and health, resources and resource efficiency, knowledge and policies and measures, the global dimension and public participation.

In order to follow developments in relation to the strategy, regular indicator reports are prepared. The indicator reports contain 14 key indicators - including indicators for economic growth, greenhouse gas emissions, air pollution, employment and discharge of nutrients to the marine environment. In addition, the trend in a wide range of more specific indicators is being monitored. Examples of these indicators are the incidence of asthma, the thickness of the ozone layer, by-catches of porpoises, the amount of PCB in cod liver and the number of organic farms.

The conclusion in the most recent indicator report of September 2008 is that in a number of areas, Denmark is on the right course in work for more sustainable development, as amongst other things the indicators show improvements in bathing water, water quality in lakes and rivers, air quality, recycling of waste and eco-labelling of products. In other areas there remain challenges. For example it is still important to addressing the challenges within the areas of nature, the aquatic environment and agriculture. The Government's Green Growth Plan will address these challenges, as have been the case with the Government's recent air quality plan in addressing the effort on clear air for all.

In March 2009, the government adopted its new strategy for sustainable development "Growth with consideration". The new strategy collects objectives and concrete actions within the following 9 areas:- Globalisation for the benefit of all people on Earth

- Climate Change – a major challenge

- Nature for the future

- Green innovation in production and consumption

- Active, healthy and well-functioning urban areas

- Better health for all

- Knowledge, research and education in an innovative society

- Human as a resource

- Responsible, long-term and sustainable economic policy

This new strategy forms the framework for the Danish government's sector specific action plans such as "The Green Transport Vision", "The Tax Reform" ("Forårspakke 2.0" and "The Green Growth Plan" and for the support and development of green technologies based on The Action Plan on Environment Efficient Technology 2007-2009".

In addition to the increased funds for research, demonstration projects and partnerships the government will enhance the dialogue with the business community through the new Business Forum for Environmental Technology on how Danish companies' opportunities for development and marketing of new green technologies could be strengthened for the benefit of the environment and the business community.

4.3.10.2 Efforts for international air transport and shipping

Denmark recognises that the international aviation and maritime transport sectors are large and rapidly growing sources of greenhouse gas emissions and have to be dealt with at international level. Given the global nature of the two sectors Denmark believes that the international organisations for civil aviation and maritime transport – ICAO and IMO – should decide and implement appropriate global measures to control greenhouse gas emissions from international aviation and maritime transport with levels of keeping EU's 2 degrees Celsius objective within reach.

Denmark welcomes that the EU in 2008 adopted a directive whereby emissions of CO_2 from aviation by 2012 are included in the EU emission trading scheme and believes that such a scheme may serve as inspiration for a future global solution for emissions from aviation. In this context Denmark wishes that the ICAO shows demonstrable progress in tackling the challenge of GHG emissions.

Regarding emissions from the international maritime sector Denmark acknowledges the recent efforts by the IMO to make progress on the issue. For a number of years Denmark has been pushing the IMO to deal with the issue of GHG emissions and has proposed nine principles that should serve as a platform for a future global regulation. These principles where agreed upon by an overwhelming majority in IMO in the spring of 2008. More over Denmark has proposed that new ships should be subject to a compulsory energy efficiency design index. The index was agreed upon in principle in IMO in 2009.

Denmark has also proposed the creation of a marked based instrument in the context of an International Fund for Greenhouse Gas from Ships. The basic idea of such a fund is a specific GHG contribution is linked to this purchase of bunker fuel. This contribution is channelled to a compensation fund, where the majority of the revenues are allocated to offsets and climate change related purposes under the UNFCCC.

4.3.10.3 Efforts to limit adverse effects in other countries

In connection with Denmark's contribution to international climate efforts, in accordance with the Kyoto Protocol Denmark will endeavour to implement policies and measures under article 3 of the Protocol in such a way that adverse effects in other countries are minimised. However, Denmark does not consider that its contributions to international climate efforts have adverse effects in other countries as, on the contrary, the reduction of emissions of greenhouse gases in Danish commitments under the Protocol will in fact contribute to limiting dangerous climate change in all countries.

If nothing is done to limit emissions of greenhouse gases, climate scenarios from the IPCC indicate that developing countries in particular will experience the greatest changes in climate.

In its international efforts, Denmark will therefore continue to take the greatest possible account of special needs and concerns of developing countries and especially least developed countries. This also applies to adverse effects which can already be ascertained from changes in the climate. The existing strong Danish focus on the special vulnerability of developing countries to climate change underlines this (see section 7.2).

4.3.10.4 *Strategies to mitigate climate change cf. article 10(b) of the Kyoto Protocol*

Denmark's Climate Strategy and measures to mitigate climate change are described in sections 4.1 and 4.3.1-4.3.9.

4.4 POLICIES AND MEASURES NO LONGER IN PLACE

Information on policies and measures no longer in place is included in the sections above for the individual sectors where relevant.

4.5 POLICIES AND MEASURES IN GREENLAND

Greenland is faced by a series of challenges in energy supply and demand. Due to climatic and infrastructural conditions as well as future developments in the industry, Greenland's consumption of energy is not likely to decrease. But Greenland is also witnessing the effects of climate change in the Arctic.

Greenland has therefore initiated policies and a series of political measures for the energy areas, supporting the objectives of the Climate Convention and the Kyoto Protocol on the reduction of emissions of greenhouse gasses. Initiatives are made to further the use of renewable and environmentally sustainable energy, i.e. hydropower, wind energy, solar energy and hydrogen. There are several dimensions to the initiatives as they will reduce costs in energy supply, reduce the vulnerability of energy supply based on fossil fuels, improve the efficiency of the current production and supply system, while mitigating global climate change.

The Home Rule Government introduced Energy Plan 2010 in 1995. Earlier energy policy guidelines had focused on security in energy supply and the development of hydropower plants as the central energy source of the future. With the Energy Plan the Government presented a complete review of the energy sector and an action plan for the development of the energy sector based on a more differentiated energy policy for the future. The overall object of the Energy Plan 2010 was to establish an energy supply that does not compromise security of supply and that ensures the least possible economic and environmental burden for society and the other energy players.

In 2007 the Energy Strategy 2008-2015 was issued. The primary focus of the strategy is still on hydropower energy, but where hydropower energy is socio-economically inefficient is must be supplemented by other renewable energy sources.

Below is a description of implemented measures as well as developing measures.

4.5.1 Implemented measures

Energy supply legislation: Energy supply legislation was introduced in 1997, when parliament passed the Energy Supply Act covering the supply of electricity, heating and fuel. The Energy Supply Act confirms the main objectives of Energy

Plan 2010, promoting the economically and environmentally best solutions to the demand for energy. In accordance with the Energy Supply Act, the supply of energy must be managed both to promote energy saving, to be economically sound, to secure the supply of energy, to improve efficiency of the production and supply system while introducing an environmentally cleaner production of energy.

The development of hydropower: The development of hydropower has been central to the national energy supply since the 1970s. Throughout the 1970s and 1980s systematic studies of possible hydropower potentials were carried out. And with the 1986 energy policy guidelines it was agreed that hydropower should be a bearing element of the future energy supply system in Greenland.

The first hydropower plant, the Buksefjord plant (1993) still supplies Nuuk with energy, and a third turbine was introduced in 2008 to meet the increased demand for energy in the capital area. The effect of the plant is currently 45 MW.

In 2005, a hydropower plant was introduced in Tasiilaq in East Greenland, and in 2008 a third plant was opened in Qorlortorsuaq, supplying the towns of Narsaq and Qaqortoq in South Greenland. The Qorlortorsuaq hydropower plant has an effect of 7.2 MW, where the Tasiilaq plant has an effect of 1.2 MW.

In 2010 a fourth plant will be introduced, supplying the second largest town of Greenland, Sisimiut, with renewable energy. The Sisimiut hydropower plant will have an effect of 15 MW.

In 2010 the four hydropower plants will produce enough energy to save more than 30.000 m^3 of oil, cutting CO_2 emissions by more than 80.000 tonnes annually.

Waste incineration facilities: In waste management Greenland is challenged by the vast distances and thereby the dependence of local waste management schemes. But in Qaqortoq, Nuuk, Maniitsoq, Aasiaat, Sisimiut and Ilulissat incineration plants are in use, handling approximately 65 % of all waste produced in Greenland. From these facilities much of the residual heat is used for district heating.

In small towns and settlements 46 small-scale incineration facilities have been established, handling approximately 9 % of the waste produced in Greenland. The primary object of these facilities is to provide waste disposal as an alternative to open landfills in small communities.

The incineration of waste to some extent replaces fuel for heating and reduces emissions of methane that would otherwise occur if waste was deposited at landfill sites.

Sector Programme for Renovation with environmental and energy effects in Greenland 2000-2003: The objective of the sector programme was to ensure that the extraordinary efforts in renovation of buildings and supply plants would take into account environmental and energy aspects.

Projects carried out under the programme included renovation of combined electricity and heat production plants (CHP plants), supply grids, revision of the building regulations, renovation of buildings, preparation of a new energy plan and behaviour-regulating measures.

As a proportion of the supply of energy is still produced by diesel-powered generators, the effects of a reduction in the consumption of electricity will have a direct effect on the environment and on the emissions of greenhouse gasses. This reduction can be achieved partly via electricity saving measures in the production processes and distribution, and partly by addressing the consumers. Better energy exploitation of electricity production through renovation and establishing CHP plants will reduce fuel consumption in boiler plants.

In 2003 an evaluation of the sector programme was carried out, estimating a reduction in CO_2 emission of more than 3,900 tonnes annually (see table 4.24 below). The calculations were based on information from the energy statistics of the Danish Energy Authority and estimates of reductions in the consumption of both electricity and oil.

TABLE 4.24 EXPECTED ENERGY SAVINGS AND REDUCTIONS IN CO_2 EMISSIONS, SECTOR PROGRAMME FOR RENOVATION WITH ENVIRONMENTAL AND ENERGY IMPROVEMENTS IN GREENLAND 2000-2003

Source: The Sector Programme secretariat, Statistics Greenland (Energy Statistics 2001), the Environmental and Nature Agency of the Greenland Home Rule, and Danish Energy Authority,

	Electricity (in kWh)	*Oil (in litres)*	*Total*
Overall framework conditions	-	-	
International commitments	-	-	
Supply	4,674,603 kWh	750,000 litres	
Building renovation	-	236,610 litres	
Measures to reduce consumption	-	31,000 litres	
Waste disposal	-	-	
Planning and monitoring	-	-	
Estimated annual energy savings from sector programme	**4,674,603 kWh**	**1,017,610 litres**	
Estimated annual energy savings from sector programme, in Giga Joules	16,829[1] GJ	36,500[2] GJ	53,328 GJ
Estimated annual reduction in CO_2 emissions (in tonnes)[3]			**3,946 tonnes**

[1] 1,000 kWh = 3.6 GJ
[2] Assumed calorific value= 42.70 GJ per tonnes. Density = 0.84 tonnes per m^3
[3] Assumed CO_2 content = 74.0 kg per GJ

4.5.2 Future measures

Industries based on renewable energy: The use of renewable energy is also an important resource in developing industries in Greenland. The best example is in the aluminium industry, where plans are to establish an aluminium smelter with an annual production capacity of 350,000 tonnes. The smelter will be powered by renewable energy from the Tasersiaq and Imarsuup Isua lakes, where hydropower stations will have a total effect of 650 MW.

Energy accounting: The Ministry of Infrastructure and Environment is introducing energy accounting on a trial basis in 2009-2011.

Energy accounting will cover the consumption of electricity, water and heating (based on electricity or oil), and subject to energy accounting in a selection of large companies and administrative organizations, including the Greenland Home Rule, the Greenland Airport Authority and KNI/ Polaroil, the single distributor of oil.

The initiatives will increase knowledge on consumption of energy, water and heating in the organizations, thereby bringing forward incentives for changes in behaviour, renovations to improve the energy efficiency etc. Based on the experience in energy accounting a permanent programme will be introduced, covering a wider range of public sector offices and private enterprises.

Research and development within the renewable energy sector: The Ministry of Infrastructure and Environment supports the research in and development of new initiatives within the renewable energy sector. The ministry has a DKK 1.5 million programme for research in and the development of renewable energy technologies in Greenland.

The programme was laid out to support research in hydrogen energy, but today the programme gives financial support to a wide range of small-scale projects. Furthermore, the Ministry of Infrastructure and Environment facilitates networking and the sharing of knowledge in the projects.

The projects supported under the programme are all small of scale, but they bring knowledge to entrepreneurs in Greenland. Solar panels have been established to supply a folk high school with energy, in a settlement a micro-hydropower plant is introduced to supplement energy from a CHP plant, wind energy is introduced on a trial basis, the potential for geothermal energy is tested, and in a northern settlement improved isolation and solar energy is evaluated in a house.

The Greenland analysis on reduction of greenhouse gas emissions 2008-2012: In autumn 2009 the parliament adopted an analysis on reduction of greenhouse gas emissions for the Kyoto period.

The analysis estimates the potential for reductions in greenhouse gas emissions in Greenland, discussing a list of instruments to be introduced. Recommendations included are further assessments of costs for implementation of instruments, the establishment of a programme for energy coaches, and analysis of possible economic incentives for reduced energy consumption.

4.6 POLICIES AND MEASURES ON FAROE ISLANDS

The Climate Convention was ratified by the Realm, and therefore it also applies for the Faroe Islands. When ratifying the Kyoto Protocol the Danish government took a territorial reservation for the Faroe Islands.

In the spring 2008 the Faroese Government started a process formulating a Climate Strategy, and in the autumn 2008 a catalogue of potential options to reduce emissions of greenhouse gases was published.

In December 2009 the Faroese Climate Policy has been adopted by the Faroese Parliament. The policy is adopted by all the political parties in the Parliament. The national target is to reduce the domestic emissions of greenhouse gases by at least 20% in the period 2010 to 2020 compared with the level of emissions in 2005.

Renewable energy was less than 5% of total energy supplies on the Faroe Islands in 2006. However, there is unexploited potential, especially in wind and wave power.

Oil consumption has increased since 1990, with a slight drop up to 1994. In 2007 hydropower was 38,9% of electricity production. Electricity supply on the Faroe Islands is carried out by the supply company SEV, which is owned by the Faroese municipalities jointly. The Faroe Islands work with NERI on the annual inventory of greenhouse emissions for the Climate Convention. In the latest inventory of April 2008, total greenhouse gas emissions from the Faroe Islands in 2006 were calculated at 0,731 mill. tonnes CO_2 equivalents. It is vital that the statistics are prepared and the cooperation on the annual emissions inventories and other information for the Climate Convention continues and grows so that the Realm can meet its commitments under the Climate Convention.

5 Projections and the total effect of policies and measures

and supplementarity relating to Kyoto Protocol mechanisms

5 Projections and the total effect of policies and measures

- and supplementarity relating to Kyoto Protocol mechanisms

5.1 Projections

5.1.1 Introduction and overall effect of policies and measures

According to the EU's burden sharing agreement, Denmark has committed itself to a reduction of greenhouse gas emissions by 21% in the period 2008-2012 in relation to the base year 1990/95 under the Kyoto Protocol.

In connection with this agreement, Denmark had reservations with respect to effects of large imports of electricity from Norway and Sweden in the base year 1990, which reduced Denmark's emissions that year by 6.3 mill. tonnes of CO_2 compared to the domestic production of electricity to cover consumption. The Danish position was, and is, that the Danish EU reduction commitment should not be based on low emissions in a single year like in 1990, where low emissions were due to exceptionally large imports of electricity. In March 2002, Denmark had to accept a Council decision subjecting Denmark to the legal commitment to reduce emissions by 21% compared to the base year, without correcting for imports of electricity.

Denmark was, however, assured in a political declaration from the EU Council of Ministers and the European Commission that the assumptions relating to base year emissions will be taken into account in connection with fixing the assigned amount of emissions in 2006, measured in tonnes of CO_2 equivalents. A full taking into account of this would give a reduction burden for Denmark in 2008-2012 which is equal to 21% of the 1990 level corrected for imports of electricity. The difference corresponds to 5 mill. tonnes of CO_2 equivalents annually in 2008-2012. In 2006, Denmark accepted that the taking into account only constituted 1/5 of Denmark's assumptions relating to base year emissions corresponding to 1 mill. tonnes of CO_2 equivalents annually in 2008-2012. It is expected that a final decision on this will be taken in 2010.

The legal reduction commitment of 21% entails that Denmark has to reduce its greenhouse gas emissions from an amount corresponding to 69.3 mill. tonnes of CO_2 equivalents in the base year 1990/95 to 54,8 mill. tonnes of CO_2 equivalents annually in 2008-2012. Outside of the EU also Greenland's part of the realms total assigned amount under the Kyoto Protocol will be added when compliance with the Kyoto Protocol is going to be assessed for the period 2008-2012. This internal assigned amount for Greenland amounts to 0,6 mill. tonnes of CO_2 equivalents annually in 2008-2012 with the total assigned amount for the Realm under the Kyoto Protocol being 55,4 mill. tonnes as described in section 3.4. However, in the rest of this chapter, only the greenhouse gas projections for Denmark, and Denmark's projected use of credits from sinks an the use of the Kyoto Mechnisms will be compared with Denmarks 21% target under the Kyoto-protocol and the EU Burden Sharing.

The comprehensive projections from February 2009 include the period 2007-2025 and are shown in Annex E1. Projections for 2013-2025 are, however, somewhat more uncertain than the projections up to 2013, due to several factors, including the fact that uncertainties concerning measures and their expected effects increase with projection length. The projection is a "with measures" projection, which includes measures that have been or are expected to be implemented. The projections are based on a number of sector-specific projections of the domestic emissions for this period. These emissions depend on the extent of economic activity in all sectors of society, energy prices, technological development, and legislation regulating individual activities in relation to the environment, energy efficiency, etc. Among the most important preconditions are the Ministry of Finances' estimate of economic development and the IEA's expectations regarding future energy prices. Since the Climate Strategy of 2003 and the lastest follow-up baseline projection with measures adopted until just before the the adoption of Denmark's 2nd National Allocation Plan under til EU ETS, a new baseline projection with additional measures decided until mid 2008 has been prepared. Also the previous emission inventories have been up-dated as a result of new knowledge etc. However, in 2007 the base year has been fixed under a UFCCC-led review of Denmarks's and Greenlands GHG emission inventories, and can no longer alter for the 1st commitment period 2008-2012 as described in section 3.5. The climate deficit - i.e. what Denmark lacks to fulfil the target for reduction of greenhouse gas emissions under the Kyoto Protocol and EU burden sharing - has changed considerably in comparison to the estimate in the Climate Strategy from before the adoption of additional measures since 2003. The previously projected deficit has in the February 2009 projections changed to a minor over delivery when the projected effects of the credits from sinks and Kyoto Mechanisms are taken into account.

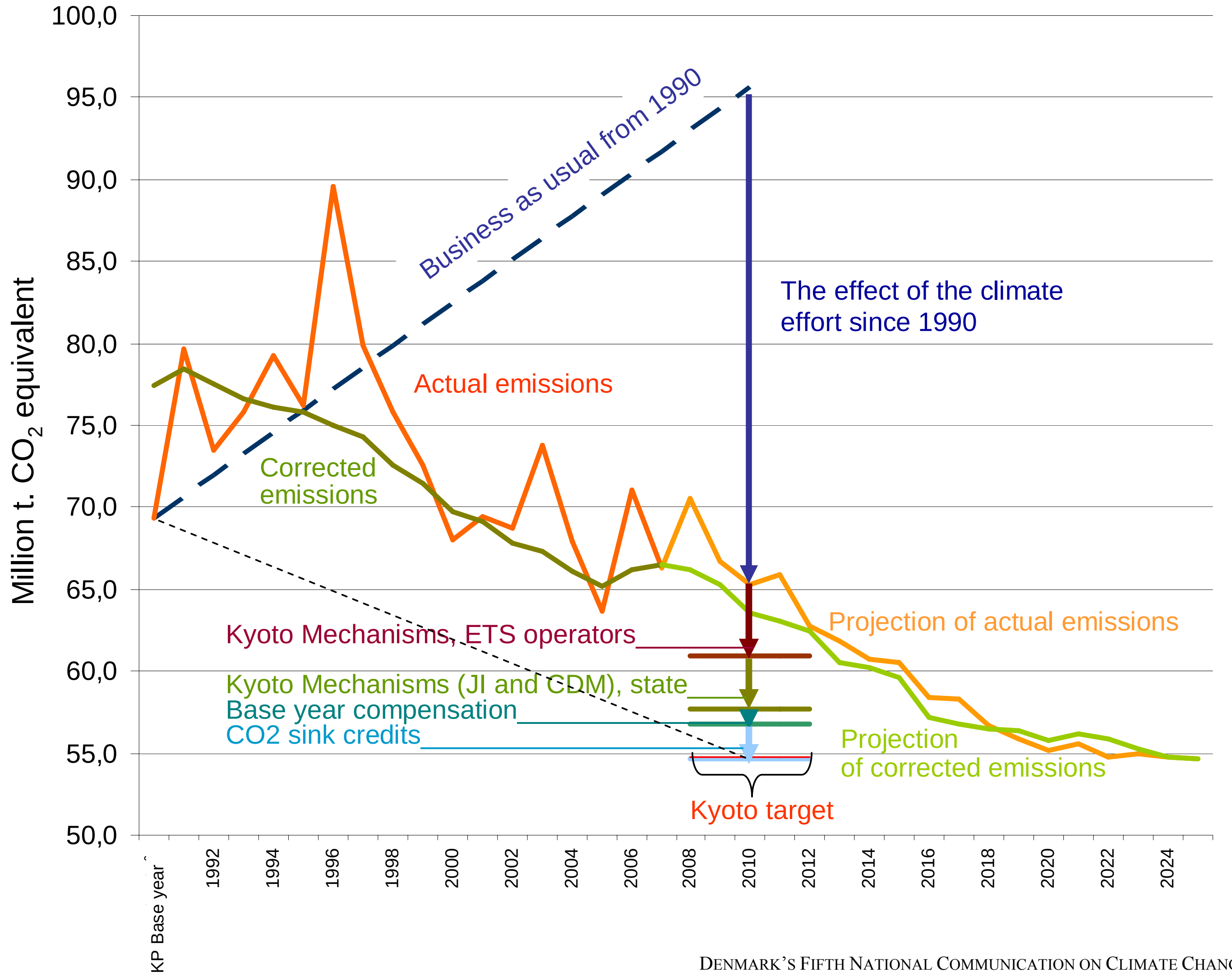
As an element in the implementation of Denmark's National Allocation Plan 2008-12, a political energy agreement on further specific policies and measures with greenhouse gas emission reduction as one of the key objectives was reached on 21 February 2008. On the basis of the adoption of these new measures, the "with measures" greenhouse gas emission projection from January 2007 has been updated with this and other changes in assumptions and projected parameters showing a de-crease in annual greenhouse gas emissions 2008-2012 of 1,6 million tonnes of CO_2 equivalent from 67.8 to 66.2 million tonnes of CO_2 equivalents in the February 2009 projection, as shown in Table 5.1.

TABLE 5.1: HOW THE KYOTO TARGET WILL BE ACHIEVED ACCORDING TO DENMARK'S NATIONAL ALLOCATION PLAN 2008-12, THE "WITH MEASURES" PROJECTION FROM FEBRUARY 2009 WHICH INCLUDES THE EFFECT OF THE MEASURES ADOPTED WITH THE ENERGY AGREEMENT OF 21 FEBRUARY 2008 AND OTHER CHANGES UNTIL MID 2008 AND INFORMATION ON CREDITS FROM SINKS AND THE KYOTO MECHANISMS UPDATED IN MARCH 2009.

	Annual greenhouse gas emissions 2008-2012 in million tonnes of CO_2 equivalent[1]
The "without measures since 1990"-projection	**95,6**
The updated "with measures"-projection of February 2009[2]	**66,231**
Denmark's assigned amount as annual average 2008-2012	**54,765**
Sink credits from afforestation since 1990 (KP, Article 3.3)	0,288
Sink credits from forest management, cropland management and grassland management (KP, Article 3.4)	1,9
Total sink credits	**2,188**
Kyoto Mechanism, JI- and CDM-projects financed by the state[3]	3,2
Base year compensation under the EU Burden Sharing	1,0
Total other state credits	**4,2**
Projection of ETS operator's CO_2 emissions as annual average 2008-2012	29,8
ETS operator's CO_2 allowances 2008-2012 as annual average	24,5
Total ETS operators credits from use of the Kyoto Mechanisms	**5,3**
Total credits	**11,688**
Denmark's assigned amount and credits as annual average 2008-2012	**66,453**
Gap after credits from sinks and the Kyoto Mechanisms[4]	**-0,222**
Decided over delivery as compensation for travel by plane by state employees and COP 15 off-set	0,030
Gap after credits and compensation for travel and COP15[4]	**-0,192**

[1] The number of digits shown in the table are results of estimations and calculations and does not represent the certainty level of the figures.
[2] In 2009 political agreements were reached on a Green Transport Vision for Denmark, a general Tax Reform and a Green Growth Plan. The effects of these agreements and plans are not included in the projections in the table, but is expected to be included in the planned update of the government's climate strategy in 2010.
[3] For the purpose of safe guarding the achievement of Denmark's target under the Kyoto Protocol and the EU Burden Sharing, the 2009 national budget includes two reserves (DKK 500 million) for additional JI- and CDM projects to cover possible losses if, contrary to expectations, Denmark does not get compensation for the reference year, and/or to cover uncertainty in projections etc. Possible credits from these reserves are not included in the table.
[4] A negative gap means over delivery.

FIGURE 5.1: HOW THE KYOTO TARGET WILL BE ACHIEVED ACCORDING TO DENMARK'S NATIONAL ALLOCATION PLAN 2008-12, THE UPDATED "WITH MEASURES" PROJECTION FROM FEBRUARY 2009 WHICH INCLUDES THE EFFECT OF THE MEASURES ADOPTED WITH THE ENERGY AGREEMENT OF 21 FEBRUARY 2008 AND OTHER CHANGES AND UPDATED INFORMATION ON CREDITS FROM SINKS AND THE KYOTO MECHANISMS



The emissions in the February 2009 baseline projection are 1,6 mill. tonnes of CO_2 equivalents lower than in the baseline projection without the additional measures adopted with the National Allocation Plan. The February 2009 baseline projection for the entire period 2007-2025 is shown in Figure 5.1, together with the historic trend – with and without corrections for the interannual variations in electricity exchange and temperature/heating degree days, and information on the amount of credits from sinks and the Kyoto Mechanisms projected in March 2009.

On the basis of the February 2009 projection of greenhouse gas emissions and on the basis of the March 2009 update of information on credits from activities in the sinks categories under Article 3.3 and 3.4 of the Kyoto Protocol and on credits from the state planned and ETS-operator expected use of the Kyoto Mechanisms, Denmark will reach its target under the Kyoto Protocol and the EU Burden Sharing as shown in Table 5.1 and Figure 5.1.

As it can be seen from Table 5.1, the February 2009 greenhouse gas projection suggests that there will be a minor over delivery of nearly 0.17 million tones of CO_2 equivalent. However, several uncertainties will remain until the end of the commitment period 2008-2012. E.g. removals by sinks are highly temperature dependant and could be lower than expected and thus also the amount of sinks credits could be lower than projected. The projected over delivery is within the overall uncertainty due to unknown factors such as temperature and final delivery of credits from JI- and CDM-projects. For the purpose of safe guarding the achievement of Denmark's target under the Kyoto Protocol and the EU Burden Sharing, the state budget includes a DKK 450 million reserve for additional JI- and CDM projects.

Furthermore, new knowledge about activities and emission factors could also have implications for the greenhouse gas emission projections. This has been the case after the February 2009 projection. For the purpose of analysing possible new and additional policies and measures with a view to achieving Denmark's 2020 emission reduction target for the non-EU ETS activities, interim updates of the February 2009 "with (existing) measures" projection in 2009 suggested that additional initiatives could be needed to ascertain that Denmark can live up to its very ambitious targets - both the 2008-2012 target under the Kyoto Protocol and the 2013-2020 target under the EU Effort Sharing Decision for the sectors outside the EU ETS.

To be on the safe side of the 2008-2012 target, the government adopted additional initiatives in December 2009.

The interim updates and the additional initiatives are described in section 5.2.7 as a preliminary "with additional measures" projection.

In 2010, the government will present a new Climate Strategy 2020, focusing on possible further cost effective actions until 2020 for the purpose of achieving Denmark's 2020 reduction target outside the EU Emission Trading Scheme.

5.1.2 Energy including all activities with fuel combution within transport, military, business, agriculture, forestry, fisheries and the domestic sector

In this section the projection of the total emissions of CO_2, CH_4 and N_2O from combustion of fuels and from fugetive emissions from fuels is described. The projection includes all fuel-consuming sectors, which in addition to the energy sector, include the transport sector and military, business, agriculture, forestry and fisheries, as well as the domestic sector – both stationary and mobile sources. A more detailed description of the approach used in the energy projection is in Annex E2.

5.1.2.1 Methods

The projection is based on a projection of the development in energy consumption in the period 2007-2025. The emissions of CO_2, CH_4 and N_2O have been calculated by multiplying the energy consumption by emission factors.

The projection of end-user energy consumption by the business and domestic sectors is based on an ADAM/EMMA projection. EMMA is a macro model that describes the final energy consumption broken down into a number of sectors and seven types of energy. It is based on historical experience with the behaviour of businesses and households and is documented in NERI 1995[37].

In EMMA, energy consumption in the business sector is determined by three factors: production, energy prices/taxes and energy efficiencies/ trends. Increased production will increase the demand for energy input, whereas increased energy prices and taxes will pull in the direction of a more limited demand for the fuels. Improved energy efficiency will mean that production can be maintained using less energy, and in EMMA this results in reduced energy consumption.

The projection of production by businesses is based on the ADAM projection in the so called 2015-plan by the Danish Ministry of Finance.

The projection of electricity and heat production is based on the Danish Energy Agency's RAMSES model, using as the basis the demand for electricity and district heat according to the projection of the consumption sectors. In the projection, electricity and heat production is divided between existing and possible new production plants on the basis of technical specifications and prices of fuels and CO_2 allowances. The model also determines electricity prices on the Nordic market and the degree of electricity exchange with the other Nordic countries. In this regard it takes account of the limitations in exchange capacity. Electricity production has been liberalised throughout the Nordic region and therefore it is not closely linked to Danish demand, but rather to the characteristics of the individual power plant and market prices. Industrial and local mini-CHP production is not projected in the RAMSES model so a separate (bottom-up) projection has been made of this production.

The projection of other sectors (primarily extraction of oil and gas as well as oil refineries) is based on data on expansion plans and ad-hoc assumptions.

[37] Environmental satellite models for ADAM, NERI Technical Report no. 148, DMU 1995

The projection of road transport is carried out within EMMA. Projection of rail transport and domestic ferries and freighters, is based on report the transport sector's energy consumption and emissions, Danish Road Directorate, 2002[38], whereas domestic air transport is based on the study "European energy and transport – trends to 2030" from 2003.

The basis for the emissions projections is the official Danish national fuel consumption projections from the DEA (2008a). These activity data are used in combination with sector specific emission factors derived from emission models developed at NERI for road transport, aviation, railways, sea transport and working machinery. A more in-depth documentation can be seen in Nielsen et al. (2009b).

5.1.2.2 Assumptions and key parameters

In general, the projection is based on the policies applicable by the spring 2008, including the Agreement on Danish Energy Policy from February 2008. The projection is based on energy consumption in 2006. The basic assumption is that energy consumption in the future will equal the 2006 level, unless there is a drop in economic activity, and/or prices, technical improvements, initiatives, climate, etc. change. Therefore, only initiatives where the effect will change in relation to 2006 (including new initiatives) are included specifically in calculating the projection. Therefore, the projection should be regarded as a "with measures" projection.

The IEA price assumptions for fossil fuels (World Energy Outlook, 2007[39]) and a euro-dollar rate of 0.73 have been applied. However, from the observed level in December 2007, a road towards the IEA prices has been conducted so that the IEA prices are reached in 2012. Prices of biomass have been estimated and presented in the study "Future prices on biomass for energy purposes, December 2007". District-heating prices are based on production costs, while the price of electricity, as mentioned above, results from calculations and is based on marginal production costs.

Other assumptions behind the energy projection are economic growth of about 1.9% p.a., moderate prices of fossil fuels based on the IEA assumptions, prices of CO_2 allowances of about EUR 24 per tonne (2006-prices) in 2008-12, and about EUR 30 per tonne from 2013 and forward.

Efforts have been made to coordinate assumptions for the electricity market with the other Nordic countries. Planned investment in production and transmission capacity as well as closing plants is largely agreed with Norway, Sweden and Finland. The differences between the models and the date of completion of the projections means, however, that the resulting electricity prices and figures for electricity exchange are not the same.

Tables 5.2 and 5.3 illustrate a number of key assumptions for the projection.

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[38] The transport sector's energy consumption and emissions, Road Directorat, 2002 (http://www.trm.dk/graphics/Synkron-Library/trafikministeriet/Publikationer/pdf/emissioner.pdf) (in Danish)

[39] In november 2005 WEO2005 was published by the International Energy Agency. Updated Danish energy projections and GHG projections based on WEO2005 and other new information will by finalised in 2006.

TABLE 5.2 GROWTH ASSUMPTIONS[1]

Source: Danish Energy Agency

Percent p.a.	1980-2003	2007	2008	2009	2010	2011	2012	2013	2014	2015	2015-2025
Production value:											
Primary indust. excl. energy	1.1	1.7	1.7	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Building and construction	0.8	1.6	0.0	-1.9	-2.1	-0.2	1.1	2.8	2.7	2.6	2.3
Manufacturing excl. energy	1.7	2.6	1.4	0.0	1.1	-0.1	-0.1	1.0	1.0	0.9	1.9
Public service	1.7	1.7	1.6	1.0	1.0	1.0	1.0	0.8	0.8	0.8	1.1
Trade	2.4	3.3	2.1	2.0	1.3	1.5	2.6	2.2	2.4	2.4	2.4
Financial services	3.0	3.8	2.3	2.0	1.6	1.9	3.5	1.5	2.1	2.0	2.2
Other services	3.1	1.8	1.4	2.4	2.2	2.0	1.9	1.9	1.9	1.8	1.9
Total	*2.0*	*2.5*	*1.6*	*1.0*	*1.0*	*1.0*	*1.5*	*1.6*	*1.7*	*1.7*	*2.0*
Private consumption	1.3	2.2	1.6	1.3	1.1	2.3	2.8	2.2	1.9	1.8	2.3
Housing stock 1995 prices	1.4	1.8	1.4	2.4	2.2	2.0	1.9	1.9	1.9	1.8	1.9
Housing stock, m^2	0.8	1.0	0.9	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7
GDP	1.8	2.0	1.3	1.1	0.5	1.1	1.4	1.6	1.8	1.7	1.9
Gross added value (GAV)	1.8	2.1	1.4	0.9	0.8	0.9	1.5	1.3	1.7	1.6	1.8
Deflator, (GAV)	3.9	2.2	2.8	2.7	2.7	2.6	2.5	2.3	2.2	2.2	2.2
Deflator, private cons.	3.9	1.7	2.6	2.0	2.1	1.9	1.8	1.7	1.6	1.6	1.9

[1] The growth rates are from *The Danish Finance Ministry (2015-.plan)*

TABLE 5.3 CHANGES IN ENERGY PRICES IN DKK EXCL. TAXES, DEFLATED

Source: Danish Energy Agency

Annual growth in %	2007	2008	2009	2010	2011	2012	2013	2014	2015	2015-2025
Crude oil	0	21	-27	14	14	14	14	0	0	1
Gas, consumers	-16	17	-22	13	14	14	15	0	0	1
Coal	23	18	-25	17	17	17	17	0	0	-1
Elec. Wholesale market	-4	46	-9	-7	8	-11	8	-4	9	-1
Elec. consumer	6	41	-8	-6	7	-11	7	-3	8	-1
District heating	-2	9	-7	3	4	5	4	0	-1	0

5.1.2.3 Results

Figure 5.2 and Table 5.4 show the development of total energy consumption (excl. fuels for non-energy purposes) with these assumptions, broken down by sector.

FIGURE 5.2 GROSS ENERGY CONSUMPTION 1990-2025, 1990-2006 ARE OBSERVED

Source: Danish Energy Agency

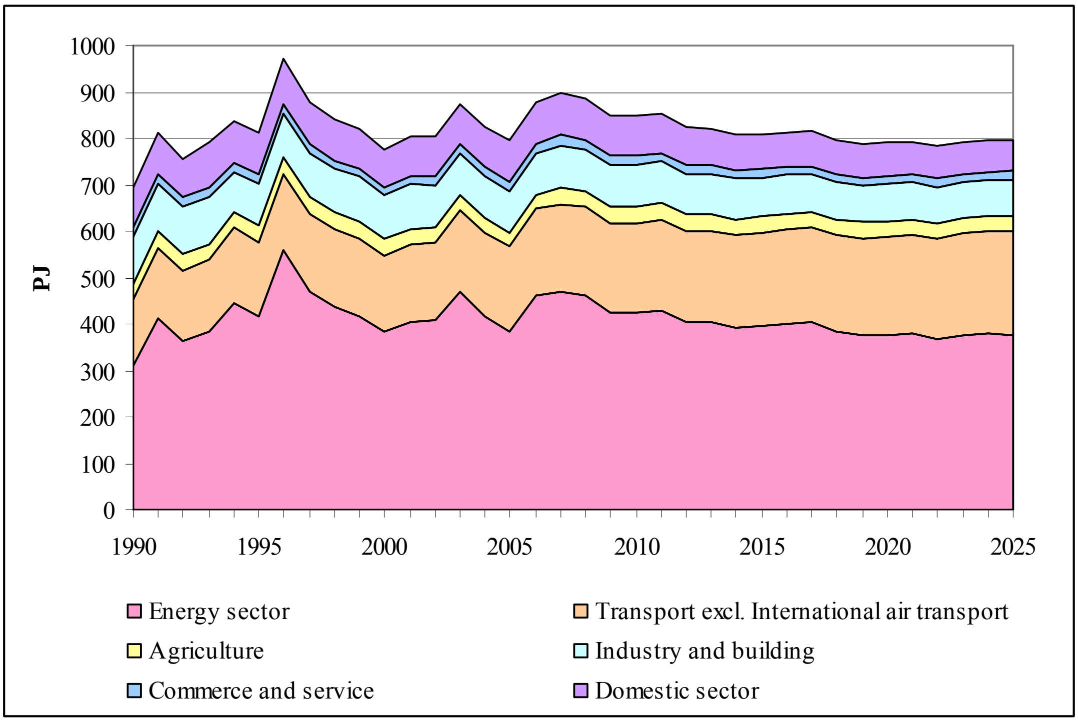


TABLE 5.4 GROSS ENERGY CONSUMPTION 1990-2025, 1990-2006 ARE OBSERVED

Source: Danish Energy Agency

PJ	1990	2006	2010	2015	2020	2025
Energy sector	309.7	462.3	423.5	394.6	376.6	375.8
- of which flaring	4.2	7.1	7.8	7.7	7.5	5.3
Transport excl. International air transport	143.7	185.2	194.3	201.6	211.1	223.4
Agriculture	33.9	31.6	34.6	34.6	33.8	33.4
Industry and building	98.7	89.3	90.1	84.6	79.9	79.3
Commerce and service	21.3	20.1	19.6	17.6	17.1	17.0
Domestic sector	85.2	87.8	85.7	77.1	71.7	68.4
Total	**692.5**	**876.4**	**847.9**	**810.1**	**790.3**	**797.2**

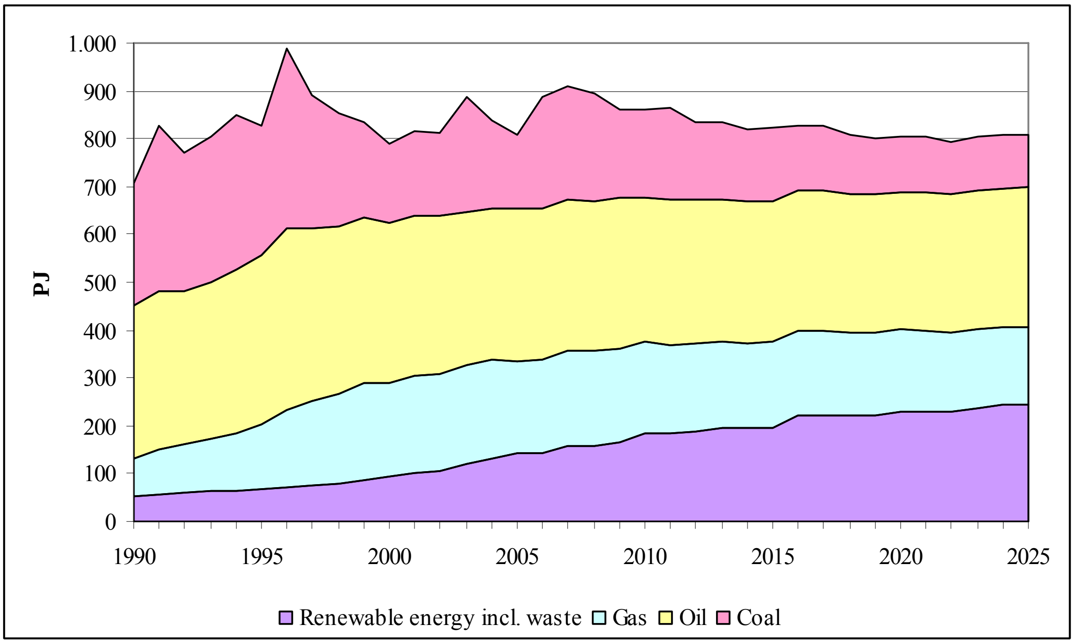
In years with ample precipitation Denmark is a net importer of electricity produced at Norwegian and Swedish hydropower stations, while in years with scanty precipitation, it is a net exporter of electricity to Norway and Sweden. This has resulted in large fluctuations in the observed Danish gross energy consumption in the period 1990-2006.

Energy consumption is expected to decrease within most sectors. However, energy for transport purposes is expected to continually grow. The decrease in final energy is among others due to implementation of energy saving initiatives decided in the latest energy agreements.

Figure 5.3 shows the development of total energy consumption, broken down by fuels, which determine the size of CO_2 emissions because the fuels have very different emission factors.

FIGURE 5.3 GROSS ENERGY CONSUMPTION 1990-2030, 1990-2006 ARE OBSERVED

Source: Danish Energy Agency



The increase in the quantity of renewable energy is due primarily to expansion of wind turbines (both on land and offshore) and increased use of biomass and biogas. Also from 2015 more and more renewable energy will be used in the transport sector.

The fuel composition of electricity and district heat production in 2025 will be more based on renewable energy and less on coal and gas than today. According export of electricity Denmark is expected to be net exporter until 2018. This is primarily due to energy savings which will lead to a rise in the Danish excess capacity.

TABLE 5.5 TOTAL EMISSIONS OF CO_2, CH_4 AND N_2O IN CO_2 EQUIVALENTS FROM ENERGY-CONSUMING ACTIVITIES IN THE PROJECTION (WITH MEASURES), 1990-2007 ARE OBSERVED

Source: 1990-2007: The National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, Technical report no. 703, 2009.

Unit: '000 tonnes CO_2 equivalents		**1990**	**2000**	**2005**	**"2010"[1]**	**2015**	**2020**	**2025**
Energy	(1A1)	26315	25429	22559	25371	21179	17254	16443
Transport (incl. Military)	(1A3+1A5)	10820	12363	13492	13905	14057	14194	15003
Business	(1A2+1A4a)	6912	7015	6618	6676	6212	5956	5935
Agriculture, forestry and fisheries	(1A1c)	2549	2422	2254	2362	2392	2412	2443
Domestic sector	(1A4b)	5183	4282	4144	3476	2729	2137	1732
Total from energy-consuming activities		**51779**	**51510**	**49067**	**51790**	**46569**	**41953**	**41556**

[1] "2010" means average annual emissions from 2008-2012

The resulting total emissions of CO_2, CH_4 and N_2O from energy-consuming activities in the ”with measures” projection is illustrated in Table 5.5.

5.1.2.4 Sensitivity analyses and scenario calculations

The projection and underlying assumptions are naturally very uncertain. Therefore, sensitivity analyses have previously been completed with alternative assumptions for fuel prices and prices of CO_2 allowances cf. Table 5.6.

TABLE 5.6 ASSUMPTIONS OF FUEL PRICES AND PRICES OF CO_2 ALLOWANCES IN 2030

Source: Danish Energy Agency

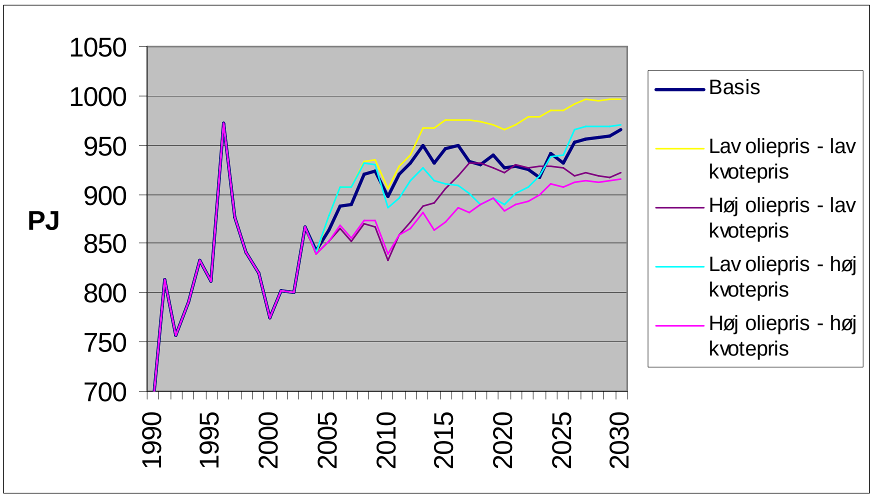
		Low	Basis	High
Crude oil	2000-USD/barrel	20	29[1)]	50
Coal	2000-USD/tonne	37	44[1)]	60
Natural gas in Europe	2000-USD/MBtu	3.0	4.3[1)]	7.4
CO2 allowances	2000-USD/tonne	8	24	58

[1] IEA assumptions from WEO 2004

As shown in a former sensitivity analysis, high prices for oil, gas, coal and CO_2 allowances could reduce gross energy consumption in the former projection until 2030 by about 50 PJ or 5% compared with the former projections central estimate, while low prices increase consumption by about 30 PJ or 3%, cf. Figure 5.4.

FIGURE 5.4 TOTAL GROSS ENERGY CONSUMPTION, IN PJ.

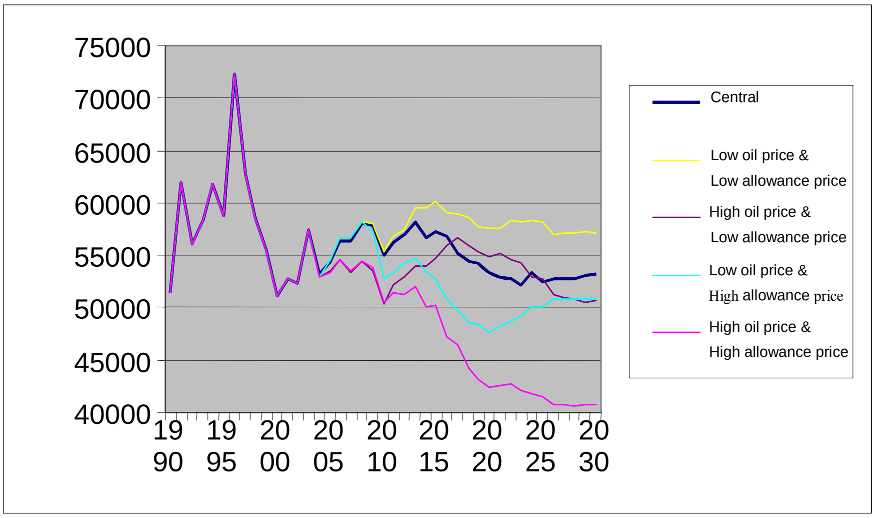
Source: Danish Energy Agency



As can be seen, the changes in total energy consumption could be moderate, but they conceal large fluctuations in the composition of fuels in the supply sector. With the high prices of natural gas, oil and CO_2 allowances, expansion will be exclusively with renewable energy – wind and biomass, while with low prices of CO_2 allowances, higher prices of natural gas and moderately higher coal prices, new coal-fired plants will be built.

The effects on CO_2 emissions from the reorganisation of fuels in the supply sector: a reduction of 23% in the case of high prices, and an increase of 7% for low prices in 2030, cf. Figure 5.5. The effects are considerably less in 2010. Here, CO_2 emissions are 4.5 mill. tonnes under the former basis projection with higher prices, but only 0.3 mill. tonnes over with low prices.

FIGURE 5.5 ENERGY-RELATED CO_2 EMISSIONS, IN '000 TONNES CO_2 EQUIVALENTS.
Source: Danish Energy Agency



5.1.3 Transport

As mentioned in section 5.1.2, the latest projection of road transport, rail transport, domestic ferries and freighters, together with domestic air transport is documented in Nielsen et al. (2009b). The underlying energy projection, among others, use the methods described in the report *The transport sector's energy consumption and emissions*, Danish Road Directorate, 2002.

5.1.3.1 Methods

In the forecast model all activity rates and emissions are defined in SNAP sector categories (Selected Nomenclature for Air Pollution) according to the CORINAIR system. The aggregation to the sector codes used for both the UNFCCC and UNECE Conventions is based on a correspondence list between SNAP and IPCC classification codes (CRF).

Military transport activities (land and air) refer to the CRF sector Other (1A5), while the Transport-Navigation sector (1A3d) comprises national sea transport (ship movements between two Danish ports) and recreational craft. The working machinery and materiel in industry is grouped in Industry-Other (1A2f), while agricultural and forestry machinery is accounted for in the agriculture/ forestry/fisheries (1A4c) sector together with fishing activities. The description of methodologies and references for the transport part of the Danish inventory is given in two sections; one for road transport and one for the other mobile sources.

For road transport, the detailed methodology is used to make annual estimates of the Danish emissions, as described in the EMEP/CORINAIR Emission Inventory Guidebook (EMEP/CORINAIR, 2007). The actual calculations are made with a model developed by NERI, using the European COPERT III model methodology, and updated fuel consumption and emission factors from the latest version of COPERT – COPERT IV. The latter model approach is explained in (EMEP/ CORINAIR, 2007). In COPERT, fuel consumption and emission simulations can be made for operationally hot engines, taking into account gradually stricter emission standards and emission degradation due to catalyst wear. Furthermore, the emission effects of cold-start and evaporation are simulated.

Other mobile sources are divided into several sub-sectors: sea transport, fishery, air traffic, railways, military, and working machinery and equipment in the sectors agriculture, forestry, industry and residential. The emission calculations are made using the detailed method as described in the EMEP/CORINAIR Emission Inventory Guidebook (EMEP/CORINAIR, 2007) for air traffic, off-road working machinery and equipment, and ferries, while for the remaining sectors the simple method is used.

The official Danish national fuel consumption projections from the DEA (2008a) are used in combination with sector specific emission factors derived from an emission model developed at NERI for road transport. The road transport emission model uses the basis emission factor data from the most recent edition of the COPERT model – COPERT IV.

A more in-depth documentation of the transport emission forecast can be seen in Nielsen et al. (2009b).

5.1.3.2 Assumptions and key parameters

Detailed information on assumptions and key parameters are given in Nielsen et al. (2009b).

5.1.3.3 Results

The result of the total projection of emissions of greenhouse gases by the transport sector up to 2025 is described in Table 5.7. As with the historical emissions inventories, the national totals for projected emissions of greenhouse gases do not include emissions from international air transport and international marine transport.

TABLE 5.7 TOTAL PROJECTION OF GREENHOUSE GAS EMISSIONS BY THE TRANSPORT SECTOR 2010-2025 AND THE EMISSION INVENTORIES FOR 1990, 2000 AND 2007

Source: 1990-2007: The National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, Technical report no. 703, 2009.

		1990	2000	2007	"2010"	2015	2020	2025
CO_2 ('000 tonnes)	Civil air traffic	243	154	107	161	169	181	192
	Road transport	9,275	11,202	13,198	12,745	12,899	13,017	13,794
	Railways	297	228	228	228	234	247	265
	National marine transport	714	476	454	452	449	449	449
	Defence (mobile sources)	119	111	175	153	153	153	153
	Total	**10,647**	**12,171**	**14,160**	**13,738**	**13,905**	**14,048**	**14,853**
	International air transport	1,736	2,350	2,701	2,605	2,741	2,983	3,183
	International marine transport	3,087	4,279	3,559	3,443	3,443	3,443	3,443
CH_4 ('000 tonnes CO_2 eq.)	Civil air traffic	0	0	0	0	0	0	0
	Road transport	3	2	1	20	14	10	8
	Railways	0	0	0	0	0	0	0
	National marine transport	0	0	0	1	1	1	1
	Defence (mobile sources)	0	0	0	0	0	0	0
	Total	**3**	**2**	**1**	**21**	**14**	**11**	**9**
	International air transport	0	0	0	1	1	1	1
	International marine transport	0	0	0	2	2	2	2
N_2O ('000 tonnes CO_2 eq.)	Civil air traffic	0	0	0	3	3	3	4
	Road transport	0	0	0	132	123	121	126
	Railways	0	0	0	2	2	2	2
	National marine transport	0	0	0	8	8	8	8
	Defence (mobile sources)	0	0	0	2	2	2	2
	Total	**0**	**1**	**1**	**143**	**135**	**133**	**138**
	International air transport	0	0	0	28	29	32	34
	International marine transport	0	0	0	67	67	67	67
GHG ('000 tonnes CO_2 eq.)	Civil air traffic	243	154	107	164	172	185	196
	Road transport	9,278	11,205	13,199	12,896	13,036	13,148	13,928
	Railways	297	228	228	230	236	249	267
	National marine transport	714	476	454	460	458	458	458
	Defence (mobile sources)	119	111	175	155	155	155	155
	Total	**10,650**	**12,174**	**14,162**	**13,902**	**14,054**	**14,191**	**15,000**
	International air transport	1,736	2,350	2,702	2,634	2,771	3,016	3,218
	International marine transport	3,087	4,280	3,559	3,512	3,512	3,512	3,512

5.1.3.4 Sensitivity analyses and scenario calculations

The projection cannot be better than the material on which it is based. It is no surprise that there is great uncertainty linked to the economic data, in particular in the more distant future. Similarly, on a number of occasions it has been demonstrated that tachograph data is also uncertain.

For the above reasons it is important to stress that the projection should only be used a descriptive tool for developments from one period to another. The uncertainty of the values for the individual years may be great, and interpreting the level for the specific year may be incorrect.

However, independent analyses and scenario calculations have not been prepared for the transport projection. In the sensitivity analyses prepared in connection with the energy projections, energy consumption and emissions by the transport sector are also influenced, however, when the price of fuel changes.

5.1.4 Industry

In addition to the emissions of greenhouse gases connected to energy consumption by industry discussed in section 5.1.2, greenhouse gases are also emitted from a number of industrial processes. These include emissions from the production of cement, lime, bricks/tiles, glass etc., as well as emissions of the fluorine-containing industrial gases HFCs, PFCs and SF_6 (F gases) from the production and use of products containing these substances, such as refrigerants, foaming agents, and as insulation gases.

5.1.4.1 Methods

For process emissions, there is often proportionality between production and emissions, if there are no significant changes in the technology used in production or any measures to limit emissions. However, it is often not possible to obtain information from enterprises on the expected future production, partly for commercial reasons and partly because market and production conditions are unpredictable.

F gases, however, are exceptional because they are contained in the product itself, e.g. as a refrigerant or insulator gas, and they are slowly released into the atmosphere over a number of years. In this regard, emission rates etc. in the IPCC guidelines for emissions inventories have also been used in the projections.

5.1.4.2 Assumptions and key parameters

The projection of the emissions is based on implemented and adopted policies and measures, described in Chapter 4, including a statutory order on phasing out certain industrial gases. This statutory order will result in a reduction in greenhouse gas emissions of, on average, 0.4-0.7 mill. tonnes CO_2 equivalents per year in the period 2008-2012. It is covered by a ban on the use of HFC as a coolant in the retail trade and stationary A/C systems from 1 January 2007, except for refilling of existing systems, and as a foaming agent in PUR foam from 1 January 2006.

With regard to process emissions, unchanged market and production conditions have been assumed consistently. The only deviations are, that from 2004 production of nitric acid ceased in Denmark; that in the period 2002-2007 an increase of 5% in the production of clinker for cement production is assumed; and that emissions of process CO_2 from steel production from 2005 are assumed to be at the 2001 level as from 2010 production will resume after a period of zero production from 2002-2007.

5.1.4.3 Results

Results of projections of F gases and process emissions appear in Tables 5.8 and 5.9.

TABLE 5.8 EMISSIONS OF INDUSTRIAL GREENHOUSE GASES (HFCS, PFCS AND SF_6), 1990-2007 ARE OBSERVED.

Source: 1990-2007: National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025. NERI Technical report no. 703, 2009.

'000 tonnes of CO_2 equivalents	**1995**	**2000**	**2007**	**"2010"**	**2015**	**2020**	**2025**
HFCs	218	605	840	786	488	152	152
PFCs	1	18	15	10	7	6	6
SF_6	107	59	30	58	123	59	59
F-gases total	**326**	**682**	**886**	**855**	**619**	**217**	**217**

TABLE 5.9 PROJECTION OF PROCESS EMISSIONS FROM CEMENT, CHALK AND TILE PRODUCTION AS WELL AS CHEMICAL PRODUCTION AND METAL PRODUCTION. 1990, 2000 AND 2007 ARE OBSERVED

Source: 1990-2007: National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025. NERI Technical report no. 703, 2009.

'000 tonnes CO_2-eq.	**1990**	**2000**	**2007**	**"2010"**	**2015**	**2020**	**2025**
Mineral products	1,073	1,641	1,607	1,664	1,656	1,649	1,650
Chemical industry	1,044	1,004	2.16	2.18	2.18	2.18	2.18
Metal production	28.4	40.7	0	45.0	45.0	45.0	45.0
Process emissions, total	**2,145**	**2,685**	**1,609**	**1,711**	**1,704**	**1,696**	**1,698**

5.1.4.4 Sensitivity analyses and scenario calculations

There are no sensitivity analyses and scenario calculations emissions of greenhouse gases from the business sector. On the basis of the effects described above, for example, it can be ascertained that the resumption of production of nitric acid in Denmark – with the same technology as prior to the cessation in 2004, which in practice will probably not be the case – will increase annual emissions in 2008-2012 by about 1 mill. tonnes CO_2 equivalents. In other contexts it has also been assessed that any relaxation of Danish regulation regarding F gases to align with EU regulation will increase Danish emissions of F gases by 0.4 – 0.7 mill. tonnes CO_2 equivalents per year in 2008-2012.

5.1.5 Agriculture

Agriculture accounts for approximately 18% of Denmark's total emissions of greenhouse gases, when also emissions from energy use are taken into account. The gases emitted by agriculture are mainly methane and nitrous oxide. The methane and nitrous oxide emissions are not taxed and are only regulated indirectly via the regulation of the effect on the aquatic environment of nitrogen losses from agriculture, e.g. in the Action Plans for the Aquatic Environment II and III, general structural developments, and the common CAP reform. The most recent projected greenhouse gas emissions from the agricultural sectors (*Nielsen et al., 2009b*) are provided in table 5.10. Possibilities for further reduction of the methane and nitrous oxide emissions in the agricultural sector was examined recently (*Fødevareministeriet, 2008*)

5.1.5.1 Methods

The present projection is similar to the latest basic projection for greenhouse gases published in 2007 (*Illerup et al., 2007*), except that the historic emission from 1990 to 2006 has been updated in accordance with the latest official reporting from Denmark.

The following measures are included in the present projection: The ammonia action plan, improvements in feed efficiency, the effects of implementation of the Plan for the Aquatic Environment III (VMPIII), the EU agricultural reform and expected emission-reducing technologies.

The emission of carbon dioxide from agriculture (*Gyldenkærne et al., 2007*) is not included in this projection as it is reported under forestry and land-use change

5.1.5.2 Assumptions and key parameters

For dairy cows is it assumed a 10% increase compared to the most recent baseline projection by *Poulsen et al. (2008)*. This increase has been made because the latest development in the Danish heard of dairy cattle is slightly increasing due to the increase in the Danish milk quota. The review concerns the establishment of ammonia-reducing technology in the stable, extension of biogas production, increased requirements for the utilisation of N in animal manure resulting from the Plan for the Aquatic Environment III (VMPIII), as well as the predicted assumptions for cattle and pig production. For other animal categories is only minor changes is foreseen (*Poulsen et al. 2008*)

The Health Check of the CAP reform is supposed to have a minor influence the figures in Table 5.10. With an increase in the EU milk quota an increase in the yearly milk production per cow of 0,6% is assumed. With productivity gains of 1% per cow per year, this will result in a reduction in the number of cows of 0,4% per year after 2008. In other words the decline in number of cows will continue but at a lower pace. For pigs the current reduction in numbers will be reversed, but the numbers are not expected to exceed the 2003-2004 levels (Jacobsen, 2008).

5.1.5.3 Results

During the period from 1990 to 2006, the emission of greenhouse gases declined from 13,03 ktonnes CO_2 equivalents to 9.6 ktonnes CO_2 equivalents. Until 2010 it is expected at slightly increase in the green house gas emission from agriculture to 9.9 ktonnes CO_2 equivalents. Until 2025 a slightly further decrease is expected to 9.4 ktonnes CO_2 equivalents in 2025. This means that in the period from 2006 to 2025, emissions are expected to decrease by 2% (Table 5.10).

The reduction both in the historical data (1990 - 2006) and the projection can mainly be explained by improved utilisation of nitrogen in manure, a significant fall in the use of fertiliser and a reduced nitrogen leaching. These are consequences of active environmental policy measures in this area. Measures in the form of technologies to reduce ammonia emissions in the stable as well as expansion of biogas production are taken into account in the projections but do not contribute to significant changes in the total greenhouse gas emission.

The Health Check of the CAP reform is assumed to have a minor influence on the figures in Table 5.10. With an increase in the EU milk quota an increase in the yearly milk production per cow of 0,6% is assumed. With productivity gains of 1% per cow per year, this will result in a reduction in the number of cows of 0,4% per year after 2008. In other words the decline in number of cows will continue but at a lower pace. For pigs the current reduction in numbers will be reversed, but the numbers are not expected to exceed the 2003-2004 levels (*Jacobsen, 2008*).

5.1.5.4 Sensitivity analyses and scenario calculations

Prior to the preparation of the a former projection for agriculture, NERI published a report in 2004, which through the following five scenarios illustrated the consequences of agricultural emissions of methane and nitrous oxide:

1. Baseline scenario - based on agricultural conditions in 2002
2. Implementation of the EU CAP – Common Agricultural Policy
3. Implementation of CAP + constant pig production at the 2003 level

4a. Implementation of CAP + 25% reduction in N run-off

4b. As 4a + specific initiatives for extra afforestation.

The results of these five scenarios appear in Table 5.11. As can be seen, there is only a small difference between the new baseline projection and the second scenario with the CAP reform in 2008-12. The scenario where pig production is kept at the 2003 level gives slightly lower emissions. A further 25% reduction of nitrogen run-off would lead to a further reduction of about 0.5 mill. tonnes CO_2 equivalents per year in both 2008-12 and 2013-17. Increased conversion of agricultural area to forest would give a further reduction of 0.4 mill. tonnes CO_2 equivalents per year in 2013-17, whereas extra CO_2 removals in 2008-12 only amount to one-quarter of this.

TABLE 5.10. PROJECTED GREENHOUSE GAS EMISSION FROM THE DIFFERENT SECTORS UNTIL 2025.
Source: 1990-2007: National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025. NERI Technical report no. 703, 2009

	CRF category	Source	1990	2000	2006	2010	2020	2025
CH_4, Gg	4A – Enteric Fermentation	Enteric fermentation	156,63	137,45	124,85	130,37	117,23	118,96
	4B - Manure Management	Manure Management (incl. reduction from biogas)	33,82	42,49	49,63	50,26	60,61	60,93
	4. Agriculture	**CH_4 – Total in Gg**	**190,44**	**179,94**	**174,49**	**180,63**	**177,84**	**179,90**
N_2O, Gg	4B- Manure Management	Manure Management (incl. reduction from biogas)	2,21	1,97	1,72	1,88	1,65	1,65
	4D.1 – Direct Soil Emissions	Mineral fertilizer	7,69	4,83	3,68	3,74	3,17	3,17
		Animal manure applied to soils	3,51	3,40	3,43	3,77	3,86	3,88
		N-fixing crops	0,87	0,75	0,68	0,68	0,68	0,68
		Crop residue	1,17	1,09	1,06	1,04	1,00	1,00
		Histosoils	0,38	0,36	0,37	0,35	0,35	0,35
	4D.2 – Animal Production	Pasture	1,01	0,99	0,90	0,89	0,79	0,80
	4D.3 – Indirect Soil Emissions	Atm. Deposition	1,72	1,33	1,12	0,97	0,88	0,88
		N-leaching and runn-off	10,50	7,05	6,03	6,20	5,50	5,50
	4D.4 – Other	Sewage sludges /industrial waste	0,09	0,17	0,27	0,27	0,27	0,27
	4. Agriculture	**N_2O – Total in Gg**	**29,14**	**21,93**	**19,28**	**19,80**	**18,15**	**18,18**
CO_2-eq., Mill. Tonnes	**4. Agriculture**	**CH_4 – Total in Mill. Tonnes CO_2-eq.**	**4,00**	**3,78**	**3,66**	**3,79**	**3,73**	**3,78**
	4. Agriculture	**N_2O – Total in Mill. Tonnes CO_2-eq.**	**9,03**	**6,80**	**5,98**	**6,14**	**5,63**	**5,63**
	4. Agriculture	**GHG – Total in Mill. Tonnes CO_2-eq.**	**13,03**	**10,58**	**9,64**	**9,93**	**9,36**	**9,41**

TABLE 5.11 EXPECTED EMISSIONS OF METHANE AND NITROUS OXIDE FROM AGRICULTURE 2003 – 2017
Source: Projections of greenhouse gas emissions, Memorandum to the Danish EPA, NERI, May 2005 and Projection of Greenhouse Gas Emission from the Agricultural Sector until 2017, NERI, 2004

Emissions of greenhouse gases from agriculture	**2003**	**2012**	**2017**	**2008-2012**	**2013-2017**
	Million tonnes CO_2 equivalents				
1. Baseline scenario	9.84	9.55	9.26	9.59	9.41
2. CAP Reform	9.84	9.49	9.16	9.57	9.33
3. CAP + pig production as in 2003	9.84	9.22	8.89	9.35	9.05
4.a CAP + 25% reduction in runoff	9.84	8.65	8.25	8.93	8.45
4.b CAP + 25% red. in runoff + extra initiatives for further afforestation	9.84	8.47	7.63	8.84	8.05

5.1.6 Forestry

Removals of CO_2 in Danish forests distinguish between removals in the permanent forest existing as of 1 January 1990, and removals in new forest established since 1990. After the submission of the Fourth National Communication, Denmark has elected Article 3.4 for forest management under the Kyoto Protocol. Therefore, projections for forestry now include CO_2 removals in forests existing as of 1 January 1990 in addition to removals in new forests under Article 3.3 of the Protocol. In 2009, all forest projections have been updated on the basis of new estimates from the Articles 3.3 and 3.4 monitoring project. In addition to the key information given in the following sections, further information can be obtained from *Johannsen V.K. et al (2009)*.

5.1.6.1 Methods

The prognosis for carbon stock during the period 2008 - 2020 is based on the NFI data on carbon stock in management classes - species and age classes. Forecasts are based on are allocation to age classes based on probabilities for rejuvenation of each management class. It assumes a constant distribution of species (no species change), but a calculation of percentage of area rejuvenated each year with the same species.

For each year, these calculations are combined with NFI data for carbon stocks in each management class. Evolution of the total carbon pool can then be calculated.

5.1.6.2 Assumptions and key parameters

The probabilities for rejuvenation is estimated based on the forest census data from 1990 and 2000 (*Nord-Larsen & Heding, 2002*). The projections involve no estimation of growth or harvesting.

The projections are performed similarly for old as well as new forests. In the afforestation an annual afforestation of 1900 ha is assumed, with a species distribution similar to the distribution observed in the NFI, except for a constant area with Christmas trees.

The key input parameters for the new estimates and projections have been obtained from the following sources of information:

1. National Forest Inventory - NFI - conducted by Forest and Landscape Denmark for The Danish Forest and Nature Agency, Ministry of Environment. The NFI started in 2002 and is a continous forest inventory with partial replacement. The rotation is 5 years. (*Nord-Larsen et al 2008*).

2. Forest Census 1990 and 2000, conducted by Statistics Denmark - in cooperation with The Danish Forest and Nature Agency and Forest and Landscape Denmark. (*Danmarks Statistik 1994, Larsen & Johannsen 2002*).

3. Mapping of the forest area based on satellite images in 1990 and 2005, with suppport from ESA - GMES - FM and the Ministry of Climate and Energy.

5.1.6.3 Results

The forecast for the period 2008 - 2020 show a different afforestation profile than previously estimated as it can be seen from table 5.12 and a decreasing trend of forest carbon in stock in forests from before 1990 as it can be seen from Table 5.13.

The trend in forests from before 1990 is due to the current high proportion of old trees, which face rejuvenation. Hereby large old trees felled and replaced by new small trees. The net result is that the total carbon stock decreases. If the forests had a completely even distribution of ages, carbon stock would be virtually constant - assuming unchanged harvesting and growth. Changes in forest management, may affect the development of forests. Thus, a postponement of cutting of old trees - will postpone the decline in carbon storage. Conversely, increased logging (e.g. due to increased demand, increased price or similar) may lead to a sharper decline in carbon stock.

Table 5.13 shows the expected CO_2 net-sequestration in forests remaining forests in selected years up to 2025. The new estimates show that forests remaining forests has been a souce since 2007, which is also the expectations according to the new projections. The projections are very dependent on the future demand for wood for energy production and market prices for wood in general. Increased demand for wood could lead to an additional decrease in C sequestration within the forest sector.

For the period 2008-2012 it must be noted that only ±183 Gg CO_2 yr^{-1} can be accounted for under Article 3.4 of the Kyoto Protocol.

TABLE 5.12 AREA OF AFFORESTATION AND CO_2 BINDING IN WOODY BIOMASS AND FOREST FLOORS (LITTER) SINCE 1990 AND PROJECTIONS FOR SELECTED YEARS UNTIL 2030.

Source: 1990-2007: The National Inventory Report (NIR2009), NERI April 2009 and revised estimates by Forest & Landscape Denmark *(Johannsen V.K. et al. 2009)*..
2008-2025: Forest & Landscape Denmark *(Johannsen V.K. et al. 2009)*.

NIR2009, April 2009:	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2010[1]**	**2015**	**2020**	**2025**
Private afforestation with subsidies, ha	0	178	1764	2454	3061	0	900	900	900	900
CO_2 binding (Gg)	0	-1.0	-16	-56	-71	-84	-120	-193	-280	-319
Public afforestation, ha	119	537	378	276	164	425	400	400	400	400
CO_2 binding, Gg	0	-6.0	-23	-44	-47	-50	-68	-102	-123	-160
Total afforestation including private afforestation without subsidies, ha	**730**	**1326**	**2753**	**3341**	**3836**	**1036**	**1900**	**1900**	**1900**	**1900**
Total CO_2 binding, Gg	**0**	**-15**	**-70**	**-158**	**-184**	**-209**	**-293**	**-437**	**-604**	**-712**
Revised estimates, August 2009	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2010[1]**	**2015**	**2020**	**2025**
Total annual afforestation including private afforestation without subsidies, ha	2216	2209	3828	5799	3836	1036	1900	1900	1900	1900
Total accumulated afforestation including private afforestation without subsidies, ha	0	11082	22152	39201	45000	48836	53672	63172	72672	82172
Total CO_2 binding, Gg (A)	**-51**	**-51**	**-138**	**-137**	**-326**	**132**	**-225**	**-208**	**-359**	**-359**
CO_2 emissions Gg (future Deforestation)							**30**			
Total CO_2 binding, Gg (A & D)	**-51**	**-51**	**-138**	**-137**	**-326**	**132**	**-195**	**-208**	**-359**	**-359**

[1]The value for 2010 is the average of the five years 2008-2012.

TABLE 5.13 THE REMOVALS AND EMISSIONS OF CO_2 IN FORESTS REMAINING FORESTS 1990 AND PROJECTIONS FOR SELECTED YEARS UNTIL 2025[1].

Source: 1990-2007: The National Inventory Report (NIR2009), NERI April 2009 and revised estimates by Forest & Landscape Denmark, (*Johannsen V.K. et al. 2009*).
2008-2025: In formation from Forest and Landscape Denmark, *(Johannsen V.K. et al. 2009)*.

NIR2009, April 2009:	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2010[2]**	**2015**	**2020**	**2025**
Gross uptake of CO_2 (Gg yr^{-1})	-5742	-5742	-6083	-6083	-6083	-6594	-6594	-6594	-6594	-6594
Loss of CO_2 in harvested wood (Gg yr^{-1})	2911	2765	5489	4411	3509	3824	2897	3058	3219	3380
Net annual sink for CO_2(Gg yr^{-1})	**-2831**	**-2977**	**-594**	**-1672**	**-2574**	**-2770**	**-3697[3]**	**-3536**	**-3375**	**-3214**
Revised estimates, August 2009	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2010[2]**	**2015**	**2020**	**2025**
Area, in ha	555037	555037	554730	553254	553254	553254	553254	553254	553254	553254
Area change, in ha (historic Deforestation)	0	-307	0	0	0	0	0	0	0	0
Stock in Gg C	102800	104071	105284	105927	106111	106316	105894	105428	104989	104373
Net annual sink for CO_2(Gg yr^{-1})	**-932**	**-721**	**-679**	**-677**	**-750**	**596**	**420[3]**	**251**	**416**	**501**

[1]Removals by sinks are displayed as negative figures, emissions by sources as positive.
[2]The value for 2010 is the average of the five years 2008-2012.
[3]The Danish cap for article 3.4 forest management 2008-2012 is ±183 Gg CO_2 yr^{-1}.

5.1.6.4 *Sensitivity analyses and scenario calculations*

Full sensitivity analyses have not been carried out. If incentives for afforestation are increased and if the rate of afforestation is doubled from about 1900 ha per year in 2010 to about 3800 ha per year (as in 2000), sequestration after 10-20 years will also double. However, at the moment it will hardly be realistic to increase removals significantly through afforestation in the remaining years of 2008-12.

5.1.7 Waste

Greenhouse gas emissions under this sector include methane (CH_4) from landfills and methane and nitrous oxide (N_2O) from wastewater treatment.

5.1.7.1 *Methods*

5.1.7.1.1 *Landfills*

CH_4 emissions from landfills are calculated using an emissions model in which activity data are annual data for the amount of waste landfilled and in which the emissions factors, i.e. the amount of CH_4 emitted per quantity of waste deposited, are obtained from the assumptions in the model for the decay of waste and the release of CH_4.

The model has been developed and applied in the annual historical emissions inventories for the Climate Convention. As a result the model has been developed in accordance with the guidelines in the IPCC Guidelines (1996) and the IPCC Good Practice Guidance (2001). On the recommendation of these reports, the model follows the Tier 2 method, which is a decomposition method. The model is described in the reports connected to the Climate Convention, most recently NIR2006. Briefly, the model assumes that carbon in landfilled waste decays and is converted to CH_4. This process is assumed by the model to continue so that 10 years after landfilling one-half of the carbon has been converted to CH_4. The model and the results have been evaluated through the Climate Convention in connection with the annual emissions inventories. The result of this evaluation has been that the model should continue to be used, unchanged, in the estimation inventories. In the NIR2006 sensitivity analysis of the the model results against variation of (1) the decay half life time and (2) compostition of the waste. Preliminary main results of these analysis are that the model is quite robust in the sence that variation of the parameters within reasonable limits produce minor change in model output only.

For the projection of emissions, the same CH_4 emissions model has been used as that used in the calculation of the historical emissions. The decay model for emissions of CH_4 implies that fluctuations over the time series of the emissions are much less than the fluctuation of the landfilled waste amount.

Recovery of CH_4 by landfill gas plants has been deducted from the calculated CH_4 emissions cf. Table 5.14. Energy statistics have been used for the historical data. For the projection of this deduction for gas recovered, the Energy Agency's general projection only includes a projection of landfill gas, and in this connection this is not considered useful. In an assignment for the Danish EPA (Danish EPA, 2005) LFG-consult (H. C. Willumsen) reviewed Danish landfills and prepared scenarios for recovery of CH_4 for the years 2005-2009. The result of the projection is shown in Table 5.14. For this projection a scenario (Danish EPA, 2005) without optimisation of the landfill gas plants has been used. The period 2010-2030 in the projection is calculated using exponential extrapolation. Further, the emissions calculated (Table 5.14, gross emissions) are deducted an oxidation of 10 % which takes place in the toplayer of the landfill, refer IPCC GPG, 2001.

TABLE 5.14 METHANE EMISSIONS FROM LANDFILLS FOR THE PERIOD 1990 TO 2025, 1990-200 ARE OBSERVED.

Source: 1990-2007: National Inventory Report (NIR2009), the National Environmental Research Institute (NERI), April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, February 2009.

Tonnes methane, CH4.	**1990**	**2000**	**2007**	**2008-12**	**2015**	**2020**	**2025**
Methane emissions from landfill sites (gross)	71 100	75 300	63 900	63 000	61 800	61 600	61 600
Recovery of methane from landfill sites	500	11 000	7 700	5 400	4 100	3 400	3 000
Methane emissions from landfill sites (net)	**63 600**	**57 900**	**50 600**	**51 800**	**52 000**	**52 400**	**52 700**

5.1.7.1.2 Wastewater

Calculations of emissions of methane from wastewater handling are based on theoretical maximum emissions, called gross emissions of methane. These gross emissions are based on emissions from the entire methane potential in the amount of organic degradable material in the input wastewater at the treatment plants. The methane potential used as biogas or which is incinerated is deducted from this theoretical maximum. The resulting net methane emissions are an estimate of the actual emissions of methane during wastewater treatment at treatment plants. Key parameters are industrial contributions to wastewater input to treatment plants and the fraction of wastewater sludge treated aerobically.

Calculations of emissions of nitrous oxide are divided into a contribution from wastewater-treatment processes at treatment plants, called direct emissions, and a contribution from output wastewater, called indirect N_2O emissions.

Any methane emissions from wastewater handling in specific industries are not included in the calculations.

5.1.7.2 Assumptions and key parameters

5.1.7.2.1 Landfills

Amounts of waste are collated by the Danish EPA in the information system for waste and recycling (ISAG). The ISAG was first used in 1993. The ISAG is based on statutory registration and reporting from Danish waste-treatment plants for all waste entering or leaving the plants. Information concerning waste in the previous year must be reported to the Danish EPA each year, no later than 31 January. The reports on waste statistics for 2006 are the 13th in the series. The results are published as annual waste statistics, most recently for 2006 in Waste Statistics 2006 Environmental Review no. 2, 2008. in Danish. The most recent annual statistics in English are on the year 2004, DEPA 2006. These annual statistics include landfilled waste.

The projection with measures is based on the government Waste Strategy 2005-2008, in which decoupling of growth in waste amounts from growth in the economy is a fundamental element. The Waste Strategy includes targets for landfilling waste for 2008. In terms of sectors, the Strategy distribution (%) of landfilled waste for 2001 and the targets for 2008 in relation to the total waste amount is in Table 5.15.

TABLE 5.15 PERCENTAGE OF WASTE AMOUNTS FOR LANDFILLING

Source: Projections of greenhouse gas emissions, DEPA (2008): Waste Statistics 2006 and the government's Waste Strategy 2005-2008

	Distribution 2006	Targets for 2008
Domestic waste	1	0
Bulky waste	21	25
Garden waste, etc.	1	0
Waste from institutions, trade and offices	8	5
Industry	19	15
Building and construction	3	8
Wastewater treatment plants	5	5
Power plants	2	10
Total	**6**	**9**

5.1.7.2.2 Wastewater

The calculations of direct emissions and projections are based on population figures as well as a calculation procedure for emissions factors adjusted for the N contribution from industry in input wastewater.

In general the industrial contribution is assumed to be constant from 1999 and after. The emissions contribution from industry has been set at 40,5% from 2004 and forward for both the projections. Nitrous oxide production takes place under anaerobic and aerobic conditions (nitrification and denitrification), but formation is primarily under aerobic conditions. Nitrous oxide emissions are expected to remain at a constant level due to fully optimised cleaning rate of wastewater before discharge.

5.1.7.3 Results

5.1.7.3.1 Landfills

The overall projection of methane (CH_4) from landfills is described in Table 5.16.

TABLE 5.16. EMISSIONS OF CH_4 FROM LANDFILLS IN CO_2 EQUIVALENTS (1000 TONNES =GG) OBSERVED: 1990-2007. PROJECTED: 2008-2025

Source: 1990-2007: National Inventory Report (NIR2009), the National Environmental Research Institute (NERI), April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, February 2009

Common reporting format (CRF) Sector/Source	1990	2000	2007	2008-12	2015	2020	2025
6A Managed waste disposal on land	1 335	1 215	1 063	1 089	1 091	1 099	1 108

5.1.7.3.2 Wastewater

The projection of total methane and nitrous gas emissions from wastewater handling in CO_2 equivalents is in Table 5.17.

TABLE 5.17 SUM OF EMISSIONS OF CH_4 AND N_2O FROM WASTEWATER IN CO_2 EQUIVALENTS (1000 TONNES OR GG) OBSERVED: 1990-2007. PROJECTED: 2008-2025

Source: 1990-2007: National Inventory Report (NIR2009), the National Environmental Research Institute (NERI), April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, February 2009

Common reporting format(CRF) Sector/Source	1990	2000	2007	2008-12	2015	2020	2025
6B Wastewater treatment	213	283	303	300	288	277	265

5.1.7.4 Sensitivity analyses and scenario calculations

Sensitivity analyses have not been carried out for the waste sector.

5.2 ASSESSMENT OF AGGREGATE AFFECTS OF POLICIES AND MEASURES

The total effect of policies and measures is described in section 5.1.1.

In this section further information on the total effect of policies and measures on a gas by gas basis is given.

5.2.1 Carbon dioxide, CO_2

Figure 5.6 shows the expected development in CO_2 emissions in Denmark's economic setors. A more detailed projection in IPCC source and sector categories is contained in annex E1. The biggest source of CO_2 emissions in Denmark is combustion of fossil fuels, including electricity and heat production and transport.

The transport sector has had the biggest increase in CO_2 emissions since 1990, and the emissions are expected to continue rising for the whole of the projection period. CO_2 emissions from the transport sector were 10,528 Gg of CO_2 in 1990 and had risen to 13,986 Gg of CO_2 in 2007, whereas the projection for 2008-2012 is 13,585 Gg of CO_2 annually. Emissions from energy production, including conversion and distribution have varied in 1990-2007 due to great variations in exports/imports of energy.

The total CO_2 emissions without land-use change and forestry (LUCF) was 52,793 Gg in 1990 and 53,228 Gg in 2007, while for the period 2008-2012 it has been calculated that the average annual CO_2 emissions will be 53,000 Gg CO_2.

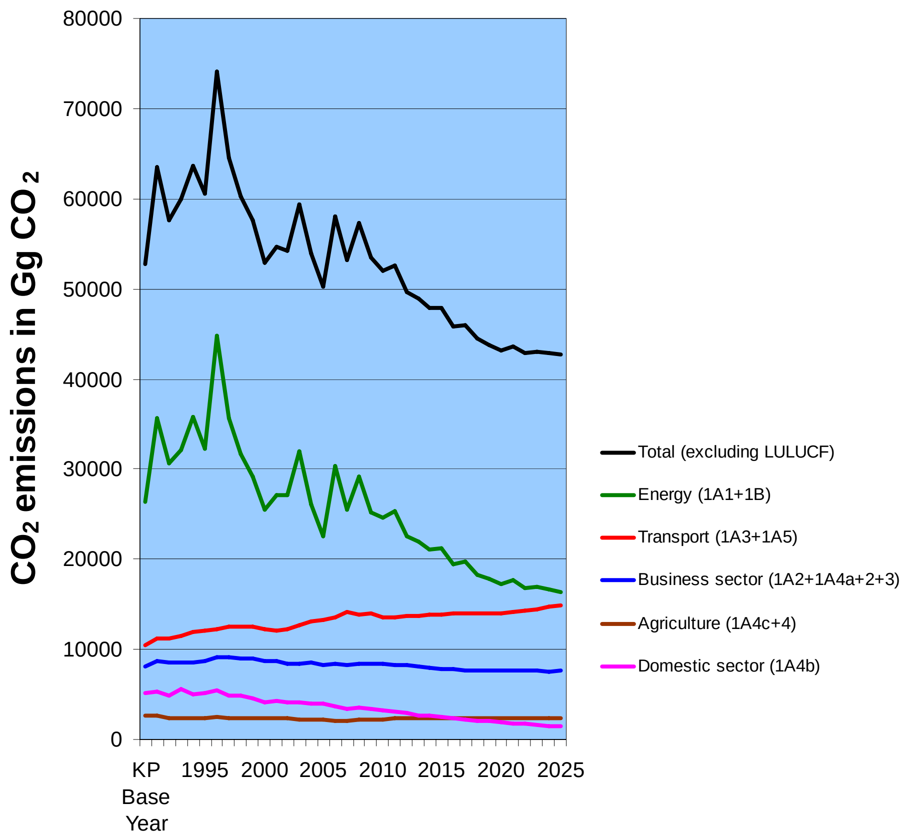
Due to new knowlegde since NIR2006, base year emissions reported in NIR2009 and shown here deviate slightly from the base year under the Kyoto Protocol determined in 2007.

The previous projections of emissions and removals by the categories in the LULUCF sector are outdated. When new inventories for the LULUCF sector and the activities under Articles 3.3 and 3.4 of the Kyoto Protocol will be available for the NIR2010 report, new projections for this sector and these activities will be elaborated. Another reason for not including the LULUCF sector in the projections is that only specific parts of the emissions and removals estimated in accordance with the rules under the UNFCCC are to be taken into account under the Kyoto Protocol's Articles 3.3 and 3.4 in the period 2008-2012. And for the period after 2012 , the effect of activities in the LULUCF sector on Denmark's effort in achieving its post 2012 reduction targets will not be known until detailed accounting rules for the accounting of emissions and removals in the LULUCF sector under a international post 2012 agreement have been decided.

FIGURE 5.6 PROJECTIONS OF DENMARK'S CO_2 EMISSIONS IN 2008 - 2025 AND EMISSIONS OBSERVED IN 1990-2007

Source: 1990-2007: The National Inventory Report (NIR), NERI, April 2009.

2008-2025: Projections of greenhouse gas emissions 2007 to 2025, NERI, February 2009

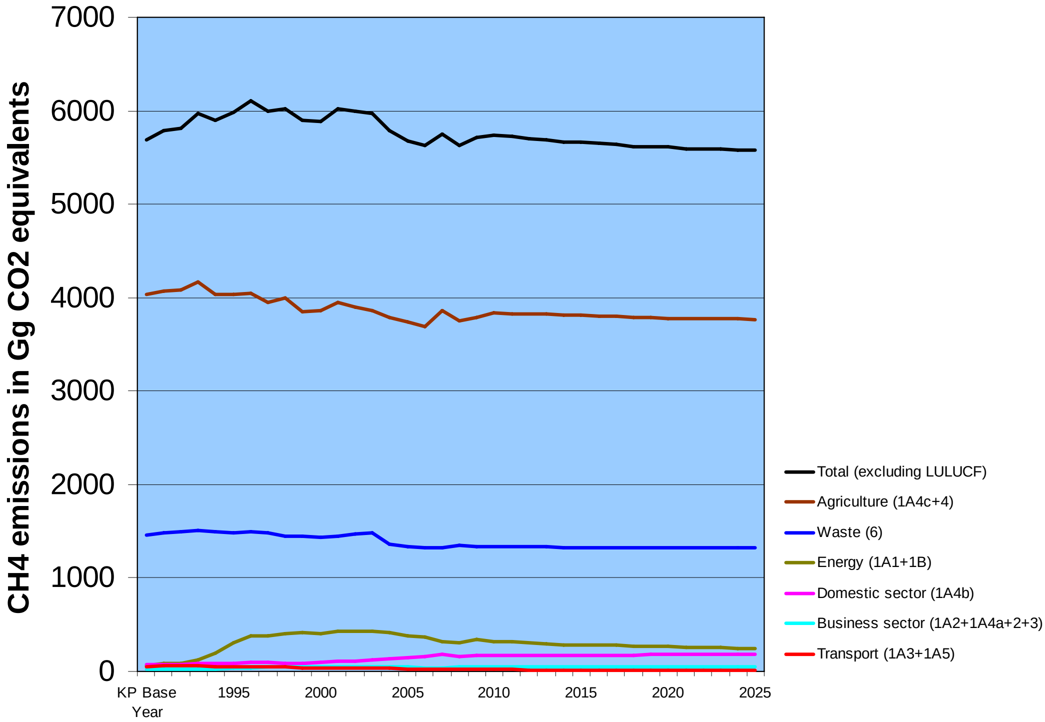


5.2.2 Methane (CH_4)

Most of the methane emissions come from farm animals' digestive systems (enteric fermentation). The projections are shown in Figure 5.7. The very small changes in emissions from agriculture from 1990 to 2012 and the continued reductions in the projection period are primarily due to very little changes in cattle stocks. The next largest source of methane is landfills, from which emissions were also reduced from 1990 to 2007. Methane emissions from the energy sector have, however, increased considerably during the same period, due to an increase in the use of gas-driven motors. This has altogether led to an increase in total methane emissions from 5,695 Gg of CO_2 equivalents in 1990 to 5,748 Gg of CO_2 equivalents in 2007, whereas the projection for 2008-2012 is lower, i.e. 5,702 Gg of CO_2 equivalents annually.

FIGURE 5.7 PROJECTIONS OF DENMARK'S METHANE EMISSIONS 2008 – 25, EMISSIONS IN 1990-2007 ARE OBSERVED

Source: 1990-2007: The National Inventory Report (NIR), NERI), April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, February 2009

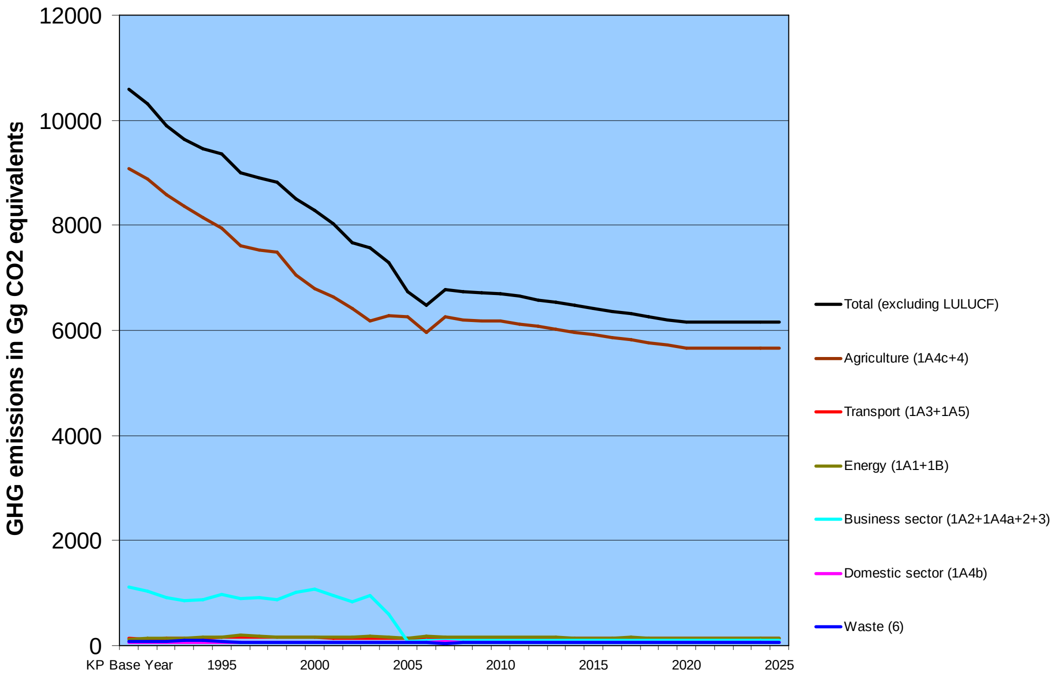


5.2.3 Nitrous oxide, N_2O

Agriculture is by far the main source of emissions of nitrous oxide because this forms in soil through bacterial conversion of nitrogen in fertiliser and manure. The projections are shown in Figure 5.8. The main reason for the reduction in total nitrous oxide emissions from 10,527 Gg CO_2 equivalents in 1990 to 6,780 Gg CO_2 equivalents in 2007 is a combination of the Action Plans for the Aquatic Environment I and II and the Action Plan for Sustainable Agriculture. The projection for 2008-12 is 6,674 Gg CO_2 equivalents annually. This substantial reduction is not least due to the fact that Denmark ceased to produce nitrous acid in 2004, as shown under the Business sector (industrial processes) in Figure 5.8. Contributions from the transport and energy sectors are expected to increase, whereas contributions from agriculture are expected to be somewhat less than in 2001.

FIGURE 5.8 PROJECTIONS OF DENMARK'S NITROUS OXIDE EMISSIONS IN 2008-25, EMISSIONS IN 1990-2007 ARE OBSERVED

Source: 1990-2007: The National Inventory Report (NIR), NERI, April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, February 2009



5.2.4 Industrial gases HFCs, PFCs and SF_6

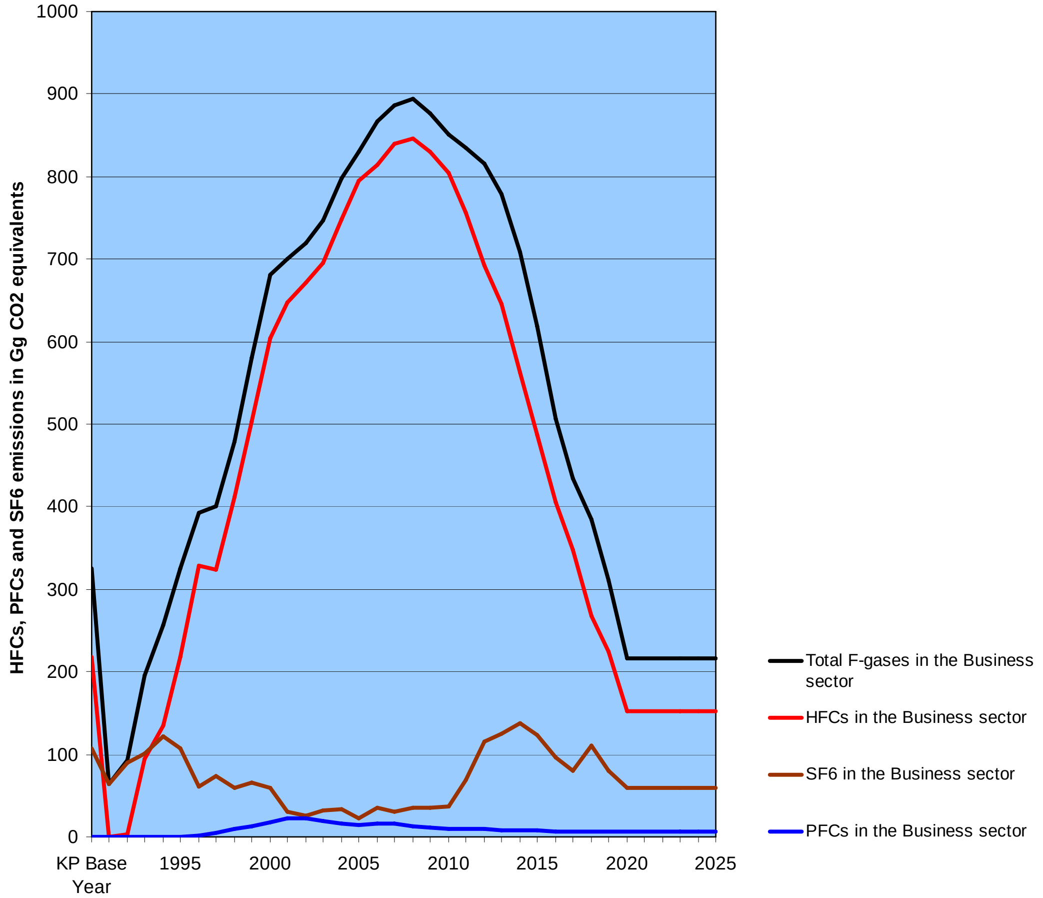
In accordance with the possibilities offered in the Kyoto Protocol, Denmark has chosen 1995 as the base year for emissions of the industrial gases, or F-gases, HFCs, PFCs and SF_6. Total emissions of these gases corresponded to 326 Gg CO_2 equivalents in 1995 and annual emissions have more than doubled since the year 2000. The rate of increase has decreased since 2003, when emissions corresponded to 746 Gg CO_2 equivalents. In the projections, the total F-gas emission is expected to peak in 2008 at 895 Gg CO_2 equivalents

As it can be seen from Figure 5.9, the trends for the three individual types of F-gas are very different due the different uses of these gases. With HFCs being the major contributor, the trend for HFC emissions follow the trend for total F-gas emissions closely.

The decrease in the rate of increase is primarily due to taxes and regulations introduced concerning the use of new installations/products. For the period 2008-12 total emissions of industrial gases corresponding to 786 Gg CO_2 equivalents annually are projected, after which a major reduction in emissions of HFCs is expected and will result in a considerable reduction in emissions of industrial gases following the first period of commitment.

FIGURE 5.9 PROJECTIONS OF DENMARK'S INDUSTRIAL GREENHOUSE GAS EMISSIONS (THE F-GASES) IN 2008-25, EMISSIONS IN 1995-2007 ARE OBSERVED

Source: 1990-2007: The National Inventory Report (NIR), NERI, April 2009
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, February 2009

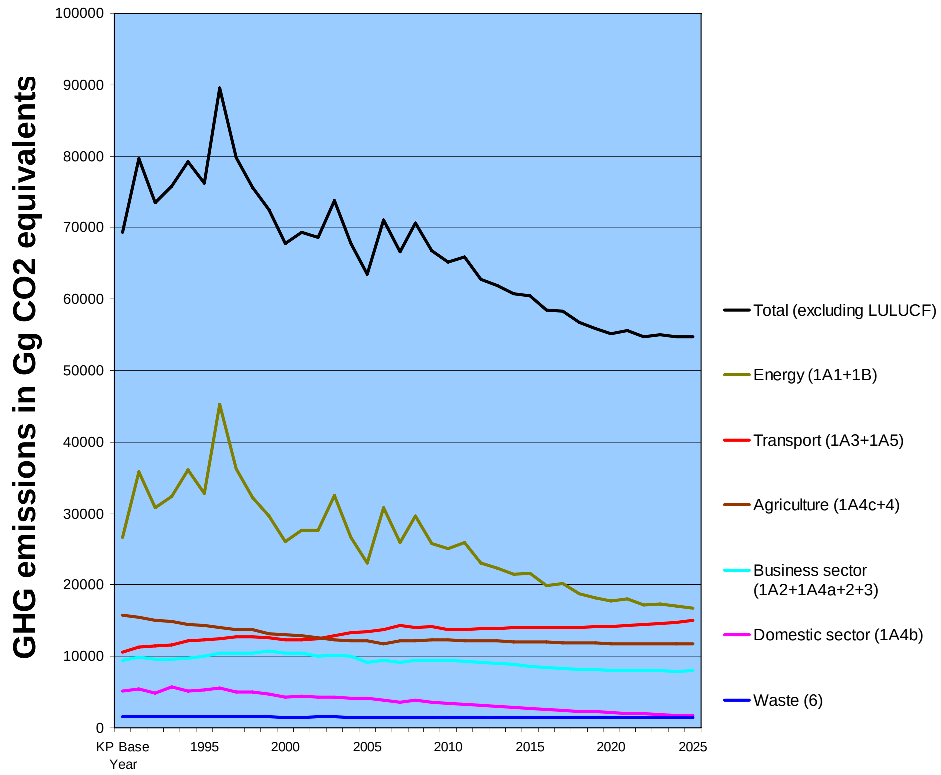


5.2.5 Denmark's total greenhouse gas emissions and removals

Figure 5.10 shows the base year and projections of Denmark's total greenhouse gas emissions and removals. The overall trend and effect of policies and measures is commented in section 5.1.1. Further details in IPCC source and sector categories are contained in Annex E1.

FIGURE 5.10 PROJECTIONS OF DENMARK'S TOTAL GREENHOUSE GAS EMISSIONS IN 2008-2025, EMISSIONS IN 1990-2007 ARE OBSERVED

Source: 1990-2007: National Inventory Report (NIR), NERI, April 2009.
2008-2025: Projection of greenhouse gas emissions 2007 to 2025, NERI, February 2009.



5.2.6 Projections without measures

According to the guidelines for national reporting, projections in National Communications could also include any results from projections “without measures”, i.e. projections without the expected effects of measures implemented after a certain point in time.

The Effort Analysis from 2005 includes such a projection of Denmark's greenhouse gas emissions in 2008-2012 excluding measures which were implemented from 1990 to 2001. The results of the *Effort Analysis* are described in Annex B1.

Note that the analysis has been prepared on the basis of a previous projection which include the effect of measures described in Denmark’s Third National Communication as the analysis was started in 2003.

As stated in Annex B1 in the *Efforts Analysis*, it has been estimated that average Danish emissions of greenhouse gases in 2008-2012 would have been 95.6 mill. tonnes CO_2 equivalents– i.e. about 15.6 mill. tonnes CO_2 equivalents greater that the previous projection with measures, if the measures initiated in the period 1990-2001 had not been initiated.

5.2.7 Projections with additional measures

In accordance with the reporting guidelines for National Communications, it is also possible to include information on greenhouse gas projections where the expected effects of additional policies and measures that are planned but still not implemented are included.

The Government's most recent sector specific plans with greenhouse gas emission reduction as one of their objectives (the Green Transport Vision, the Tax Reform and the Green Growth agricultural plan) contains additional policies and measures that are in the planning phase.

However, despite the fact that many important initiatives have already been implemented in order to achieve the 2008-2012 reduction target under the Kyoto Protocol and the EU Burden Sharing Agreement., new knowledge included in a preliminary update of Denmark's with existing measures greenhouse gas emission projection suggests, that additional initiatives have to be taken to make certain, that Denmark can live up to its very ambitious target.

To be on the safe side of this very ambitious target, the government adopted additional initiatives in December 2009.

Furthermore, in 2010, the government will present a new Climate Strategy 2020, focusing on possible further actions until 2020 for the purpose of achieving Denmark's 2020 reduction target outside the EU Emission Trading Scheme.

As mentioned in section 5.1.1 the work on these additional initiatives has included interim updates of the "with (existing) measures" projections from February 2009, where the estimated effects of the Green Transport Vision, the Tax Reform and the Green Growth agricultural plan have been taken into account.

These interim updates have shown that new knowledge about activities and emission factors more than counteracted the estimated effects of the new sector specific plans in the projections, even when taking into account the expected effects of the current economic recession, suggesting that additional initiatives could be needed both for achieving the 2008-2012 target under the Kyoto Protocol and the 2013-2020 target under the EU Effort Sharing Decision for the sectors outside the EU ETS.

The new knowledge about activities and emission factors which increase the projected greenhouse gas emissions by sources and removals by sinks include:

- New knowledge about the non-biogenic fraction in waste incinerated – the share of plastics etc. is bigger than previously estimated – this will increase CO_2 emissions from waste incineration in comparison with the February April 2009 projection,

- New knowlegde about the projected effects of biofuels – the previously estimated effects have been lowered due to a delay in the phasing in of the increase in the share of biofuels – this will increase greenhouse gas emissions from transport in comparison with the February 2009 projection,

- New knowlegde about the carbon balance in Danish forests – forests existing before 1990 will be a net-source in 2008-2012 and not a net-sink as previously projected – this will turn the projected credits from Forest Management under Article 3.4 of the Kyoto Protocol in March 2009 into debits,

- New knowlegde about the carbon balance in Danish cropland and grazing land soils – the estimated net-net reduction in emissions from soils since 1990 will be lowered due to temperatures in 2008-2012 that are higher than previously projected – this will lead to a decrease the amount of credits from Cropland Management and Grazing Land Management under Article 3.4 of the Kyoto Protocol in comparison with what has been previously estimated.

Due to the new knowledge mentioned above, the interim update showns an increase of about 0.9 mill. tonnes annually 2008-2012 in projected greenhouse gas emissions outside the EU ETS. In comparison with the non-ETS projection presented together with the second National Allocation Plan (NAP2) in 2007, the effect of the abandoned EU set-aside scheme in the agricultural sector (see section 4.3.7.4), estimated at 0.1 mill. tonnes, has also contributed to the increase in non-ETS emissions since NAP2.

This interim update suggests that, without implementation of additional initiatives, Denmark could expect a deficit of about 1 mill. tonnes of CO_2 equivalents annually in average 2008-2012.

Additional policies and measures to be implemented for the purpose of achieving both the 2008-2012 target under the Kyoto Protocol were therefore decided by the government in December 2009.

- Allocation of DKK 400 mio. to support the substitution of individual oil based furnaces for modern, low-emitting heating solutions, including systems based on renewable energy such as heat pumps and solar heating. Reduces emissions 0.05 mill. tonnes annually in average 2008-2012.

- The decision to use emission rights of about 2.75 mill. tonnes, which are expected not to to be allocated due to closures and fewer new entrants, for fulfilling the national reduction target.

- Allocation of DKK 225 mio. in the budget for 2010 for development of sustainable JI and CDM projects and the purchase of 2 mill. tonnes CO_2 credits.

The initiatives eliminate the estimated deficit from the interim update of about 1 mill. tonnes of CO_2 equivalents annually in average 2008-2012 and ensure that Denmark fulfills its national target.

When consolidated estimates become available, an updated and consolidated new ”with measures” projection is expected to be elaborated and published in 2010.

5.3 SUPPLEMENTARITY RELATING TO MECHANISMS UNDER ARTICLES 6, 12 AND 17 OF THE KYOTO PROTOCOL

According to the Kyoto Protocol, the use of the mechanisms in Articles 6 (JI), 12 (CDM) and 17 (IET) of the Protocol must serve as a supplement to domestic action to reduce greenhouse gas emissions. The reason for this is that action in the Annex I countries drives technological development and is also consistent with the agreement that Annex I countries must lead the way in efforts to reduce global emissions.

The formulation used in the Protocol ("..supplemental to domestic action..") is not further qualified and no specific requirements are laid down regarding how large a proportion of the total national reduction objective may be fulfilled using flexible mechanisms. The Marrakech Accord stipulated that "...the use of mechanisms shall be supplemental to domestic action and that domestic action shall thus constitute a significant element of the efforts made by each Party...".

The National Allocation Plan

The European Commission approved the Danish National Allocation Plan (NAP) in 2007. The NAP contains a detailed plan for the reduction efforts and ensures that Denmark reaches its goal for the Kyoto Protocol period 2008 – 2012. In the NAP, the gap between the emission target and emissions under business as usual amounted to 13 million tonnes pr. year. Of this gap, 5.2 million tonnes are covered by efforts in the emission trading sector, while the remaining 7.8 million tonnes are covered by efforts in the non-emission trading sector using various instruments, including the use of CDM-credits, sinks and additional domestic efforts. The NAP also ensures that Denmark honours the supplementarity principle.

5.4 METHODOLOGY USED FOR THE PRESENTED GREENHOUSE GAS EMISSION PROJECTIONS

The methodologies used for the presented greenhouse gas emission projections are described in for the relevant sectors in section 5.1.2-5.1.7.

5.5 GREENLAND AND THE FAROE ISLANDS

5.5.1 Greenland

Times series for CO_2 emissions and total greenhouse gas emissions from 1990, 1995, and 2000 to 2007 are presented in table 5.20 below.

TABLE 5.20 CO_2 AND TOTAL GREENHOUSE GAS EMISSIONS CALCULATED AS CO_2 EQUIVALENT EMISSIONS IN GG (1.000 TONNES) IN 1990, 1995 AND 2000-2007

Source: Greenland Government and Statistics Greenland (2009) *GHG inventory for Greenland.*

Gg	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007
CO_2	625,2	533,5	665,7	616,3	577,6	647,3	643,8	633,6	657,0	649,2
GHG[1]	651,4	558,8	691,1	642,6	603,7	675,3	663,6	663,0	686,5	679,3

[1]Total CO_2 equivalent emissions with land use, land-use change and forestry. Data is based on the summery report for CO_2 equivalents from 1990 – 2007 as presented in the Greenhouse gas inventory for Greenland, march 2009

The times series above is based on the 2009 Greenhouse gas inventory for Greenland. Times series reported in the fourth National Communication were based on energy statistics, where CO_2 emissions are calculated from the burning of fossil fuels in energy production. In the new data emissions from the incineration of waste and the use of waste oil in CHP plants is included.

In the 2009 Greenhouse gas inventory for Greenland better information on the use of energy in sectors and new information on bunkering in Greenland waters is available, leading to small changes in emissions data for 2004 to 2007. Furthermore, an incorrect reference to the use of waste oil in 1990 has been corrected with the new data.

Times series for expected CO_2 equivalent emissions in 2008 to 2012 are given in table 5.21 below. The data are based on extrapolated emissions used in the *Greenland analysis on reduction of greenhouse gas emissions 2008 – 2012*.

TABLE 5.21 EXPECTED CO_2 EQUIVALENT EMISSIONS (IN 1.000 TONNES) IN 2008-2012

Source: Greenland Home Rule (2009), Draft strategy on reduction of greenhouse gas emissions 2008-2012.

Gg	**2008**	**2009**	**2010**	**2011**	**2012**	**2008-2012**
GHG in Gg CO_2 eq.	665.9	671.5	666.1	662.6	667.9	3,334

The extrapolated CO_2 equivalent emissions for the Kyoto period are based on the Greenland *Analysis for reduction of greenhouse gas emissions 2008-2012* endorsed by Parliament at its Autumn Session 2009. Data is extrapolated from the current emissions if no extraordinary initiatives are introduced to reduce emissions of CO_2.

The allowed CO_2 equivalent emissions for the Kyoto period are 3,012,000 tons. Therefore the strategy points at instruments, which can be used to reduce emissions, i.e. investments in new oil-fired boilers, campaigns to address patterns of consumption etc.

5.5.2 The Faroe Islands

As mentioned in Section 4.6, a national target to reduce the domestic emissions of greenhouse gases by at least 20% in the period 2010 to 2020 compared with the level of emissions in 2005 was adopted by the Faroese Parliament in December 2009.

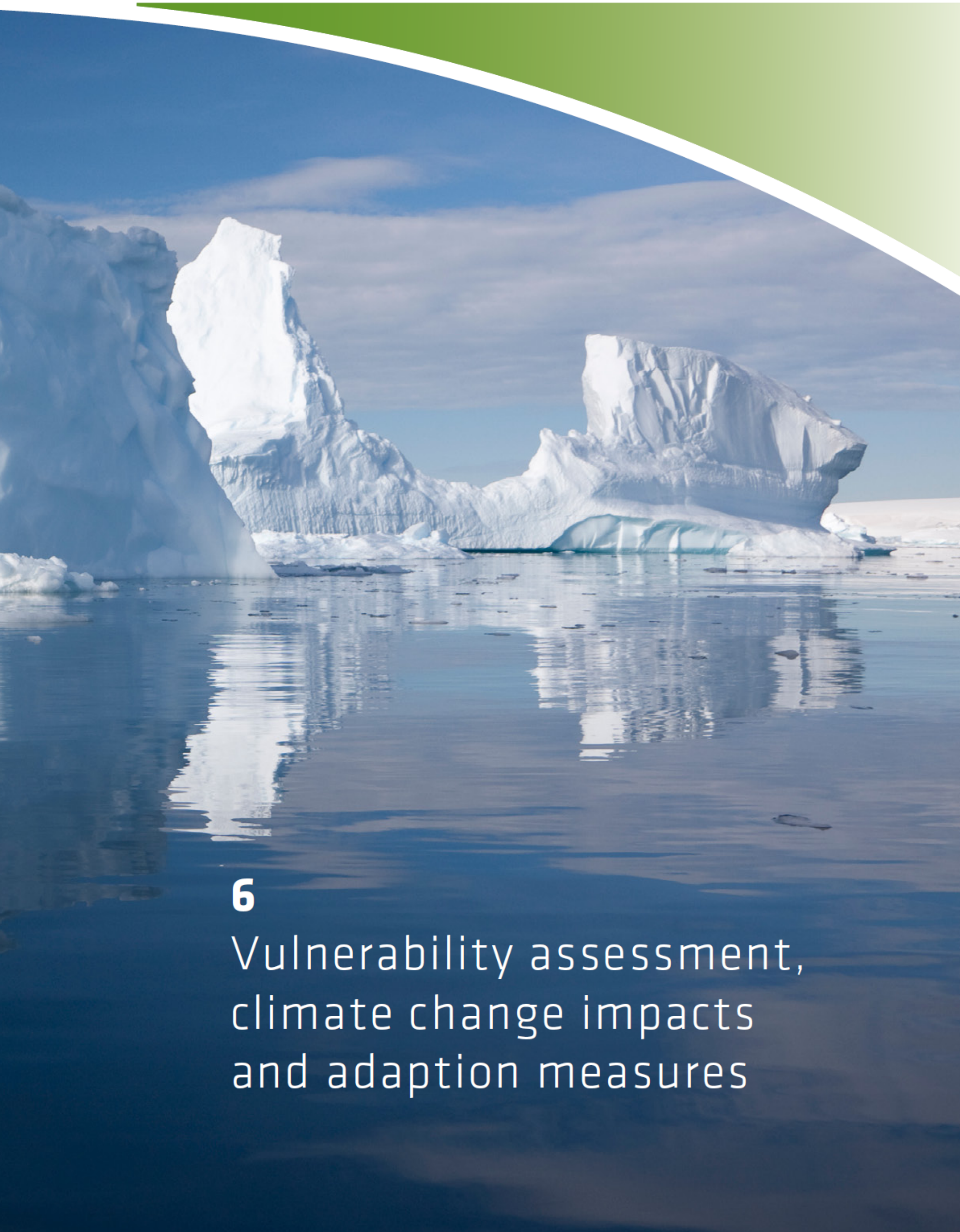
Times serie for Faroe Islands' total greenhouse gas emissions from 1990, 1995, and 2000 to 2007 are presented in table 5.21 below.

If no new mesures were to be implemented, the increase in Faroe Islands' greenhouse gas emissions seen in recent years will most likely continue in the future.

TABLE 5.21 FAROE ISLANDS' TOTAL GREENHOUSE GAS EMISSIONS CALCULATED AS CO_2 EQUIVALENT EMISSIONS IN GG (1.000 TONNES) IN 1990, 1995 AND 2000-2007

Source: Faroe Islands' Home Rule, The Ministry of the Interior and NERI (2009) .

	1990	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total GHG emissions in Gg	702	571	792	765	783	784	762	770	792	771
Index (1990=100)	100	81	113	109	112	112	109	110	113	110



6
Vulnerability assessment, climate change impacts and adaption measures

6 Vulnerability assessment, climate change impacts and adaptation measures

6.1 Expected impacts of climate change

6.1.1 Climate in the future

In relation to future global climate change, Denmark is a robust country. This is primarily because of a long tradition of legislation which prevents building in river valleys, along the coast and in forests. Agricultural land is well-drained and many farmers are able to irrigate in dry periods. Moreover, the Danish population is aware of, and uses systematic warning systems of extreme weather events and the consequences thereof.

Natural and man-made forcings of the climate of the future, e.g. volcanic eruptions, varied solar activity, increased greenhouse effect and emissions of aerosols are best assessed using climate models. Simple projections on the basis of the current climate and observed trends only provide a limited impression of possible future climate changes. Climate models, which are based on the laws of physics, are mathematical descriptions of the components of the climate system: atmosphere, ocean, ice and snow, land surfaces and the biosphere. Calculations are carried out on large computers and increasingly demand cooperation between modelling centres in order to reduce or quantify uncertainties.

The most important source of uncertainty regarding the future climate is related to the lack of knowledge on future greenhouse gas emissions. In addition there is uncertainty regarding the sensitivity of the climate system to these greenhouse gases. Finally, uncertainty is linked to the interrelationship between changes in the global climate and the regional effects that may arise. These effects can be divided into direct consequences of climate change and indirect effects resulting from climate change in countries outside the Realm.

6.1.2 Climate trends in Denmark

6.1.2.1 The latest developments

Since the Ice Age, Denmark has had a temperate maritime climate. This climate, with wet winters and cool summers is now changing. The latest statistics[40] from DMI

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[40] Cappelen, 2009a

(Danish Meteorological Institute) show that the mean temperature is approaching 8.5°C, an increase of almost 1.5°C since the end of the 19th century. This increase is more than double the increase in the global mean temperature for the same period. Now, the average winter temperature is most often warmer than 2ºC and the average summer temperature is about 16ºC.

The annual precipitation measured in Denmark is now about 750 mm. This has increased by about 15% - or 100 mm – since records began in 1874. Precipitation is greatest in west and Southern Jutland, with almost 1000 mm, and least precipitation is measured on the eastern islands, where about 600 mm is recorded each year. It is typical that wet areas experience the greatest percentage increase. Therefore, precipitation has increased most in west Jutland, by about 20% in the past 85 years. In the same period drainage into water courses has increased correspondingly[41]. As a result, run-off of nutrients from agricultural soil continues to be very large in wet years, despite national initiatives in the Action Plans for the Aquatic Environment I-III. The link between precipitation, drainage and run-off must be taken into account when the EU Water Framework Directive is to be implemented.

The Danish climate has become more maritime in the 20th century. On average, the cloud cover has increased by about 5 percent since observations began in 1874. With the clouds, more precipitation has come, there are fewer days with snow cover, and temperatures are higher. The direct consequences such as decreased need for ice-breaking, shorter sledging season, earlier pollen season, longer growing season and longer swimming season, can already be felt by the Danish population.

The sea level around Denmark has risen over the past 115 years. The maximum observed rise is in south-western Denmark, where the water level is rising by about 1 mm per year. In northern and eastern Denmark uplift of the land after the Ice Age is roughly in line with the rise in sea level.

6.1.2.2 Projected climate changes in Denmark

The natural causes of future climate change are difficult to assess in advance. The basis for assessing the increased greenhouse effect is also uncertain for several reasons. An important source of uncertainty about the future climate arises from the lack of knowledge about future global emissions of greenhouse gases and other substances that affect the climate. Moreover, there is uncertainty regarding the sensitivity of the climate system to these greenhouse gases.

DMI/Danish Climate Centre (in cooperation with the Hadley Centre for Climate Prediction and Research and the Max Planck Institut für Meteorologie in Hamburg) has carried out global and regional calculations for several internationally recognised scenarios for future emissions of greenhouse gases and aerosols[42]. Analyses with global and regional climate models show the following general changes for the climate in Denmark in the period 2071-2100 in relation to 1961-1990:

- A rise in the annual mean temperature of 3-5°C, depending on the chosen scenario for emissions of greenhouse gases. Greatest warming at night and no

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[41] Ministry of the Environment, 2004: Nature & Environment 2003 Theme: Water in Denmark. (Available at www.mst.dk)

[42] Christensen, 2000; Stendel et al., 2000; Stendel et al., 2001; Christensen and Christensen, 2001, 2003, 2004, 2007; May,1999; May, 2001; Andersen et al., 2001; Christensen at al., 2002, 2007; Christensen 2005; Jacob et al. 2007; Déqué et al. 2007

major difference between the increase in summer and winter. Warming leads to fewer days with frost and snow and less days with snow cover. Average snow cover decreases to about 25% of present-day values.

- An increase of 10-40% in winter precipitation and a reduction in the order of 10-25% in summer precipitation. A clear tendency towards more episodes with very heavy precipitation, particularly in autumn and lengthy dry periods, especially in the summer.

- A tendency towards more frequent westerly winds and at the same time a shift of the storm tracks over the North Atlantic slightly eastward, leading to a small increase in storm activity over Denmark and the adjacent waters. On this basis, calculations with storm surge models show that the highest sea level in the more extreme cases could rise by 5-10% relative to today (about 0.3 m on the west coast)43. In addition to this there is the global rise in sea level which the IPCC estimates at between 0.1-0.9 m over the level today.

A combined positive effect on the runoff from land areas has been calculated. There would be an increase of the order of 10% in the period December to April when the simultaneous effect of increased winter precipitation and larger evaporation is taken into account. More run-off in the entire Baltic region could make the surface layers in the inner Danish waters less saline. In combination with changed wind conditions and increased run-off of nutrients, this could present a risk of negative consequences for marine ecosystems and commercial fish stocks in the form of oxygen depletion.

Note that the uncertainty mentioned above is significant in assessing future climate change, especially in projecting precipitation and extreme weather phenomena such as storms and floods. The DMI models and most other models show climate sensitivity at about 3°C for a doubling in the CO_2 content in the atmosphere, but model studies published in 2005 in the journal Nature[44], show that climate sensitivity could be considerably greater than hitherto assumed.

6.1.3 Impacts and Danish strategy for adaptation to a changing climate

6.1.3.1 Earlier evaluations

The impacts of possible climate change in Denmark have been evaluated several times since 1988, and most recently in the Danish EPA report of 2004: Adapting to the climate of the future[45]. The general conclusion is that the direct impacts in moderate climate scenarios would be modest and could be countered by suitable ongoing adaptation. Overall, estimates indicate that it will be an advantage to conduct long-term planning and keep to appropriate safety margins. This means can help identifying the areas of society which require short-term decisions, whilst continuously improving the basis for less urgent decisions. The report points out that changes in the extreme climate could be the cause of the unexpected future climate evolution for the Danish people. Local decision-makers are encouraged to incorporate climate change in all current decisions on planning and ongoing maintenance.

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[43] Kaas et al. 2001: Christensen 2005
[44] Stainforth et al., 2005
[45] Danish EPA, 2004: Adapting to the climate of the future (available at www.mst.dk)

6.1.3.2 *Danish strategy for adaptation to a changing climate*

In October 2005 the Danish government initiated preparations to meet the impacts of climate change. On the basis of three possible future climate scenarios, IPCC's A2 and B2 and a scenario based on the EU 2 degrees target a catalogue of consequences and measures was established as a first step. As the next step, in March 2008, the Danish government launched a Danish strategy for adaptation to a changing climate[46].

The strategy is based on the notion that adaptation to climate change is a long-term process, and that it is still uncertain what the consequences of climate change will be and how soon they will take effect. The government will therefore initiate an information campaign and organise the area, with the aim of ensuring that climate change is incorporated into planning and development so that public authorities, businesses and citizens have the best possible basis for considering whether, how and when climate change should be taken into account.

The strategy comprises the following measures:

- establishing an organizational framework, including establishing a horizontal coordination forum for adaptation that will ensure a coordinated effort among public authorities
- a targeted information campaign, including creation of a web portal operated by an information centre
- a research strategy that will include establishment of a coordinating body to ensure that Danish climate research focuses on the adaptation question to a greater extent

After the Government's adoption of the strategy, a new coordination forum was created to ensure a common basis and cooperation and coordination across sectors and authorities. All relevant state authorities and representatives from the municipalities and region and the new coordination unit for research participate in the coordination forum cf. Figure 6.1.

The main objectives of the Coordination Forum are among others to monitor national and international developments with respect to climate change and to report to the government on the implementation status for the Danish strategy.

The new information centre on adaptation is established in the Ministry of Climate and Energy and a new web portal (www.klimatilpasning.dk) was launched in January 2009. The main duties of the information centre will be communication, with the web portal occupying a very central position.

The web portal should appear as a place where citizens, authorities, business people and specialists can find updated knowledge on adaptation to climate change with the necessary links to climate data, oceanographic data, groundwater data and geodata that will be made available by the various sector institutions.

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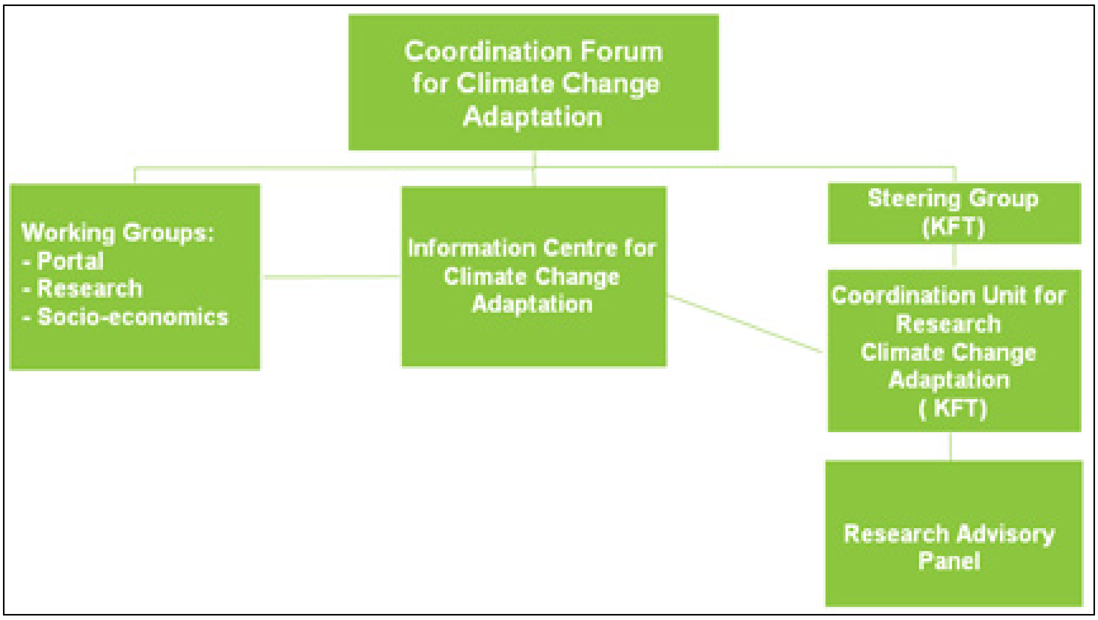
[46]http://www.klimatilpasning.dk/da-DK/Info/Publikationer/publikationer2008/Documents/klimatilpasningsstrategi_UK_web.pdf

FIGURE 6.1 ORGANISATION CHART FOR THE COORDINATION FORUM RESPONSIBLE FOR THE IMPLEMENTATION OF THE GOVERNMENT'S ADATATION STRATEGY.

Source: Danish Energy Agency



A new national Coordination Unit for Research in Climate Change Adaptation is established at the National Environmental Research Institute at the University of Aarhus in cooperation with the Danish Meteorological Institute, the Geological Survey of Denmark and Greenland (GEUS), the University of Copenhagen and Denmark's Technical University.

The main objectives of Coordination Unit for Research in Climate Change Adaptation are among others to coordinate and facilitate synergies on national-level research activities on adaptation and to collate authoritative date on climate change and impacts to the new web portal.

The strategy includes a description of the vulnerability of those sectors where climate change is expected to have significant consequences. Focus will be on autonomous adaptation measures already underway, and what is necessary to advance this process.

In a number of areas it will already be prudent to undertake adjustments that take into account present IPCC knowledge concerning the future climate, for example, with respect to long-term infrastructure investments and decisions.

Sectors in which climatic changes may be significant are described in the following sub-sections.

6.1.3.2.1 Coastal Zone Management

The Danish coastline partly comprises active coastal cliffs where the sea erodes material, and partly beach-ridge complexes, where the material is deposited in the lee of prevailing winds. About 80% of the population lives in urban areas connected to the coast. A total of about 1800 km of coastline is protected by dykes or other coastal protection.

A special problem is linked to low lying areas which are exposed to both increases in the sea level and are under pressure from increasing drainage from the land. In particular, many of the coastal towns near estuaries of larger rivers or at the bottom of fjords could have complex problems. Merely building higher dykes, for instance, is not a long-term solution as the problem of backwater flooding will just become greater as a result of river water being unable to flow freely into the sea. A long term solution requires the involvement of river valleys further inland.

The Danish strategy for adaptation to a changing climate aims to facilitate development of tools to carry out coastal zone management in a climate adaptation perspective. One of the clear tools to do that is the release of the web portal www.klimatilpasning.dk which acts as the one and only entrance to climate adaptation in Denmark. Here the different stakeholders in coastal zone management in Denmark can find the necessary information needed. Several tools are under development.

One of the tools already implemented is a road show, initiated by the Ministry of Transport (Danish Coastal Authority) to the municipalities which are responsible for the local spatial planning. The aim of the road show is to give the municipalities direct advice on how climate adaptation should be carried out according to the climate adaptation strategy and the present knowledge level.

6.1.3.2.2 Buildings and infrastructure

Buildings

Buildings can be vulnerable to climate change, which can increase the risk of collapse, declining health and significant loss of value as a result of more storms, snow or subsidence damage, water encroachment, deteriorating indoor climate and reduced building lifetime. The greatest challenges in the short term are that stronger storms will constitute a safety risk in those parts of existing buildings that do not meet the building code's safety requirements. In the longer term, more and longer-lasting heat waves could have health-related consequences, especially for the elderly and weak, in nursing homes, for example.

Autonomous adaptation must be expected with regard to limiting snow-load and storm damage as well as controlling indoor climate in particular. With respect to strengthening existing buildings, however, autonomous adaptation will be limited if owners are not familiar with weaknesses in the bearing elements of their buildings. Autonomous adaptation will only occur in new construction if those who set the European and Danish wind load standards determine that these standards be increased, for example. As for counteracting consequences of heat waves, installation of air conditioning in existing buildings could be expected, along with a demand for buildings with more efficient indoor climate control.

In general, it is the responsibility of individual building owners to see that applicable regulations are complied with, and it is also they who will seek solutions for satisfactory indoor climate. It is estimated that there is no need, in the short term, to change the laws pertaining to building safety under extreme weather conditions. As for countering heat waves, the new regulations regarding the energy framework in the building code represent a step towards promoting solar screening and heat-deflecting windows, which will make it easier to regulate indoor climate.

No special, planned measures are recommended for building extensions or renovation.

As support for ongoing adaptation, there may be a need to inform owners of existing buildings of the typical weaknesses in the bearing elements, with corresponding instructions on how to remedy them. In the same manner, there may be a need for instructions on new building solutions to reduce indoor temperature extremes during heat waves, especially for vulnerable buildings. Finally, there may be a need to inform construction technicians of recommended future-oriented design parameters, for example, concerning maximum snow load and wind speed, temperatures and durations of future heat waves and the maximum precipitation intensity a building should withstand.

There may be a need for economic analyses as a basis for measures in the two main areas named above. Uncertainty in such analyses comes partly from doubt about the significant climate parameters and partly from lack of knowledge about the costs of taking given changes into account. There is a lack of knowledge of how many existing buildings would be damaged as a result of increased storm activity, the types of damage and the cost of prevention.

With regard to cooling, there is a lack of knowledge of how far the ongoing adaptation will go and which solutions the market will offer and owners will choose.

<u>Roads and railways</u>

Roads, bridges, tunnels and railway lines are potentially vulnerable to increased precipitation, groundwater levels, temperatures and winds. Electrified railway lines may face increased wind damage with great economic and traffic consequences as a result of stronger storms and higher wind speeds. The electrical power units themselves are vulnerable to higher wind speeds.

In connection with the expansion and renovation of roads and railway lines, adaptation to climate change is expected to be made at the same time as work is carried out. Alternatively preparatory work can be carried out for adaptation at a later time.

It is expected there will be a need to undertake a large number of economic analyses to be able to optimise the timing and extent of road and railway adaptation to climate change.

<u>Sewer systems</u>

The long-term outlook for climate adaptation of sewers is good. Adapting to heavier rains is a marginal cost if done in connection with sewer renovation. Most municipalities already take advantage of this possibility by following the recommendations in the Waste Water Committee's Report no. 27, namely that sewer systems, including treatment plants, meet established functional standards, taking into account the expected changes in precipitation, throughout their lifetimes.

6.1.3.2.3 Water resources

The size of the drinking water resource is influenced by both access to groundwater, the consumption of water and the need for groundwater in securing good status of surface water bodies as stated in the European Water Framework Directive. With the prospect of warmer summers, with greater risks of heavy downpours and longer periods without precipitation or even of drought, Denmark can expect an increased demand for water for several purposes:

- In urban areas a need will arise for cooling and watering of green areas. The existing problems of over-use of groundwater resources close to urban areas could be exacerbated.

- In rural areas the need to irrigate will increase significantly, and the current problems with conflicts of interest between agriculture and natural aquatic environments could be exacerbated.

Net precipitation is expected to increase as a result of the increasing difference between winter and summer precipitation. A change in precipitation patterns with fewer rain events, but of greater intensity will, however, affect surface drainage and thus formation of groundwater. In general, however, greater winter precipitation will bring about greater groundwater formation and increasing groundwater levels[47].

Just as important as the quantity of groundwater is its quality. Along low-lying coasts, the intrusion of salt water may affect the quality of groundwater. With a rising sea level, salt penetration would present a greater risk, which may lead to limitations on water-extraction possibilities in more places than is the case today.

Specific climate adaptation measures will occur when it is not possible to maintain water levels in watercourses and wetlands while at the same time maintaining water supply. In such cases, water extraction can be moved to areas where water resources are more abundant or the effect on watercourses and wetlands is less.

A reassessment of permits for water extraction to comply with water provision targets and watercourse quality is not expected to result in amending rules, guidelines, etc. It will be possible to include this in ongoing activities.

A precondition of a planned relocation of water extraction will be that goals are set so that it is possible to determine 1) the quality and quantity of water extraction to be relocated and 2) in which areas this will be possible. Such a gradual adaptation of water extraction should start at the earliest after 2009, when the first generation of water plans under the Water Framework Directive must be drawn up.

6.1.3.2.4 Energy supply

Climate change with higher average temperatures and higher wind speeds will affect energy consumption. A winter temperature rise of 2–3°C is expected to reduce heating requirements significantly. A rise in summer temperatures, on the other hand, could lead to increased cooling needs.

Increased wind speed can on the one hand lead to greater electricity production from wind turbines, but on the other hand, in storm situations wind turbines must be shut down to avoid storm damage. Increased precipitation in the Nordic region may lead to greater electricity production from hydro power. In contrast, longer periods of

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[47] van Roosmalen, L. (2009), The effects of future climate change on groundwater and stream discharge in Denmark, Ph.D. thesis, Dept. Of Geography and Geology, Univ. of Copenhagen

drought in the Nordic region may also provide better opportunities for Danish electricity exports.

Danish as well as foreign electricity distribution grids may be damaged by storm impacts. The Danish distribution grid is currently being cabled underground is expected to be fully cabled within the next 10 years. When the distribution network is fully cabled underground, the consequences of climate change will be less significant. Increased wind speeds are not expected to cause serious problems for wind turbines, since they are protected against extreme wind speeds.

Energy supply is characterised by a typical investment horizon of 10–30 years. Production plants can be adapted to new framework conditions and to a certain extent to altered climatic conditions. The existing energy production plants are relatively invulnerable to the climate changes expected in the next 20–30 years. Ongoing changeover and adaptation of plant capacities are taking place as required.

Short-term climate changes with slightly increased wind speeds are expected to mean slightly increased electricity production from wind turbines. This could increase investment in wind turbines and thus lead to expansion of this energy source. Meanwhile, it is expected that conditions such as fuel and CO_2 allowance prices for our alternative forms of electricity production will have much larger influence on the expansion of wind energy.

Higher average temperatures are expected to reduce the need for heating in winter and perhaps increase the need for cooling and summer. Therefore, using the district heating system to produce district cooling could be considered. In district cooling, the energy in district heating water is used to produce comfort cooling. In this way surplus heat from electricity production at combined heat and power plants in summer can be used as an energy source to produce cooling as an alternative to electrically operated air conditioning. An example of this is under establishment in the centre of Copenhagen.

6.1.3.2.5 Agriculture

For Danish agriculture, the overall effects of impacts of climate change are estimated to be advantageous. Changes in cultivation practice can be implemented at short notice and production is expected to grow with rising temperature, CO_2 concentrations and a longer growing season.

However, this could also bring about an increased and altered need for plant protection based on altered disease and insect patterns and an increased need for fertilizer and the consequent risk of runoff into the water. Greater winter precipitation will increase the risk of nitrogen and phosphorus leaching into the aquatic environment and combined with higher water temperatures, this could mean a greater risk of oxygen depletion. Increased winter precipitation and rising water levels will in some places cause flooding or such high ground water levels that agricultural exploitation may be difficult to maintain. This may be the case along a number of fjords and watercourses. Higher summer temperatures and longer periods of drought may increase the need for irrigation of sandy soils, which may affect the flow in watercourses.

Short term adaptation can optimize production under given conditions. Long term adaptation is expected to involve changes in agriculture's structure, technology and land use, irrigation systems, etc, as well as development and adaptation of new species and types of crops.

Research and development efforts are expected to support development and implementation of new forms of production and technologies that can contribute to exploiting the new possibilities for greater productivity while ensuring that agriculture can meet the requirements of low environmental impact and high food safety. Such research and development activity should take expected climate changes into account and incorporate new research areas relevant to climate changes.

Dissemination of the current knowledge on the nature and extent of climate changes for both the agricultural business and the associated research and consulting sector such as the administrative/political level will be important, so that relevant climate change adaptation measures can be incorporated in ongoing adaptation and regulations in the sector. It is important that research, development and consulting within the sector include awareness that changes in the basic climatic conditions mean that older data and experience should be used with caution.

Climate change and increased CO2 content in the atmosphere up to 2050 are expected to increase the yield level of many agricultural crops by 10–15%. However, there will probably also be increased costs for fertilizer and pesticides. Increased yields may also be less than expected as a result of the need for increased restrictions on use of fertilizers and pesticides out of concern for nature and the aquatic environment. There may also be restrictions on cultivation of low-lying areas and on irrigation in dry summers, which will reduce the advantages in these areas.

6.1.3.2.6 Forestry

Climate change, for instance changes in temperature, precipitation, and wind affects flora and fauna. The long lifecycle of forest trees (typically 80-100 years) and a limited ability to adapt within one tree generation may cause a number of problems.

Denmark is placed centrally in a vegetation belt of temperate deciduous forest, and, with moderate future climate change, a majority of existing tree species that thrive well today are expected to persist in Denmark. Norway spruce, however, may be the exception. Norway spruce occures naturally in regions with cold winters, and the species has already shown signs of poorer health in periods with warmer winters and much precipitation. Summers characterised by drought may have a potentially larger effect on Norway spruce, because its roots do not reach as far into the ground as other species. Norway spruce makes up approx. 19% of the area covered by vegetation, and – often being grown in monoculture – there is also a large risk of forest fires, even if today this is not a major problem.

Beside its effects on the growth of trees, regeneration dynamics, and stability, a changed climate may also pave the way for introduction of new pests or for propagation of existing known pests, which, possibly in combination with weakened vegetation, may cause problems relating to forest health and stability. Changes in forest management practices could be one way to adapt.

A higher atmospheric content of CO_2 and longer growth seasons will increase forest increment, and will also improve water household of trees in connection with photosynthesis. In contrast, warmer and drier summers may cause problems relating to water household, and be significant in relation to forest health, which again may reduce forest increment.

Already today, the National Forest Programme, the Forest Act, and associated support schemes, are assisting in the development of more robust forests, making them more flexible and tolerant towards changing climate variables, for instance precipitation. Adaptation takes the form of continuous efforts to shift to near-nature forestry and focus on genetic diversity in the choice of tree species and plant material. Cooperating with the Royal Veterinary and Agricultural University[48], the Danish Forest and Nature Agency has also been in charge of the development of new concepts for near-nature forestry. The statutory windfall pool provides for economic support for replanting robust tree species. The list of species and provinence is updated on a continuous basis, thus enabling the best possible adaptation to the climate of the future. In accordance with national goals, forest areas must be increased and forest landscapes must cover 20-25% of Denmark in the course of one tree generation (80-100 years.).

6.1.3.2.7 Fisheries and marine ecosystems

Marine ecosystems are sensitive to climate change because their component species' distributions will change, leading to new kinds and intensities of interactions between species. General changes in key atmospheric parameters can have fundamental consequences for ocean currents, including their role in important feedback mechanisms on regional climate patterns (e. g. a possible weakening of the Gulf Stream as a part of the Meridional Overturning Circulation in the North Atlantic). In addition, changes in the role and capacity of the oceans for absorbing CO_2, and how these changes will affect ocean acidification, can potentially have fundamental impacts on marine ecosystems, including their living resources which are the basis for commercially important fisheries (MacKenzie and Visser, 2001).

According to the Danish strategy for adaptation to a changing climate, increasing water temperature, together with increased precipitation and runoff from land, changed wind patterns and acidification of the oceans will lead to changes in the structure and function of marine ecosystems near Denmark and abroad. Some species will benefit from climate changes, while others will experience reduced growth and survival. Increased precipitation could lead to increased export of fertilizer nutrients from agriculture to fjords and coastal areas, leading to an increase in the frequency and duration of anoxia events and their negative impacts on fish.

Changes in climate conditions can increase stresses on species and populations that are already threatened and will make it difficult to rebuild these species and populations to sustainable levels. Salmon and trout, whose eggs and larvae develop in running water (e. g., streams, rivers) will be particularly sensitive to temperature changes, and reproductive success of cod in the eastern Baltic will also be affected by hydrographic changes caused by climate change. Warmer temperatures can promote the abundance of new species, such as anchovy and hake, which could open new fishery possibilities, but warmer temperatures will also promote new types of pathogenic bacteria and toxic algae, which can threaten fish and shellfish populations as well as human food supplies from the sea. These impacts also apply to sea culture

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[48] Jørgen Bo Larsen/KVL, 2005: Contribution to the EPA and DMI ”Nyt Klimaforum” on 15 April and Handlingsplan for naturnær skovdrift, Ministry of the Environment, Forest and Nature Agency, May 2005

of rainbow trout, which may no longer be feasible in Danish waters due to rising temperatures. In addition, acidification of the oceans can be a significant threat against wild mussel and other shellfish populations, as well as their sea-based culture.

6.1.3.2.8 Natural ecosystems

Many species of fauna and flora have their natural limit of extent close to Denmark, and a certain northward shift of species could therefore be expected. However, not all foreign species would be equally welcome. Pests such as the Colorado beetle have long had their northern limit just south of Denmark. The progress of the Iberian slug in recent years may be connected with a generally milder winter climate. Overall, there are a number of animal and plant species which should still be monitored because they appear to be very sensitive to climate change. In the short run it is estimated that limited changes in the climate will generally mean that a number of nature types and species currently in Denmark will be weakened, disappear or become extinct, because they do not have the possibility of moving to other areas or time to adapt. In the short, this could mean that certain ecosystems could be less stable and thus more vulnerable to invasive species,

However in the long run climate change could mean a slight increase in the overall species diversity in Denmark, provided that the sea level only rises slightly and that the species south of the border are actually able to spread northward. Some species could no longer be present and other species could arrive.

Both freshwater and marine ecosystems are sensitive to climate change. At the moment it is not possible to estimate the total impacts.

6.1.3.2.9 Land use planning

The Danish society has a long and well established tradition for national, regional and local planning. The planning instrument is therefore a natural element in Danish adaptation measures.

Many Danish municipalities are already underway with adapting their planning to the expected climate changes. This work is followed centrally to secure coordination and adherence to national strategies. Private and public building owners will to a certain extent be able to adapt their decisions about building and construction work to the altered risks and possibilities that climate change will bring, as the relevant information becomes available at the new web portal. Another important source of information is municipal planning, which should therefore always reflect and adapt to the risks and possibilities brought on by climate change.

Plan09 is a project, which aims at facilitating adaptation measures in the municipal planning process by providing examples of adaptation and demonstration project from participating municipalities. Another example of an important tool in the national and local planning process with regards to adaptation is the new Danish National Digital Elevation Model, which is used to identify areas sensitive to future flooding.

The national authorities continually evaluate whether there is a need to draw up requirements for municipal planning. This could, for example, be worked into “monitoring of national interests in municipal planning”.

Other national planning initiatives include adaptation measures. An example is the “urban political initiative” that includes handling of increased precipitation in urban areas

6.1.3.2.10 Health

Both climate and climate-related behavioural changes can be significant for health. More heat waves can mean a greater risk of sunstroke and dehydration, which in the worst case can be life-threatening. Especially the elderly, sick, and small children require extra attention, including in health planning. A number of infectious diseases are related to climatic conditions. Altered pollen production as a result of milder winters, etc., can mean that the number of people developing pollen allergies may rise, and the symptoms may worsen. Warmer summers will cause greater growth of toxic algae and some saltwater bacteria, which can pose a risk to people with weakened immune systems.

More accidents may occur following extreme weather events such as storms and floods. More accidents may also occur due to more outdoor activity during warmer summers eg. bicycle accidents. In addition, more outdoor activity can increase the risk of bee or wasp stings and life-threatening allergic reactions to them. More extreme rain can lead to greater runoff of health-damaging substances and micro-organisms. There may be an increased health risk associated with exposure to mixed rain and wastewater on land and in cellars, for example. There may also be a need to clarify how long the land should remain unused before re-allowing access as a recreational area, for example. The combination of wetter winters, warmer summers and more extreme downpours may cause more moisture damage and mould growth in buildings as well as greater occurrence of dust mites in buildings, with the consequent health problems.

Health measures in regions and municipalities include responding to heat waves, which can be augmented by relatives and neighbours helping those in high-risk groups. Initiatives for increased monitoring of illnesses related to climate change are expected to appear as problems arise. Longer pollen seasons can increase the need for preventative medicine, including vaccinations and advice about behavioural changes with respect to minimising exposure to pollen. Other relevant sectors are expected to contribute to prevention and warnings concerning climate-related health risks, indoor climate problems, allergens, drinking water, recreational water, foodstuffs, etc.

Alteration of the monitoring system for infectious diseases related to climate change may include minor amendment of the Statutory Order on Doctors' Reporting of Infectious Diseases, etc.

An extension of public prevention and treatment programmes and monitoring systems may be relevant in connection with more heat waves, altered infectious disease patterns, increasing occurrence of allergies and accidents and any increased occurrence of skin cancer in the future climate.

Climate change may require reprioritisation or adjustment of information campaigns for the above areas directed to the general public and other groups in municipalities and health services, for example.

6.1.3.2.11 Rescue preparedness

More frequent and dangerous storms, flooding, powerful rainstorms, drought, etc. create a need for more resource-demanding efforts and assistance from rescue preparedness. Rescue preparedness can be deployed in actions to prevent, limit and aid injuries and damage to people, property and the environment.

For this, continuous consideration and decisions are required with regard to procurement, development, maintenance, composition and strategic location of equipment. As part of a political agreement on rescue preparedness after 2006 the extent of state rescue preparedness has been examined. Weather-related events are included in this examination, partly with regard to risks and threats and partly in connection with the capacity of the rescue preparedness.

Ongoing adaptation of rescue preparedness is always underway. This development will continue on the basis of observed weather events, experience from efforts undertaken and expectations for the future.

Since 2007, the municipalities have based their rescue preparedness on local risk evaluations, which include risks caused by weather events. The Danish Emergency Management Agency (DEMA) will contribute to seeing that knowledge about climate change and extreme weather events is taken into account in this risk-based designing of municipal rescue preparedness and planning.

6.1.3.2.12 Insurance aspects

Weather and climate effects are core insurance business areas. Insurance companies calculate the risk, set a price for covering it, then spread their own risk over the whole world through reinsurance and pay compensation for damage when it occurs. If the weather and the consequences of climate change become less predictable, this will affect price setting and conditions for reinsurance and thus insurance costs. It may become difficult or impossible to obtain insurance coverage for some risk areas.

Insurance of buildings and personal property is by nature short-term – typically renewed annually, whereas effects of climate change set in gradually in the longer term. The Danish climate scenarios state that the highest water level may increase by up to 105 cm in 2100. This means that the economic effects of sea level rise, for example, or more and stronger storms will be seen gradually in the accounts of insurance companies and there will be a gradual cost increase in annual insurance premiums as a result.

Direct insurance companies and reinsurance companies are already aware that possible economic impacts of climate change in the future is assuming more and more importance.

The Danish Insurance Association is presently heading an industry-wide agenda on climate change impacts on insurance conditions. This work includes effects of higher temperatures, more frequent and stronger rainfall, more frequent and possibly stronger storms. Ministry of Economics and Business is presently looking at possible outcomes of changes in the general sea level.

Work on obtaining relevant data and models for price setting should be continued. In this context, premium-setting based on expected developments could come into play, and the development of new financial instruments of risk transfer could be realised. To the extent that insurance companies exempt coverage, it could become relevant in the long term to see damage in a societal context, regardless of whether it is covered by insurance or not.

6.2 Vulnerability Assessment

Vulnerability assessments have been an element in the preparatory work of the adaptation strategy. To some extent, information on this is included in section 6.1.3 and its sub-sections on the adaptation strategy.

6.3 Adaptation Measures

As described in section 6.1.3, the Danish adaptation strategy comprises the following measures:

- establishing an organizational framework, including establishing a horizontal coordination forum for adaptation that will ensure a coordinated effort among public authorities,
- a targeted information campaign, including creation of a web portal operated by an information centre, and
- a research strategy that will include establishment of a coordinating body to ensure that Danish climate research focuses on the adaptation question to a greater extent.

Further information on adaptation measures is given in section 6.1.3 and its sub-sections.

6.4 Climate changes in Greenland

Greenland has an Arctic climate. About 80% of the land is covered by the up to 3 km-thick ice sheet, while the ice-free land areas are limited to a coastal strip 50-300 km wide. Furthest south, and closest to the edge of the ice, the climate is sub-Arctic with a mean temperature of more than 10°C in July. The climate in south-west Greenland, where most of the 55,000 population live is low-Arctic. It is characterised by relatively mild winters with a lot of snow and periods of thaw and wet summers with average temperatures of less than 10°C in the warmest month. North and north-east Greenland are in the high-Arctic zone. The climate has continental characteristics with very cold winters – down to minus 50 degrees (Celsius) in north Greenland. The temperature is rarely above freezing from September to May. Winter precipitation is limited as parts of north Greenland has a desert climate with less than 25 mm precipitation per year, corresponding to about 1% of the precipitation at the southern tip of Greenland. The continental climate in high-Arctic Greenland is determined by sea ice from the Arctic Ocean, which hitherto has made up the pack-ice belt, often up to several hundred kilometres wide, which floats southwards along the east coast of Greenland. In recent years, the extent of the Polar Ice has been reduced for long periods, and this has led to unusual events such as wave erosion along the coasts which previously had not seen open sea to the same extent. The climate in high-Arctic Greenland is greatly influenced by the amount and spread of sea ice.

Projections of future climate evolution using global and regional climate models[49] show the following general changes in the climate of Greenland for the period 2071-2100 compared with 1961-1990 for the A1B IPCC scenario:

- A rise in the mean annual temperature in south Greenland of about 2°C, slightly more in winter than in summer. In northern Greenland temperatures could rise by 5-6°C in winter, but only slightly in summer. The largest temperature changes, 6-8°C along the west coast and 10-12°C along the east coast is projected in winter in those regions where there is sea ice under present-day conditions, but not in a future climate.
- A general increase in precipitation of 10-50%. The winter increase could however be significantly greater in north Greenland – locally up to more than 200%.

Almost the entire population of Greenland live in towns and settlements in the low-Arctic part of the country, where the main industry is fisheries. Only in the northernmost part of the high-Arctic region on the west and east coasts are there small communities that live to some extent from hunting mammals and birds.

A description is given in the following two sections of what could or would happen on land and in the marine environment as a consequence of the expected climate changes. The description is based exclusively on general evaluations[50] with the present knowledge concerning factors determining the welfare of the relevant species and ecosystems[51].

6.4.1 Effects and possibility for adaptation on land

6.4.1.1 Humans

Seen from the point of view of the local community, the changes mentioned would be of limited practical importance and perhaps even an advantage in the form of more plant growth, more reindeer and musk oxen and perhaps better possibilities for farming in south Greenland. The increased thawing of the permafrost could bring problems in areas where houses, roads, airports and other structures have foundations in the permafrost, but since the vast majority of structures in Greenland stand on solid rock, the problem would only be a local one. Increased melting of the ice cap would provide more water - for hydropower for example - but this resource is not generally a constraint today. However, extensive melting may cause problems for the supply of water. The costs of heating in the winter would be reduced and there would generally be fewer problems from hard frost.

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[49] May, 1999; Stendel et al., 2000

[50] Assessments by Hans Meltofte and Søren Rysgaard, NERI and Søren Anker Pedersen, Greenland Nature Institute, March 2003, Meltofte et al., 2008 (Zackenberg-bog)

[51] Vibe, 1967; Heide-Jørgensen and Johnsen ,1998; Petersen et al., 2001; Meltofte, 2002; Rysgaard et al., 2003

6.4.1.2 The importance of the snow cover

As a consequence of earlier snow melting in low-Arctic Greenland, higher summer temperatures and more summer precipitation, a longer growing season can be expected and thus a more extensive and vigorous plant cover. Immigration of species from the south can be expected, but would be impeded by barriers in the form of open seawater and competition from already established species.

There is a risk of most of the high-Arctic zone disappearing together with the special fauna and flora that are adapted to precisely this zone. In north-east Greenland, large areas are completely without vegetation. There are few species of Arctic flora and fauna, and those present have adapted to the extreme climate conditions. Many plants and mammals depend on a stable snow cover to protect them against the cold. Other species are dependent on the snow disappearing early - or being blown away altogether in winter. The distribution, duration, and thickness of the snow cover are therefore just as important factors as the temperature for the general conditions of life for many plants and animals in Greenland. In high-Arctic Greenland, more precipitation would presumably mean and increase in plant cover, and large parts of this zone would possibly change their character to become more like low-Arctic areas.

6.4.1.3 Mammals

Greenland's fauna as a whole would presumably also benefit from a milder climate and consequently more fertile and widespread plant growth, although there are important exceptions. Many of the species in high-Arctic Greenland are dependent on the dry continental climate. This applies, for example, to the Musk Ox, where thicker snow cover and more frequent periods of thaw in winter (with the formation of ice crusts in the snow) could make it difficult for the animals to forage. Examples of this are already known with the present climatic conditions, and reindeer died out for the same reason in the whole of high-Arctic Greenland during a snowy period more than 100 years ago. The artificially established population of musk oxen in south-west Greenland is unlikely to suffer similar problems. On the contrary, both reindeer and musk oxen might thrive even better in the continental low-Arctic region.

Likewise, lemming populations will be negatively affected by variability in winter temperatures and episodes of snowmelt. This will have a negative cascading trophic effect on both lemming prey (plant communities) and predators (ermines, avian predators).

6.4.2 Effects and possibility for adaptation at sea

6.4.2.1 Humans

For Greenland society, a warmer climate would probably mean increased fishing opportunities in the form of more cod, Norway haddock and other species, but fewer prawns. The possibilities for hunting ring seals and polar bears would probably be reduced, while the occurrence of several other game animals would depend on a number of environmental, ecological and human factors, including the pressure of hunting itself.

Communication conditions would be much better because the period of open water would be longer, making it easier for boats to call at many towns and settlements.

The production of calved ice could, however, increase by increased melting of ice, thus affecting navigation conditions. There would be far less sea ice. The possibility of using solid sea ice to get from place to place could be reduced as a result of thinner and later ice cover.

Melting of glaciers could have a negative effect on tourism, but the improved communication - including a longer summer season - could have a positive effect.

6.4.2.2 Marine mammals

In north-east Greenland the expected climate change would reduce the thickness of the ice in the fjords, and extend the ice-free period. As a result, more light would penetrate down in the water column, and this would stimulate biological production. Increased fresh water supply as a consequence of increased precipitation and melting of the ice cap in the inner parts of the fjords would increase the water exchange in the fjords and bring more nutritious water in from the open sea, thus contributing still further to increased primary production. Rising winter temperatures would mean that the ice would not reach the same thickness as today and could therefore could break up more easily in spring. Overall, the walrus inhabiting shore waters would benefit most from future climate change in high-Arctic Greenland.

The polar bear, on the other hand, is facing an uncertain future in east Greenland. If the ice disappears it will reduce the bears' hunting grounds and they would probably follow the ice northwards. Seals, which are attached to the ice, would presumably become concentrated in smaller areas with ice and could therefore be more easily accessible to the bears in the short term. But in the longer term, the number of bears will most likely decrease. The ice conditions on the west coast of Greenland will probably not change as much as on the east coast, and the polar bears on the west coast would therefore be less affected by the climatic changes than those on the east coast. Globally, it is likely that polar bears will be lost from many areas where they are common today, and the remaining populations will become more fragmented and isolated[52]. By the end of the 21st century, areas north of the Canadian Archipielago and northernmost Greenland will have the greatest likelihood of sustaining viable, albeit smaller, polar bear populations[53]

Based on a number of parameters such as population size, migration patterns, feeding habits and sensitivity to changes in the sea ice, the narwhal and the polar bear appear to be the marine mammal species most sensitive to climate change, followed by the hooded seal, the bowhead whale and the white whale[54].

As the ice edge receed further north during the summer new areas will be available for sub-arctic and migratory whales. Establishment of new feeding grounds will depend on the density of zooplankton, which is in turn influenced by climate-driven

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[52] Wiig et al 2008 [Effects of climate change on polar bears. Science Progress, 91(2), 151-173] Authors: ØYSTEIN WIIG, JON AARS And ERIK W. BORN

[53] Durner et al 2009 [Predicting 21st century polar bear habitat distribution from global climate models] Authors: GEORGE M. DURNER, DAVID C. DOUGLAS, RYAN M. NIELSON, STEVEN C. AMSTRUP, TRENT L. MCDONALD, IAN STIRLING,METTE MAURITZEN, ERIK W. BORN, ØSTEIN WIIG, ERIC DEWEAVER, MARK C. SERREZE, STANISLAV E. BELIKOV,1 MARIKA M. HOLLAND,JAMES MASLANIK, JON AARS, DAVID A. BAILEY, AND ANDREW E. DEROCHER

[54] Laidre et al 2008 [Quantifying the Sensitivity of Arctic Marine Mammals to Climate Induced habitat Change. Ecological Applications, 18(2) Supplement, 2008, pp. S97-S125] Authors: KRISTIN L. LAIDRE, IAN STIRLING, LLOYD F. LOWRY, ØYSTEIN WIIG, MADS PETER HEIDE-JøRGENSEN, AND STEVEN H. FERGUSON

upwellings and sea-currents. Blue, fin, minke and humpback whales have already been observed at very high latitudes in East and West Greenland.

6.4.2.3 Fisheries resources

For many of Greenland's fish species, the cold seas off Greenland limit their dispersal, for example, cod, Norway haddock, striped catfish, halibut and herring, which have their northern limit there. Therefore, relatively small variations in the temperature of the sea could result in considerable fluctuations in the dispersal of many fish species. The trend in cod fishing largely follows the average sea temperature. In the last 30 years, cod and a number of other boreal fish species have largely disappeared as a consequence of a generally colder climate in south and west Greenland. Today, more cold-adapted populations of prawn, crab, and halibut constitute the main commercial fishing resources in Greenland. A change in sea currents and a rise in temperature as a consequence of the climate changes would probably improve the conditions for cod and some other commercially exploited fish species in these areas. Increased cod stocks, however, would have a negative effect of prawn stocks due to predation.

Our knowledge about the way the ecosystems function is constantly improving, but in the case of such large changes in such a short space of time, we still know too little to make precise predictions. One of the biggest uncertainties in connection with the marine environment in south Greenland is the extent to which the sea currents and thus sea temperatures follow changes in air temperature. The balance between the part of the seawater in south-west Greenland that comes from the cold east Greenland current and the part that comes from the warm North Atlantic drift (a branch of the Gulf Stream, which bends westward, south around Iceland), and the cold water masses in Baffin Bay and Davis Strait totally determines the ecological conditions off south-west Greenland, where most of Greenland's population live.

6.5 CLIMATE CHANGES ON THE FAROE ISLANDS

The Faroe Islands have an extreme maritime climate, where the differences between summer and winter are relatively small. Projections with global climate models show the following general changes for the climate on the Faroe Islands in the period 2071-2100 in relation to the period 1961-1990:[55]

- A rise of around 3ºC in annual mean temperature. There is only a slight difference in the temperature rise in summer and winter.
- A rise in winter precipitation of about 30%, but only slight or no increase in the summer.

6.5.1 Impacts and adaptation in terrestrial and marine ecosystems

Recent research on the tolerance of plant species have shown that a warming of 2ºC will result in upward migration of plant species. The species most vulnerable to elevated summer temperature are those species currently restricted to the uppermost parts of the mountains. As species respond in an individual way to changing climate and migrate at different rates, plant species as well as plant communities in the alpine zone are threatened by competitive species from lower altitudes. The total vegetation

[55] May, 1999; Stendel et al., 2000

cover in the alpine zone is much lower than in the low alpine and temperate zones below. Thus, the alpine zone should be more easily invaded due to higher frequency of bare soils in these areas and less competition from other species, although the environment is much harsher.

Elevated summer temperature will tend to allow the upward migration of temperate and low alpine species as the dwarf shrub species seem to be the the most vulnerable. And the distribution of the dwarf shrubs is expected to increase under the assumption that the cloudiness does not increase.

Mild winters can be a threat to plants by disturbing their inactive period and can cause loss of frost hardiness. And the low tolerance of most species to changing winter temperature is the striking difference between tolerance of species in oceanic environment like the Faroe Island and to the tolerance of mountain plants in more continental areas .

Effects on the Faroese marine ecosystem and fisheries could be very severe, but are hard to predict in more detail. A warming of the ocean may by itself affect the living organisms, including commercially important fish species. The Faroe Plateau cod, as an example, already spawns in waters that by many are considered close to the maximum temperature. Increased temperatures in the spawning period, thus, may affect this very important stock negatively. But other, more indirect, effects may in the future influence the marine ecosystem even more severely.

Recent research has demonstrated that the ecosystem on the Faroe Plateau is very dependent on the primary production on the shelf and that this exhibits large inter-annual variations. A detailed understanding of these variations is still in the future, but climate variations are a likely causal agent through mechanisms that include winds and the seasonal variation of air-sea temperature difference, which may well be affected by climate change. Large-scale circulation changes also present potential effects. At present, Faroese waters are dominated by the warm flow of the North Atlantic Current, which is linked to the North Atlantic Thermohaline Circulation. If the weakening of this circulation, that is predicted by climate models, will affect the warm-water flow past the Faroes, the effects on the ecosystem and fisheries could be very severe, but at present, this is hard to predict.

6.6 ASSESSMENT OF THE SIGNIFICANCE OF CLIMATE CHANGE FOR THE WHOLE ARCTIC

In autumn 2004, the Arctic Council[56] published its assessment of the significance of climate change for the Arctic in the report Impacts of a warming Arctic (ACIA). The report is based on contributions from more than 300 climate and climate-effect researchers and it shows that climate changes in the Arctic will be more severe than in any other place on the globe, and that this will have extensive consequences both regionally and globally.

The Danish Realm has contributed to the report through a number of specific studies, projects and texts. The integrated climate and climate-effect measurement programme that has operated for almost 10 years at the high-Arctic measuring station Zackenberg in north-east Greenland has made significant contributions to describing

[56] In addition to the Danish Realm, the Arctic Council comprises Canada, Finland, Iceland, Norway, Sweden, Russia and the US

and understanding climate effects in the Arctic, and it is one of the few programmes helping establish long-term data series in the area.

In 2007 a similar and supplementary program was established at Kobbefjord close to Nuuk in south-west Greenland.

Also in 2007 a Center for Ice and Climate was established as part of the University of Copenhagen. Here research from among other things ice-core drillings has contributed significantly to knowledge of past and present climate dynamics and the dynamics of the Greenland Ice Sheet.

Other major Arctic research- and monitoring efforts carried out by institutions in the Realm include: Monitoring of the water, salt and temperature balance between the Faroes and Scotland, systematic monitoring of the Greenland Ice Sheet margin, and enhanced research efforts at the Greenland Institute of Natural Resources in relation to climate and in particular the marine environment.

Additionally intensive climate research efforts are carried out in the Realm's Arctic territories by the international scientific community, and dedicate and a major effort has been carried out in and around Greenland during the International Polar Year in 2007-2008.

The Realm intends to continue these and other climate-relevant Arctic initiatives in future years, and during the Danish chairmanship of the Arctic Council the Council expects to finalise the project: "Climate Change and the Cryosphere: Snow, Water, Ice and Permafrost in the Arctic" which will synthesise and assess the results of monitoring and research efforts in relation to the changing Arctic Cryosphere, since the Arctic Climate Impact Assessment [57](2004 and 2005).

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[57] ACIA, 2005 Arctic Climate Impact Assessment, Cambridge University Press, 1042 pp

7 Financial resources and transfer of technology

including information under

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7.1 DANISH DEVELOPMENT POLICY, COOPERATION AND PROVISION OF NEW AND ADDITIONAL FINANCIAL RESOURCES

7.1.1 Danish development policy

Danish development cooperation policy is an integrated part of Danish foreign and security policy.

Denmark's vision for global sustainable development is a world with economic development, social welfare, and greater protection of the environment. It includes a world market with free trade based on economic responsibility and environmental standards, and it includes respect for human rights, democratisation, transparency, and responsibility in administrations.

The overall goal of Danish development cooperation is poverty reduction through a long term and committed partnership with developing countries. The partnership shall enable the developing countries opportunity for a sustainable development process benefitting the poor[58].

Denmark emphasises that development cooperation should contribute to meeting the 2015 goals adopted at the UN Summit (Millennium Development Goals) and be in line with international development assistance agreements, such as the Paris Declaration and the Accra Agenda for Action.

Development cooperation is organised in line with government priorities to focus on globalisation, economic growth as the vehicle for poverty reduction, security, good governance, democracy, human rights and the environment including climate change mitigation and adaptation. In addition, development assistance is also organised in close cohesion with other foreign and security policies.

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[58] From ”Partnership 2000” – the overall strategy for Danish Development Assistance.

The effort to promote national sustainable development is closely linked to the global challenges for sustainable development - and vice versa. Growing trade and international capital flows, conflicts and refugee flows, together with the increasing pressure on natural resources, have made individual countries ever more dependent on the outside world. Denmark therefore has a great interest in contributing to sustainable development through national efforts and through the EU, the UN, the WTO, the OECD, and the international financial institutions, including the World Bank and the International Monetary Fund.

In its entire international work for global sustainable development, Denmark attaches importance to the need to integrate and balance the economic dimension (poverty-oriented growth), the social dimension (promotion of such social sectors as education and health) and the climate/environmental dimension (protection of the environment and climate).

Denmark wants a strong global structure to promote all elements of global sustainable development, including a stronger structure for promotion of international climate and environmental cooperation and climate and environmental regulation.

Denmark will continue working for global sustainable development by:

- Integrating climate change and environmental considerations into policies and decisions.
- Mainstream climate change into development assistance
- Ensuring continued progress in the global climate and environmental agenda. The goal is to gather responsibility for international environment cooperation in one single environment organisation.
- Promoting economic cooperation and partnership for development with both governments and private sector, including combating global poverty and regulating trade and investments.
- Reducing emissions of greenhouse gases globally and in a cost-effective manner. Promotion of low-carbon economy utilising the Danish model as inspiration.
- Promoting mutually committing partnerships with the private sector.
- Contributing to international peace and stability and working to promote democracy and human rights.
- Working for continued development and democratisation of the international cooperation with the emphasis on openness and participation, including participation by weaker groups and with special focus on women.

7.1.2 Development cooperation

In 2007, Danish development assistance amounted to about DKK 13.9 bn., corresponding to 0.81% of GNI (ref. Danida annual report 2007). Assistance is primarily funded through section 06(3) of the Danish Finance Act. Denmark will continue to be amongst those countries granting the most development assistance and will also grant at least 0.8% of GNI in development assistance in the years to come. In this way Danish assistance will continue significantly above the UN target of 0.7% of GNI.

Denmark seeks actively to encourage countries including EU member states whose development assistance is below the UN objective of 0.7% of GNI to increase their assistance.

In 2002 the government reviewed Denmark's development assistance and environmental assistance to developing countries with the objective of prioritising it, focusing it, and making it more effective. Annual strategies for Danish assistance to developing countries have guided the assistance over the years[59]. In particular, the potential role of development assistance in promoting global security and stability is highlighted in the 2006 statement on development co-operation, Commitment to Development. This outlines the strong Danish profile in reconstruction and conflict management, and puts special emphasis on the role of development to help resolve conflicts in Africa.

Whereas the overall guiding principles for the assistance have been unchanged, there has been an increased focus on the challenges of climate change. This includes international climate cooperation and the issue on the adaptation of developing countries to climate change, as well as their development towards a low carbon economy. There has been a shift in Danish energy support from conventional power production and transmission to a greater focus on renewable energy and rural access to energy. This is well in line with the adoption by the Johannesburg Summit on the need to improve access for the poorest people to energy as a contribution to meeting the 2015 Goals (especially the poverty goal) and improving the proportion of renewable energy in the global energy supply.

The government's strategy for development cooperation also involves stricter requirements for the governments in the cooperation countries with regard to respect for human rights and democracy. Systematic and lasting violations of human rights and democratic rules of play are irreconcilable with qualifying for Danish assistance. This has meant that development cooperation has ceased with some cooperation countries. At mid-2009, Danish programme cooperation countries were Bangladesh, Benin, Bhutan, Bolivia, Burkina Faso, Egypt, Ghana, Kenya, Mali, Mozambique, Nepal, Nicaragua, Tanzania, Uganda, Vietnam, and Zambia.

In international evaluations of Danish development cooperation policies and implementation Denmark receives good results. In the 2007 OECD Review of the Development Co-operation Policies and Programmes of Denmark the following was mentioned: "The final key feature of Denmark's development co-operation is its integrated institutional system within the Ministry of Foreign Affairs at headquarters and in partner countries. Since 2003 this has been complemented by decentralising the bilateral aid programme from headquarters to 16 key partner countries (the "programme countries"), a key step in implementing the aid effectiveness agenda. In 2005, the Danish programme was also decentralised to four multilateral missions. This process has been accompanied by a strengthened approach to quality assurance, supported by a new results-based system and an emphasis on knowledge management."[60]

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[59] World of Difference, 2004; Security, growth – development, 2005; Globalisation through partnership, 2006; Commitment to development, 2007. "A world for all", 2008.

[60] (Denmark (2007), DAC Peer Review: Main Findings and Recommendations)

The base for Danish environmental efforts in development assistance is the Strategy for Danish environmental work in developing countries 2004-2008, which was launched in 2004. This Strategy is the first to gather all environment work under one common goal – combating poverty – and the first to integrate environment efforts with the overall development assistance. The Strategy emphasises that environmental efforts include climate efforts, for example one of the elements in the Strategy is to support climate efforts through capacity building. The Strategy covers the possibilities of countries to administer work within the international environment conventions and to create opportunities to contribute to the development of CDM projects. The Strategy also aims at promoting environmental concerns as inter-disciplinary concerns in all assistance, both bilateral and multilateral. The strategy has been extended to the end of 2009.

With our EU partners, in 2004 Denmark adopted an action plan to integrate the climate into development cooperation. The Action Plan contains four elements:
1) greater priority to climate change in the dialogue with cooperation countries,
2) support to climate adaptation within relevant sector programmes,
3) support to combating the causes of climate change by reducing greenhouse gas emissions, and
4) support for capacity development to promote developing countries' efforts on climate change.

The Danish follow-up plan was completed by the end of 2005 and implementation imitated thereafter. The Danish plan named "Danish Climate Change and Development Action Programme", contains the same elements as the EU plan.

The Danish Climate Change and Development Action Programme was reviewed in late 2008. Climate change "screening" studies of bilateral development assistance to 17 Danida "priority" countries were undertaken in accordance with the action programme from 2005 to 2008. Funds have subsequently been allocated for a wide range of follow up projects and activities (more details given in 7.3). However, the significance of integrating both climate change adaptation and disaster risk reduction in country and sector programmes has also become apparent as a result of the "screening" process. Although small stand alone project grants are useful, the scale of likely adaptation needs in many of the poorest and most vulnerable countries mean that "mainstreaming" assistance (as well as multi-donor collaboration) will be the way forward.

In terms of capacity development, the review found that the regional learning events that had been conducted in 2007 and 2008 were important steps in strengthening the capacity at decentralised level to integrate climate change in development cooperation, however there is need for considerable continued capacity development at various levels in the organisation and with the partners. Numerous Danish researchers are also conducting investigations into climate change impacts, low carbon development pathways, etc.

7.1.3 New and additional assistance funds

7.1.3.1 Bilateral efforts

Danish environment efforts are to contribute to meeting the overall target for Danish development assistance – combating poverty. In addition to this, within the framework of international development cooperation it is increasingly being recognised that the negative effects of climate change could present an obstacle to combating poverty and meeting the 2015 Goals. This means that environment efforts, including climate efforts, are as principle an integrated element of the total Danish development work, and thus also part of work to realise the 2015 Goals.

Bilateral environment activities comprise a large proportion of Danish International Development Assistance (Danida) sector programme support in Bhutan, Bolivia, Egypt, Nepal and Nicaragua. Moreover, the environment aspect is incorporated in a number of other sector programmes, not least for the sectors water, energy, agriculture and fisheries, just as the environment has been integrated into Danish efforts in other sector programmes supported by Denmark. A number of independent projects are also supported by Denmark through Danida's authority to make decentralised grants. In addition there is environment work funded by the special environment assistance. This includes environment activities in Cambodia, China, Indonesia, Malaysia, Mozambique, South Africa, Tanzania, Thailand, Vietnam and Zambia. The environment assistance in Egypt, Malaysia and South Africa is being phased out.

Danish environmental efforts in developing countries are organised in close, binding cooperation with cooperation countries. Efforts aim at promoting sustainable development, including adaptation by developing countries to climate change, and relieving poverty-related pressure on the environment and nature. Within the water area for example, action is helping to ensure millions of poor people access to clean water and to protect sources of water - e.g. by tree planting and by building up capacity for sustainable management.

In the energy area, Denmark provides support for sustainable energy supply - e.g. supporting poor women in planting trees for fuel, which provides the women with an income and at the same time, protects the environment. Within nature resources, Denmark is working to strengthen sustainable management and production with a view to preventing soil exhaustion and desertification. In the richer developing countries with increasing economic activity, assistance is aimed at helping countries to protect nature and the environment, primarily by strengthening the capacity of the countries themselves to solve the problems and by raising environmental awareness.

Environmental analyses continue to play an essential role in the regular revision of the country strategies for Denmark's programme cooperation countries. Another important task is to seek better integration of the objectives of international environmental agreements in the bilateral assistance cooperation. Climate change was made a standard issue at annual consultation meetings between Denmark and the partner countries in the "Climate Change and Development Action Programme" mentioned earlier.

Until 2003, Denmark made funds available for environmental action from both section 06(3) of the Finance Act and from a special Environment, Peace and Stability

Fund (MIFRESTA). In 2004 the government decided to integrate environment assistance into the overall assistance and replace MIFRESTA with a separate budget item for special environment assistance under section 06(3) of the Finance Act.
In addition to the figures for total bilateral assistance, table 7.1 includes bilateral assistance to environment as a sector, as well as from 2007, the estimated value of bilateral assistance to environment as a crosscutting issue.

TABLE 7.1 DISBURSED DANISH TOTAL BILATERAL DEVELOPMENT ASSISTANCE AND ENVIRONMENTAL ASSISTANCE 2005-2008 (DKK MILL.)

Source: The Ministry of Foreign Affairs

	2005	2006	2007	2008
Bilateral development assistance	7,119	8,694	8,983	8,312
Estimated value of bilateral assistance to Environment based on Rio-markers	513	488	824	918

The decision not to continue MIFRESTA was a desire to improve coordination of environment activities with other Danish international development efforts. Irrespective of whether financing of environment and environment-related assistance is through separate budgets within or outside section 06(3) of the Finance Act, it is difficult to assess whether there are new and/or additional assistance funds. The difficulties are primarily methodological problems in determining additionality. Nevertheless, the total scope of Danish assistance for the environment in developing countries will continue to be extensive.

Danish bilateral and regional assistance to support implementation of the Climate Convention

It is in general not possible to give a precise figure for development assistance to climate related activities. This is due to the fact that no international precise and fulfilling definition exists of what climate assistance is. The challenge of defining climate assistance is the uncertainty of what to include or exclude. Some contributions are relatively easy to identify directly on the Financial Act, as for example the Climate Pool (see further below in this chapter). However this type of assistance does not include assistance as for example climate proofing of a road construction in Bangladesh or an agriculture programme in Uganda working with adaptation.

Keeping this in mind tables 7.2 – 7.5 provide an overview of Danish bilateral and regional assistance in terms of commitment to developing countries to implement the Climate Convention, distributed over the main categories of mitigation and adaptation and by sector category. The figures in the tables are based on the MFA Project Data Base (PDB) and the related system of categorising development assistance. The figures relate to projects and programmes marked in PDB with the so-called Rio-marker, which indicates that a major element of the programme/project is targeting the objectives of the Rio Conventions, hereunder also the Climate Convention, as well as the related conventions on biodiversity and desertification.

The projects/programmes marked with the Rio-marker are assessed all to be assistance to implementation of the Climate Convention, directly and/or indirectly.

The sectors given in the UNFCCC reporting format are not fully similar to the sector selection/definition in Danish development assistance. Where sectors are overlapping with the format, information has been utilised directly from PDB. The sector "environment" is not part of the table, however each of the environment grant have been assessed and thereafter allocated to the most appropriate sector in the table.

The actual degree of climate change adaptation or mitigation support is based on an assessment of the degree of mitigation/adaptation in each grant. Three levels are used – 0%, 10%, 50% and 100%. This methodology has been chosen given the fact that the OECD-DAC reporting system, which is used by the Danish Ministry of Foreign Affairs is not at present geared to monitor climate assistance according to the UNFCCC specified requirements.

TABLE 7.2 COMMITTED DANISH BILATERAL AND REGIONAL ASSISTANCE IN 2005 FOR IMPLEMENTATION OF THE CLIMATE CONVENTION (DKK MILL.)

Source: Danish Ministry of Foreign Affairs

Year: 2005	**Mitigation**						**Adaptation**		
Recipients / **Country/region**	Energy	Transport	Forestry	Agriculture	Waste	Industry	Capacity building	Coastal-zone man.	Other
Bhutan			4						
Bolivia				0					
Burkina Faso	21								1
Cambodia				1					
Central America									23
China	45								
Dom. Rep.	34								
Egypt	319								
Ghana			0						
Honduras			9						
India			0						
Indonesia								30	
Interregional				4		3			
Nepal						1			
Nicaragua			59						
Sahel									0
South Africa	22					3			
South East Asia						49			
Tanzania				0					
Thailand			4			9			4
Uganda									1
Vietnam				5					
Total	**441**		**75**	**10**		**65**	**0**	**30**	**30**

TABLE 7.3 COMMITTED DANISH BILATERAL AND REGIONAL ASSISTANCE IN 2006 FOR IMPLEMENTATION OF THE CLIMATE CONVENTION (DKK MILL.)

Source: Danish Ministry of Foreign Affairs

Year: 2006	**Mitigation**						**Adaptation**		
Recipients **Country/region**	Energy	Transport	Forestry	Agriculture	Waste	Industry	Capacity building	Coastal-zone man.	Other
Africa				0					2
Bolivia			7						
Cambodia									16
China						10			
Honduras			9						
Indonesia						9		6	
Interregional									1
Kenya							3		5
Mali	5								
Malaysia							15		
Nepal	155								
Nicaragua			5						
Sahel									0
South Africa									1
Tanzania			1						1
Thailand						3			
Uganda							2		
Vietnam	3			0			3	3	1
Zambia			2				5		
Total	**163**	**0**	**22**	**0**	**0**	**21**	**23**	**10**	**27**

The total support in the period 2005-08 was 1,1 BN DKK to mitigation and 500 Mill. DKK to adaptation. The adaptation support has increased significantly since 2005, not least in 2008 were the climate change programme to Vietnam was granted and the major part of the climate projects related to the Climate Change Action Programme were committed. It is worth noticing that even minor CC related contributions in major sector programmes contribute considerably to the total amounts.

Among the most notable assistance in the tables above is the assistance to mitigation of climate change through renewable energy development cooperation. The support to wind energy planning and capacity building in China provides an example for support to a richer country within mitigation efforts. The first phase of 45 Mill. DKK was committed in 2005 and the second phase of 100 Mill. DKK was committed in 2008.

TABLE 7.4 COMMITTED DANISH BILATERAL AND REGIONAL ASSISTANCE IN 2007 FOR IMPLEMENTATION OF THE CLIMATE CONVENTION (DKK MILL.).

Source: The Ministry of Foreign Affairs

Year: 2007	**Mitigation**						**Adaptation**		
Recipients / **Country/region**	Energy	Transport	Forestry	Agriculture	Waste	Industry	Capacity building	Coastal-zone man.	Other
Armenia	7								
Bangladesh									5
Bolivia									5
Central America			1						
China	2								
Ghana			1						
India				0					
Indonesia	57		8						15
Interregional						3			0
Latin America									0
Malaysia	2					8			
Mali				0					
Nepal			8						
Nicaragua				0					
Philippines	7								
Tanzania			28						22
Uganda			14						8
Vietnam				0		2			32
Total	75		60	0		13			87

Projects and programmes presented in the tables above also include assistance to CDM capacity building in Thailand, Malaysia, Indonesia, China and Vietnam. The assistance has provided technical and organisational assistance to the National Focal Points as well as information and capacity building in the private sector. The results have been positive.

The Examples of Danish bilateral climate development cooperation are provided in section 7.4.

TABLE 7.5 COMMITTEDDANISH BILATERAL AND REGIONAL ASSISTANCE IN 2008 FOR IMPLEMENTATION OF THE CLIMATE CONVENTION (DKK MILL.).

Source: The Ministry of Foreign Affairs

Year: 2008	**Mitigation**						**Adaptation**		
Recipients **Country/region**	Energy	Transport	Forestry	Agriculture	Waste	Industry	Capacity building	Coastal-zone man.	Other
Africa						1			4
Bangladesh									15
Bhutan									5
Bolivia									
Cambodia									2
Central America							5		
China	100								
Ghana									62
Interregional				0		5			2
Kenya			1			4			4
Mali							7		
Mozambique									3
Nepal									1
Nicaragua									5
Niger				0					13
South Africa	10					2			
Uganda						2			5
Vietnam	62								138
Zambia									8
Total	**172**		**1**	**0**		**12**	**12**		**254**

Starting from 2008 the Danish government has allocated specific climate funds through the so-called Climate Pool. The total amount frame was in 2008 100 Mill.DKK, of which approximately 88 mill. DKK was allocated to specific climate change projects. As shown in Table 7.6 the projects cover issues such as adaptation, mitigation, participation of developing countries in UNFCCC negotiations, civil society capacity building, participation and dialogues as well as climate diplomacy. The Climate Pool will continue in 2009 and 2010.

TABLE 7.6 CLIMATE POOL COMMITMENTS 2008 (DKK MILL.).

Source: The Ministry of Foreign Affairs

Category	**Commitment 2008 Million DKK**
Climate Change Adaptation	16.0
Climate Change Mitigation, forestry	25.0
Developing countries participation in UNFCCC negotiations	23.7
Greenland Dialog	1.8
Civil society	8.0
Climate Diplomacy	8.0
In total incl. administration	87.7

7.1.3.2 Multilateral efforts

Endeavours to create global stability and development require that the international community cooperate to provide action that promotes sustainable development. This perspective must be secured in the implementation of multilateral initiatives. Denmark therefore considers that special joined initiatives that contribute to global sustainable solutions as well as tackle global development problems are vital.

Arising from the 2005 climate change action programme, numerous initiatives on climate change adaptation and mitigation have been launched with a wide range of multilateral partners including the development banks and many agencies of the UN system.

Some of the key partners for dialogue on climate change include the Global Environment Facility (GEF), as well as the World Bank and various UN organisations, notably the United Nations Environment Programme (UNEP). In addition, climate change issues have figured in the collaborative agreements with the International Institute for Sustainable Development (IISD), the International Institute for Environment and Development (IIED) and the International Union for the Conservation of Nature (IUCN). The Commission of the European Union (EU) is also an important partner in terms of international initiatives; indeed the climate change action programme itself is part of the EU effort to integrate climate change in development cooperation.

In 2006 the Danish Ministry of Foreign Affairs commissioned analyses of the security implications of climate change, which were carried out by the IISD and included a special focus on West Africa (Burkina Faso and Ghana).[61] Following joint meetings in 2007 of the Foreign Ministers of the Nordic countries and a number of African countries, the IIED was commissioned to prepare an assessment of the climate change adaptation challenges facing the continent (IIED, 2008). Recently, a concerted effort has been made to examine the links between disaster risk reduction and climate change, including a conference in Copenhagen in November 2008.[62] In addition a comprehensive ”dialogue process” on land and water management issues was launched in November 2008. This process has continued in 2009 and the key concerns have been specified as “guiding principles” adopted by several African and Asian partners in the so-called “Nairobi Statement”. These “guiding principles” will serve as inspiration by UNFCCC-parties in the negotiation on adaptation for a new climate agreement and further provide guidance to the formulation of new development cooperation programmes related to land and water management in the context of climate change adaptation.

In terms of capacity development, UNEP and in particular the UNEP-Risø Centre (URC) has been an important partner. In addition to providing advice on climate change issues through a framework agreement and participating in the Climate Change Screening studies (see under 7.5) the URC is involved in a major project covering a number of African countries designed to promote adaptation measures

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[61] See the study report by the IISD (2008).

[62] Concern about climate change and the frequency of disasters was highlighted in the 2007 guidelines for DRR (MFA, 2007).

through a pilot funding arrangement and through capacity development (UNEP, 2008). This project, called CC-DARE, was approved at the end of 2007 and is gradually getting off the ground through preparatory studies in Senegal, Tanzania and Uganda. The idea is to operate a small grant facility in selected countries with funds for adaptation projects designed to reduce vulnerability to climate change.

Recognising that many African countries are only marginally involved in the international carbon market and were not able to attract investment funding for CDM schemes and in response to the call for support in the Nairobi Framework, a support mechanism was established in 2007 with a view to provide capacity building and assistance for development of CDM projects in Africa.

Following the adoption of the Bali Action Plan at the end of 2007, the issue of how to contribute to emissions reductions from tropical forestry has also been on the international agenda. Considerable efforts are being made to devise mechanisms for reducing emissions from deforestation and degradation (REDD). The first step towards Danish support to this aim has been to provide funding for a ”pro-poor REDD” scheme, which has been launched in five tropical countries through the IUCN and which is closely linked to efforts to promote sustainable forest management.

Through the EU, Denmark continues to work for binding and effective regulation of international environmental problems through the regional and global environment conventions. This applies, in addition to the climate convention, the conventions on biodiversity, combating desertification, the Montreal Protocol, the Basel Convention on cross-border transportation of hazardous waste and the conventions regulating chemicals, the Stockholm Convention on Persistent Organic Pollutants, and the IMO Convention on toxic primers. Denmark is working towards the goal of getting the conventions coordinated and enforced effectively and for the precautionary principle to have a central role in the rules.

Under the Conferences of the Parties under the Climate Convention in Bonn and Marrakech it was decided to establish three new funds to support initiatives by developing countries against climate change. EU Member States and others were politically committed from 2005-2008 to granting USD 410 Mill. per year to finance these funds and for other forms of support to implement the Climate Convention. Denmark’s share of this figure is USD 22.32 Mill. and it has been included in the budgets under the facilities for assistance to developing countries, to be implemented within the four-year period.

Denmark is working to strengthen the Global Environment Facility (GEF) financially and organisationally. The Danish contribution to GEF's replenishment for the years 2005-2008 shown in Table 7.7 has increased by more than 10% from 2004. Denmark, together with other EU Member States, has made an extra, voluntary contribution to the fourth replenishment of 104 Mill. DKK, thereby in total contributing 310 Mill. DKK in the period 2006-10.

TABLE 7.7 DANISH CONTRIBUTIONS TO THE GEF 2005-2008

Source: The Ministry of Foreign Affairs

	Contribution DKK Mill.			
Year	2005	2006	2007	2008
Total	65.2	77.5	77.5	77.5

Danish contributions to the GEF is placing special priority on

- Reforming GEF in order to improve efficiency
- Climate Change and Biodiversity

Since 1998 UNEP has implemented a reform programme to make its work more efficient and focussed. In recognition of this initiative, in 2001 Denmark increased its annual general contribution from DKK 13.8 to DKK 15.5 Mill.DKK, and this level has been continued in 2005- 2008. Thus, in per capita terms, Denmark is one of the largest contributors to UNEP.

Besides the annual contribution to the programme's Environment Fund, Denmark makes both technical and financial contributions to a number of special UNEP activities, particularly those taking place at the special cooperation centres for energy and the environment and for water and the environment.

Through the earlier mentioned contribution to the UNEP Risø Centre, work is supported on climate-related questions and sustainable energy. The UNEP Risø Centre was an inspiration for the UNEP cooperation centre at the Danish Hydraulic Institute (DHI) – Water and Environment. The Danish contribution to this centre helps support global initiatives by UNEP in the water area, particularly for integrated water-resource and coastal-zone management.

Denmark is a considerable contributor to the Montreal Protocol's fund for financing the phasing-out of ozone-depleting substances in developing countries. Danish contribution is described in Table 7.8.

TABLE 7.8 DANISH CONTRIBUTIONS TO THE MONTREAL PROTOCOL MULTILATERAL OZONE FUND 2005-2008

Source: The Ministry of Foreign Affairs

	Contribution (DKK Mill.)			
YEAR	2005	2006	2007	2008
Total	11.4	7.0	6.7	7.3

Another area important to Denmark is promotion of renewable energy in developing countries. Within this area, Denmark supports use of sustainable and renewable energy through so-called 'trust fund contributions' to the World Bank's Energy Sector Assistance Programme (ESMAP), 45 Mill. DKK grant 2005-09 and the Asian Development Bank's rural renewable energy fond, 20 Mill. DKK grant 2005-07.

Denmark's contribution to sustainable development includes considerable support for international organisations, particularly the UN system, in which all countries in the world participate on an equal footing. Denmark is also working to make the UN more efficient so that the division of work between the organisations becomes better and overlapping is avoided.

Danish contributions to multilateral institutions and programmes, including the UN organisations mentioned above and international NGOs working with climate-related activities are described in Table 7.9. The figures are provided as disbursement figures and there may have been be adjustments in the figures for 2005 and 2008 compared with the figures in the previous National Communication.

TABLE 7.9 DANISH DISBURSEMENT TO MULTILATERAL INSTITUTIONS, NGOS, AND PROGRAMMES

Source: The Ministry of Foreign Affairs

Danish disbursement 2005-08 to climate related activities				
Organisations	**Disbursement (mill. DKK)**			
	2005	**2006**	**2007**	**2008**
UNFCCC funds	36,80	37,20	36,10	68,90
Other volentary contributions incl. : IPCC, IUCN, IISD, WRI, IIED, ITTO, UNCCD, Global Mechanism, GWP, ECOWAS, 92-gruppen, CBD, Care, IWGIA/ICC, AFREPREN, GBIF	11,30	35,30	48,90	46,50
GEF	43,40	118,40	93,90	77,50
Contribution via EU	n/a	n/a	n/a	n/a
Contributions to other **multilateral organisations**, incl. : UNDP, UNEP, WB, UNESCO:				
UNEP (inkl. Montreal Protokol og none ear-marked contributions)	56,50	34,50	52,70	39,30
UNDP (inkl. Dryland Development Center, PEI, Greenland dialogue)	3,90	1,90	7,70	3,90
WB (incl. Environment analysis/PRSP, WSP, ESMAP, IWRM (water), African Stockpiles Programme, COM+ Alliance, WDR 2010)	22,00	19,00	25,30	17,00
UNESCO				1,70
Total	**173,90**	**246,30**	**264,60**	**254,80**

7.2 ASSISTANCE TO DEVELOPING COUNTRY PARTIES THAT ARE PARTICULARLY VULNERABLE TO CLIMATE CHANGE

The least developed countries are among the countries that are most vulnerable to climate change. Denmark therefore attaches particular importance to helping these countries adapt to climate change. A natural consequence of this is that Danish programme cooperation countries are among the least developed countries and/or the most vulnerable countries.

The climate screenings performed under the Climate Change and Development Action Programme are important instruments in ensuring that the most vulnerable countries and communities are assisted in an appropriate and integrated manner. The studies were carried out in 17 countries (programme countries and Niger and

Cambodia) from December 2005 to June 2008. The 17 studies include critical information about the impact of climate change and constitute a first step to "operationalising climate proofing" of Danish bilateral development assistance. Although this form of "climate proofing" was only one of several elements in the action programme, it is the area that has been most intensively in focus since 2005.

Probably the most important issue emerging from the studies concerns the uncertainty about trends in temperature, rainfall patterns and "extreme events" and the impact of climate change on economic growth and poverty reduction. In this context, the CCS studies emphasised the need to improve knowledge, awareness and information at regional, national and community levels, through enhanced climate data collection and analysis, refined scenarios and "downscaling" climate models to specific countries and regions. There is still a lot to learn and understand about the impact of climate change.

The projects launched based on the screenings were related to capacity building, mainstreaming of climate change, forest management, strengthening the link between climate change adaptation and disaster risk reduction as well as coastal and water resource management. The largest support to till date to a vulnerable country is the climate change adaptation and mitigation programme in Vietnam of 200 Mill. DKK. One third of the grant is allocated to climate change mitigation through energy efficiency and the remaining part is allocated to support the climate change adaptation.

7.3 Provision of financial resources, including financial resources under Article 11 of the Kyoto Protocol

Provision of financial resources through bilateral and multilateral public efforts is described in section 7.1.3 above.

In addition, provision of financial resources is also taking place through the Danish private sector, Denmark has the assistance instruments and measures for assistance to developing countries through the private sector described in the following sections.

7.3.1 Mixed credits

Mixed credits can be provided in connection with projects within both the public and the private sector. The loans are made from a Danish bank to a credit-worthy borrower in the recipient country. The interest expense, export credit premium, etc. are paid via the assistance funds. In the period 2004-2008, assistance was granted with mixed credits for 53 projects with a total contract sum of DKK 6.4 bn. and a grant for interest payments, export credit premium, premium etc., and totalling DKK 3.2 bn. (see Table 7.10).

Since 2008, climate change is an integral part of the overall SBK policy. Many projects can be regarded as directly promoting climate change mitigation. These include primarily wind energy, energy efficiency and district heating projects. Due to the organisation, modality and form of the SBK the projects are seldom linked to other bilateral assistance interventions. "Climate proofing" of infrastructure projects during planning and design is increasingly becoming a standard quality assurance element of good engineering..

TABLE 7.10 NUMBERS OF PROJECTS AND GRANTS UNDER THE SCHEME FOR MIXED CREDITS 2004-2008
Source: The Ministry of Foreign Affairs

	2004	2005	2006	2007	2008	Total
Number of projects	14	15	10	10	4	**53**
Contract sum (DKK Mill.)	2,126	2,464	0,589	0,746	0,486	**6,411**
Grant (DKK Mill.)	1,093	1,175	0,331	0,385	0,233	**3,217**

7.3.2 The Business-to-Business Programme

Through the Business-to-Business (B2B) Programme, Danida supports the establishment of long-term, sustainable partnerships between companies in Danida's programme countries and South Africa and companies in Denmark. The overall objective is to contribute to reducing poverty by promoting economic growth and social development.

The partnerships are in addition to the knowledge and technology transfer also assessed against four development impact criteria: Employment opportunities (especially for women), promotion of corporate social responsibility and strengthening of the local company's competitiveness. In addition, improvements in the working environment and in the external environment. The latter may for example be in terms of transfer of cleaner inputs and technologies, where more efficient use of raw materials and proper treatment of waste can make a positive impact on the environment. Several of the B2B projects are environment related, e.g. partnerships relating to renewable energy and waste management.

Table 7.11 illustrates the amounts allocated to the B2B Programme during the period 2006-2008 and estimate for 2009.

TABLE 7.11 COMMITMENTS UNDER THE B2B PROGRAMME, 2006-2009
Source: The Ministry of Foreign Affairs

Year	2006	2007	2008	2009 (est.)
Total DKK Mill.	157	195	192	200

7.3.3 The Business-to-Business (Environment) Programme

The Business-to-Business Programme was supplemented in 2008 by an additional component, designated the Business-to-Business (Environmental) Programme. The B2B (Env) programme replicates the well-proven B2B programme structure into China and Indonesia as a catalyst to encourage cutting-edge Danish companies in the environmental field to transfer their technology to local partners and develop long-term commercial partnerships. The decision to replace the earlier Partnership Facility Programme (PFP) by a B2B (Env) programme was motivated by a review of the PFP, which called for an alignment of support to B2B activity in the environmental field with the broader B2B programme, so as to benefit from ongoing product development and accumulation of best practice, and also to improve synergy with other interventions supported by Denmark or prioritised by the host country. To this effect the management of the programme is done by the Danish Embassy, rather than by an external consultant or focal point as was the case for PFP.

The B2B (Env) programme was launched in China in 2008 and in Indonesia in 2009. The target is to achieve annual commitments amount to 25 Mill. DKK and 10 Mill. DKK in these countries respectively.

7.3.4 Partnership Facility Programme

The Partnership Facility Programme (PFP) was established in 1996 by the Danish EPA (Danced) and taken over in 2001 by the Danish Ministry of Foreign Affairs. The goal of the Programme was to transfer technology and commercial knowledge on the environment from Danish enterprises to partner enterprises in Thailand and Malaysia by establishing commercial partnerships. The PFP was extended to China in 2005.

Last commitments under the PFP were entered into in 2007 and ongoing PFP projects are expected to be completed by end 2010. In the period from 2001 to 2007 commitments totalling 87.5 Mill. DKK were made for support under the PFP.
The PFP was succeeded in 2008 by the B2B (Env), which is available for new activities in China and Indonesia.

7.3.5 Industrialisation Fund for Developing Countries

The Industrialisation Fund for Developing Countries (IFU) invests in joint ventures in the developing countries, including joint ventures on renewable energy. Investments are either as share or loan capital, to be repaid to the financing institution. The IFU can also make grants for training personnel in companies in developing countries. The IFU administers the Danish Fund for Environment and Training.

7.4 ACTIVITIES RELATED TO TRANSFER OF TECHNOLOGY

Danish support to technology transfer in relation to implementation of the Climate Convention includes a broad spectrum of activities. These activities comprise transfer of both ”soft” technology and ”hard” technology. The extent of this technology transfer is significant and cannot be clearly separated from other activities in Danish development cooperation, just as there is often an unclear frontier between transfer of soft and hard technology.

The most important example of Danish-supported activities leading to technology transfer is Danish sector programme support to the energy sector in China, Mozambique, Burkina Faso, Egypt, Nepal and Malaysia. These sector programmes include elements such as energy planning, including plans for use of renewable energy, establishment of large wind farms, renovation of power stations, promotion of energy efficiency and promotion of sustainable use of biomass as a fuel. Within these sector programmes, transfer of soft and hard technology goes hand-in-hand.

The tables in Annex F contain examples of Danish assistance to technology transfer in the form of projects and programmes with both soft and hard technology. Finally, transfer of both soft and hard technology is the primary element of cooperation regarding CDM projects (see section 4.3.2).

In Annex F are described four selected projects/programmes that promote practical steps to facilitate and/or finance the transfer of, or access to, environmentally-sound technologies. The selected project/programmes are:

- Energy Sector Assistance Programme, Nepal
- Zafarana Wind Farm Project, component III Egypt
- Wind energy programme China
- Firewood project Burkina Faso
- Mangrove Management Information System, Vietnam

7.5 INFORMATION UNDER ARTICLE 10 OF THE KYOTO PROTOCOL

The steps taken by Denmark to promote, facilitate and finance the transfer of technology to developing countries and to build their capacity, as described in section 7.1-7.4 above, are taken in accordance with both the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

Regarding the other elements of Article 10 of the Kyoto Protocol it should be mentioned that:

- information on the implementation of commitments under the protocol regarding National systems in accordance with Article 5, paragraph 1, of the Kyoto Protocol is included in section 3.3,

- information on the implementation of commitments under the protocol regarding Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures is included in section 4.2,

- information on the implementation of commitments under the protocol regarding Adaptation measures is included in section 6.3,

- information on the implementation of commitments under the protocol regarding Activities related to transfer of technology is included in section 7.4,

- information on the implementation of commitments under the protocol regarding Research and systematic observation is included in Chapter 8, and

- information on the implementation of commitments under the protocol regarding Education, training and public awareness is included in Chapter 9.

8
Research and systematic observation

8 Research and systematic observation

8.1 Climate research and observations in general

Research and observations within climate in the broad sense of the word are going on at a number of institutes and organisations and cover a wide range of disciplines, from natural science to evaluation of policies and measures and societal aspects.

The Danish Meteorological Institute (DMI) carries out observations of climate parameters (atmosphere and ocean) under the World Meteorological Organisation's (WMO) programmes and sub-programmes: World Weather Watch Programme (WWW), Global Atmosphere Watch (GAW), Global Observing System (GOS), Global Climate Observing System (GCOS) and Global Ocean Observing System (GOOS). DMI also participates in the Network for the Detection of Atmospheric Composition Change (NDACC). Denmark is also active via DMI in the GEO initiative.

Climate monitoring and research has been a key task for DMI for more than 125 years. The National Environmental Research Institute (NERI) is in charge of monitoring the effect of climate change on nature and environment.

Danish research competence concerning the physical expressions of past climate changes is particularly at the Geological Survey of Denmark and Greenland (GEUS), the University of Copenhagen (KU) and Aarhus University. GEUS also has competencies in glaciological studies of the Greenland ice sheet and the ice sheet's interaction with climate change and in the effect of climate change on the water cycle in nature. The Geophysical Department and the Geological Institute at KU and the Geological Institute at Aarhus University have very great expertise in palaeoclimate data, and the climate group at KU is known worldwide for its ice core drilling and analyses. NERI contributes important research competence in relation to the effect of climate change on ecosystems.

DMI/Danish Climate Centre covers the physical world, i.e. measurement, theory and modelling of the climate system. However other institutions than the ones mentioned above, e.g. Forest & Landscape Denmark (SL), and Aarhus University (AU), Risø National Laboratory and the Danish National Space Centre work with different aspects of climate research. The Danish Climate Centre has published an overview report describing the bulk of current Danish research on climate changes[63].

[63] Climate Change Research – Danish Contributions, Jørgensen et al., 2001

It is partly on the basis of research competencies in the above areas that Denmark also participates actively in IPCC's work. Denmark has contributed to IPCC work through e.g. contributions to all four main reports, and several researchers have actively contributed to the 4th assessment report (AR4) published in 2007. One researcher is lead author of a chapter on future regional climate.

The Copenhagen Global Change Initiative (COGCI) is a formal collaboration including research network and PhD programme involving three Danish institutions (GEUS, DMI and NERI) and the University of Copenhagen. The COGCI comprises all relevant scientific and cross-cutting disciplines in global, regional and local effects of environment and climate problems.

Danish research contributes to a wide range of international projects under the World Climate Research Programme, such as the Climate and Cryosphere (CliC), Climate Variability and Predictability (CLIVAR), the Global Energy and Water Cycle Experiment (GEWEX), Stratospheric Processes and their Role in Climate (SPARC), the World Ocean Circulation Experiment (WOCE) and the International Polar Year (IPY).

8.2 Research

8.2.1 Research policy and funding

Climate-related research in Denmark has grown naturally within an already existing framework of institutional activities. Denmark has not previously had a general national research programme for climate change and global change. However, as follow-up on Climate 2012, a committee was appointed to look at the possibilities for improving coordination of Danish research work on climate. This committee completed its work in December 2002 on mapping Danish climate research[64] and making recommendations on this basis. In 2008 the Danish government launched 'Strategy for Adaptation to Climate Change in Denmark' cf. section 6.1.3. The strategy identifies a need to strengthen the coordination of national research activities in the context of climate change adaptation, and to ensure that synergies across a broad range of different research areas are harvested. Thus, the strategy calls for the establishment of and gives a mandate to a national Coordination Unit for Research in Climate Change Adaptation with the overarching goal to strengthen synergies between research activities related to climate change adaptation in Denmark in view of providing solid information to societal decision-making processes across a range of societal sectors, including coastal zone management, construction and planning, water resource management, energy supply, agriculture, land use and forestry, fisheries, nature management, the health sector, disaster relief, the insurance sector, and many others.

The Coordination Unit for Research in Climate Change Adaptation (in Danish: Koordineringsenhed for Forskning i klimaTilpasning - KFT) is a joint endeavour by the National Environmental Research Institute at the University of Aarhus, the Danish Meteorological Institute, the Geological Survey of Denmark and Greenland (GEUS), University of Copenhagen and Denmark's Technical University. The coordination unit aims to collate and transfer knowledge within all Danish (and

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[64] Mapping of Danish climate research and proposals for strengthening action areas. Prepared for the Working Group for a Danish Climate Research Programme, ECON Center for Economic Analysis, December 2002

international) research areas that work on the issue of climate change adaptation, and to help coordinate information access at the science-policy interface. This activity necessarily builds on strong cooperation across a wide range of scientific disciplines as well as regular interaction with both the policy-makers and other stakeholders.

The main objectives of Coordination Unit for Research in Climate Change Adaptation are

- to coordinate national-level research activities on adaptation to Climate Change;
- to facilitate research synergies and identify knowledge gaps;
- to support transfer of knowledge;
- to collate authoritative data on climate change and impacts;
- to foster national and international networks.

Key outcomes and products foreseen to result from the unit's activities over the next years include:

- Database of researchers and on-going research activities: A key task of secretariat is to develop and maintain a database on on-going research activities in Denmark and Europe. This database is geared to find synergies between and gaps in current research activities.
- Input to 'Klimaportal: Another key task of the secretariat is to facilitate input into the 'Klimaportal' hosted by the Information Centre on adaptation 'Videncenter'.
- Newsletters summaries activities by the secretariat, updates on selected on-going research activities, informs on key national and international developments in the area of climate adaptation research, reports on working groups and other activities initiated by the unit, etc.

Danish climate-related research is described in detail in the following sections, while a number of ongoing research projects are listed in Annex G.

8.2.2 Climate processes and studies including palaeoclimatic studies

8.2.2.1 DMI

DMI/The Danish Climate Centre and the Centre for Ocean and Ice carry out research into e.g. atmospheric and coupled atmospheric oceanic processes, which are important in connection with global climate change. These process studies include e.g. natural atmospheric oceanic interplay on time scales from years to decades, including main processes of importance for deep water formation in the North Atlantic.

Oceanographic projects include:

- Ecosystem West Greenland (ECOGREEN): Danish IPY project (2008-2009): Investigate the coupling between hydrography and biology. Hydrographic and biological observations in Godthaab Fjord and across Fylla Bank and modelling.

- Arctic-Atlantic Exhanges (ARATEX): Monitoring and modelling exchanges between the Arcic and the Atlantic across the Greenland-Scotland Ridge. Collaboration between the Bjerknes Centre for Climate Research, University of Bergen, the Fisheries Laboratory of the Faroese, Torshavn, the Marine Research Institute, Reykjavik, and University of Akureyri, Akureyri. Funded by The Nordic Council of Ministers for 2007-2009. Stability of Thermohaline circulation (THOR): THOR will establish an operational system that will monitor and forecast the development of the North Atlantic THC on decadal time scales and access its stability and the risk of a breakdown in a changing climate. THOR will forecast the development of the Atlantic THC and its variability until 2025, using global coupled ocean-atmosphere models. THOR will also assess induced climate implications of changes in the THC and the probability of extreme climate events with special emphasis on the European/North Atlantic region. The project will contribute to Global Monitoring for Environment and Security (GMES), to Global Observing Systems such as to the Global Ocean Observing system (GOOS), and to the International Polar Year (IPY).

- West-Nordic Ocean Climate (2002-2005) is a joint Nordic project studying changes in the circulation of the North Atlantic and its significance on climate developments in the area. Work includes observations as well as data analysis and modelling. DMI is contributing to the project in collaboration with the Greenland Nature Institute. Focus is on the waters around Greenland with special emphasis on explaining the variation in fish stocks from changes in climatic and hydrographical conditions. More specifically, the emphasis is on transport of cod larvae from Icelandic spawning grounds to the waters around Greenland, as well as the developments in west-Greenland prawn populations.

- Greenland Climate: A research project has been performed in coorporation with the Danish Climate Centre with the aim to establish a data and knowledge base on the expected climate changes in the Greenland and the surrounding seas. DMI's regional climate model was used to calculate a scenario of the climate for the period 1960-2050. The contribution of COI was simulations with a regional ocean model forced with the climate scenario. One purpose of the ocean fields, besides the analysis of the hydrography, is to provide a background for studies of the Greenland ocean environment. The fields can thus be used to drive ocean biological, and chemical models which depends on the physical parameters of the ocean.

Through assimilation of atmospheric reanalyses in atmospheric models, several studies are being carried out of atmospheric processes, partly in order to develop improved atmospheric models, and partly to detect changes in the external climate impacts. In addition, trends and variations in the latest tropospheric temperature observations from satellites (primarily MSU data) and radio soundings are being analysed and compared.

At DMI, work is going on to improve models for describing the thinning of the stratospheric ozone layer. This area is important, not only in relation to the Vienna Convention concerning protection of the stratosphere's ozone layer, but also in a climate context, because there is interaction with the greenhouse effect. Studies are performed on the downward propagation of the influence from the stratosphere on tropospheric climate. DMI is also working on studies of the processes in the tropical tropopause that control water vapour entering the stratosphere, and on models for air traffic impact on the climate.

DMI has thus participated in all major European-American Arctic ozone research campaigns since the beginning of the 1990s, such as EASOE, SESAME,THESEO, and THESEO-2000/SOLVE, as well as in the tropical HIBISCUS and Scout-O3/Amma campaigns. DMI's stratospheric research is based on analyses of a broad range of available observations compared with analyses of the meteorological conditions in the stratosphere. Research includes analyses of the dispersal of ozone-depleted air from the Polar regions to intermediate latitudes, and experimental and theoretical model work concerning the formation of polar-stratospheric clouds and cirrus formation in the tropical tropopause layer. The aim is better understanding and modelling of the processes that lead to chemical depletion of the ozone layer and transport of water vapour through the tropical tropopause.

In terms of the climate, this research is relevant because increased concentrations of greenhouse gases in the atmosphere and the depletion of the stratosphere's ozone layer are expected to lead to lower temperatures in the Polar stratosphere. These conditions could lead to more widespread formation of polar-stratospheric clouds and stronger chemical ozone depletion lasting further into the spring months. Arctic ozone depletion in the winter and spring months influences the cumulative dose of UV radiation, and this impacts human health and plant production. Efforts are being made to forecast UV radiation under climate-change conditions and model personal UV exposure. There is also experimental and model-theoretical work with cirrus clouds in the tropical tropopause and the effects of air traffic on the formation of cirrus clouds. The tropical cirrus clouds are important for additions of water vapour to the stratosphere. Stratospheric water vapour has a great influence on climate, and cirrus clouds have a direct influence on the climate.

8.2.2.2 University of Copenhagen

The Geophysical Department at the Niels Bohr Institute for Astronomy, Physics and Geophysics at the University of Copenhagen is working mainly on global and general problems, such as the natural variability of the climate at all time scales and the role of basic physical/chemical processes in the climate system. Examples of projects are the international ice core projects, the aim of which is to analyse ice cores through Greenland's ice sheet in order to obtain a climate series that covers as long a period of time as possible and to obtain information about the end of the last ice age 11,500 years ago, and about the last warm period 130,000 years ago.

8.2.2.3 University of Southern Denmark

At Odense University research is going on within the areas of the stability of the climate system, the role of the ocean in the climate system and the chemical and biological development of the atmosphere and the ocean. The newly established Centre for Planet Research at the University of Copenhagen undertakes climate research in a more general sense - for example, it studies ice deposits not only on earth but also in the solar system.

8.2.2.4 GEUS

GEUS works with the physical expressions of past climate changes, including ecosystems' response, temperature variations, changes in precipitation and sea level change.

GEUS study the effects of the climate changes in the hydrological cycle especially in relation to groundwater conditions and the interaction with surface water. The study of past vegetations and landscape development in relation to climate changes including past forest and tundra fire problems have been a key activity at GEUS.

Another research topic is past variations in the circulation of the North Atlantic ocean currents and reconstructing the surface and bottom water circulation in the Baffin Bay and the Northern Labrador Sea (The Davis Strait) off West Greenland with special reference to sea ice and iceberg drift. Furthermore, the studies aim to link this information to regional records of wind activity and large-scale ocean and atmospheric circulation records from the North Atlantic, Nordic Seas and Fram Strait. The aim is to obtain new knowledge about changes in Greenland's climate and recent geological history through studies of marine sedimentary sequences.

GEUS also works with mass balance studies and dynamics of the Greenland ice sheet, including its interaction with climate change and effect on changes in water level and interaction with ocean circulation variability. This includes studies of the connection between the Greenland ice sheet and the recently discovered glacial earthquakes related to the main outlet glaciers, so-called ice streams, from the Greenland ice sheet.

GEUS also works with the changes in the structure and dynamics of the sea ice that have occurred in a critical region of the Arctic Ocean North of Greenland as a result of a switch in Arctic atmospheric circulation due to the Arctic oscillation.

8.2.2.5 Aarhus University, NERI

NERI is carrying out research in how, since the last Ice Age, climate change has affected the biological structure of North Atlantic lakes in Greenland, Iceland and the Faroe Islands. Paleolimnological methods are being used to develop projection models.

8.2.2.6 Roskilde University, ENSPAC

A Quaternary Dating Laboratory (QUADLAB) in the Department of Environmental, Social and Spatial Change (ENSPAC), is working on the problem of triggering mechanisms and carbon sources for natural, deep-time, greenhouse warming events. Examples include the Paleocene Eocene Thermal Maximum and similar events that led up to the Eocene Climatic Optimum, the time of the highest global temperature of the past 70 million years.

In a second theme, QUADLAB (with GEUS) is using $^{40}Ar/^{39}Ar$ age based provenance studies to examine the role of the Greenland Ice Sheet in the abrupt oceanographic changes that occurred in the North Atlantic during the last glacial period.

8.2.3 Climate modelling and the climate of the future

8.2.3.1 DMI

With substantial support from the European Commission, DMI/Danish Climate Centre is working closely together with research institutions in Europe on analyses of the climatic consequences of increased greenhouse effect, depletion of the stratospheric ozone layer and variations in solar activity. The main emphasis is on

Denmark and the European region, as well as the Arctic, but global research is also being carried out.

The work includes both developing models and using the models for scenario calculations of the climate of the future. The models include:

- Regional dynamic ocean models for calculating changes in ocean and sea ice. The focus areas are the North Sea - Baltic Sea area and Greenland waters.

- Relatively simple empirical models for describing local climate change and variations (downscaling) and for use in seasonal forecasting.

- A regional dynamic atmosphere-climate model for calculating regional/local climate change and variations. The main focus has been on Denmark, Europe, and Greenland, with recent applications also on Arctic regions, West Africa and India.

- Global dynamic coupled atmosphere-ocean-sea-ice models, which are used for calculating climate change (primarily as a consequence of increased greenhouse effect) and internal variability in the climate on decadal to centennial time scale.

- State-of-the-art ice sheet models for studies of the changes of Greenland ice sheet in the past and in the future. Works to couple the ice sheet models to regional as well as global climate models are undergoing in order to assess the future changes of the Greenland ice sheet.

Both global[65] and regional[66] scenario calculations were carried out for Denmark, the Faroe Islands and Greenland based on IPCC's so-called SRES emissions scenarios - more specifically, scenarios A2, A1B and B2. The results of the global simulations have been used in the IPCC's Third and Fourth Assessment Report. New scenarios have been calculated in the European climate project ENSEMBLES for validation of model systems, quantifying the uncertainty of the projections, studies of feedbacks in the Earth system as well as providing boundary conditions and forcing fields for regional model simulations/predictions. With regard to regional simulations, the most important focus area for Denmark is changes in (extreme) precipitation, soil moisture and storm activity. For Greenland, of special interest are changes in the simulated snow accumulation on the ice sheet and changes in permafrost conditions.

In the ENSEMBLES project and another European climate project PRUDENCE[67] (2002-2004) coordinated by DMI (see also http://prudence.dmi.dk), more than ten regional climate models are used to quantify uncertainties linked to projections of the climate of the future. A method using non-linear fit of the present model bias to the observed quantity is suggested to reduce the systematic biases of the climate model so to reduce the uncertainties of the projections[6]. The projects also show among other things that the DMI system of regional climate models is representative of the

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[65] The climate of the 21st century: Transient simulations with a coupled atmosphere-ocean general circulation model, Stendel et al. 2000; May, 2008.
[66] Christensen and Christensen, 2003; Kiilsholm et al., 2004.
[67] Christensen et al. 2002; 2005
[67] Christensen et al. 2008

majority of the contributing models, and conclusions based on simulations with this model can be considered as being well within the range of the model results.

The scenarios from both ENSEMBLES and PRUDENCE are made available to all groups of researchers who are studying the effects of climate change, and to decision makers taking part in the preparation of a Danish strategy for adaptation to climate change. They have been used extensively by researchers of cross-cutting disciplines in Denmark and in Europe for assessments of climate change impacts and risks.

The research on ozone as a greenhouse gas includes the influence of ozone on circulation in the stratosphere, together with radiation forcing and climate effects caused by changes in the ozone concentration. As opposed to the increase of CO_2, changes of ozone concentrations vary greatly in both time and space. Although the climate effects of changing ozone levels are expected to be fairly modest at the surface of the earth, they will be significant in the stratosphere and the upper troposphere. As a result of the large spatial variations of ozone changes, and of the effect of ozone on long and short-wave radiation, several feedbacks are involved in the climatic response. One of these is related to increased hydrological activity, and is most dominant for ozone changes in the upper stratosphere. Work is in progress on a better representation of the stratosphere in climate models.

In the research in this area, use is made of a global climate model and more simple radiation convection models. Throughout the 1990s DMI coordinated the projects ROCS (Role of Ozone in the Climate System) and SCORE (Studies of Climate-Ozone Relationships), financed by the EU, and took part in the project Ozone as a Climate Gas financed by the Nordic Council of Ministers.

8.2.3.2 University of Copenhagen

Research at the Geophysical Department at the University of Copenhagen includes experimental/field-related, theoretical, and modelling aspects and helps to indicate methods that can be used for evaluating the climate of the future.

8.2.4 Effects of climate change

The effects of climate change on nature and ecosystems are covered by research at DMI, GEUS, NERI, Forest & Landscape Denmark (SL) under the University of Cpoenhagen, Aarhus University, Technical University of Denmark (Risø DTU) and the Danish Coastal Authority.

8.2.4.1 Aarhus University, NERI

NERI is working on the effects of climate change, especially in Greenland, and it is carrying out a standardised biological/ecological monitoring programme covering a broad spectrum of processes, fauna, and flora. In connection with this project the institute is carrying out research projects aimed at increasing knowledge of basic Arctic ecosystems.

NERI is carrying out research in the effect of climate change on biodiversity and function of the soil environment, in laboratory as well as field conditions. Work includes genetic variations in soil-living fauna, and the fauna’s physiological adaptation to extreme climate conditions. NERI has research competence concerning tolerance limits for air pollution for particularly sensitive terrestrial ecosystems. In particular, the interaction between climate change, chemical substances and other factors is being investigated.

NERI has built up competence focused on the function and dynamics of the Arctic marine ecosystem and it is investigating an Arctic fjord system and, within this, relationships between production and nutrient conversion.

Within freshwater, NERI has research competence concerning the effect of climate change on nutrient degradation and biological interaction in watercourses and lakes. Studies are being carried out for instance in Arctic, temperate and subtropical lakes, where biological interaction is being studied along climate gradients. Experimental studies are being made at an advanced test plant at Silkeborg. Models are being developed as tools of projection of nutrient transport as well as effects on freshwater ecosystems.

8.2.4.2 Aarhus University, Dept. of Agroecology and Environment

Aarhus University, Dept. of Agroecology and Environment works with the interaction of climate and agriculture, including effects of climate and atmospheric CO2 on processes in the soil-plant system. Other aspects being studied include factors affecting greenhouse gas emissions from agriculture, e.g. energy consumption in the agricultural sector, biomass for energy purposes, production and management of manure, biogas, and NH3 volatilisation, and greenhouse gases in relation to feeding strategies, manure handling, and soil tillage.

8.2.4.3 GEUS

GEUS has competence concerning long-term variations in ecosystems in Denmark and Greenland and on the Faroe Islands caused by the climate. The institute is investigating how the ecosystems react to climate change in vegetation, lakes and marine environments in Denmark and Greenland and in forests in Scandinavia. It also registers changes in sea level and their effect on the water cycle. The formation of groundwater and the effects of climate changes on this important resource is covered by GEUS during several studies these years.

Effects of climate change on the hydrological cycle in Denmark. Studies have included expected changes in groundwater levels and saline intrusion in groundwater as well as changes in river discharges and water levels.

Studies have been carried out on climate change on flooding of urban areas from rivers in Denmark as well as studies of climate change on pesticide leaching and transport in groundwater and surface water.

GEUS is also contributing through the CLIVAT capacity building, to the assessment of the impact of climate change on hydrological systems of central parts of Tanzania. The input on the anticipated climate changes area provided by DMI.

8.2.4.4 Technical University of Denmark (Risø DTU)

The Risø National Laboratory's work includes a number of sub-projects on the effects of climate change in developing countries, where the centre's activities include both analyses of vulnerability to climate change and adaptation strategies. The activities cover the energy, industrial, forestry, agricultural, transport, and waste sectors.

8.2.4.5 DMI

DMI has been carrying out research on the effects of climate change on hydrological cycle and related water resources. Studies include analyse, quantify and predict the components of the current and future water cycles and related states of water resources in Denmark, Europe and globally; evaluate their uncertainties and clarify the overall vulnerability of water resources related to the main societal and economic sectors. In a modelling study to assess the climate change impacts on local scale water resources in Denmark, DMI develop methodology and tools for dynamically coupling the regional climate model at relatively large (~ 25 km) climate grids with a Danish national hydrological model at very fine (e.g. 1 km) hydrological grid. Method accounting for the uncertainties in hydrological change predictions due to the complex geological environments in two model scales is under development.

DMI is working with modelling of both regional and global changes of permafrost. Analyses of climate model calculations have been made based provisionally on coarse-meshed global simulations. Simulations using permafrost models with refined techniques driven by DMI's regional climate model at high resolution have been performed for regions of Greenland and Alaska. The results are analysing to study the changes of permafrost on these regions. DMI also involves in modelling and field studies to quantify the long-term fluxes of greenhouse gases from the Northern Russian land mass due to permafrost thawing

There is not at the present time special competence concerning the effects on human living conditions and health, which are particularly relevant in areas of the world where dramatic climate effects are seen or expected to be seen.

8.2.4.6 University of Copenhagen, Geographical Institute

The Geographical Institute at the University of Copenhagen is doing research on soil-forming processes in relation to climate and vegetation that are of significance for, amongst other things, the exchange of greenhouse gases between soil and the atmosphere.

8.2.4.7 University of Copenhagen, Forest & Landscape Denmark

Forest & Landscape Denmark at the University of Copenhagen carries out research on the direct effect of changed CO_2 concentration on Danish forests through its cooperation with the Forest and Nature Agency under the Ministry of the Environment.

8.2.4.8 Danish Coastal Authority

The Danish Coastal Authority is working with projects focusing on the effect of climate change on coastal erosion, and on alternatives to strengthening dikes in order to adapt to climate change.

8.2.4.9 Roskilde University, ENSPAC

At ENSPAC, research in climate change effects is done with interdisciplinary perspectives in a variety of sectors using Earth observations, land surface hydrological modelling, stream ecological modelling and experimental and laboratory studies on ecological and biological responses to climate change. Earth observations are used to model land surface fluxes of heat, water vapour and CO_2.

The research combines high spatial resolution remote sensing data (5-1000 m), biochemical photosynthesis models and environmental models to understand and quantify the sensitivity of land surface fluxes to change in climate and land use. In cooperation with Risø-DTU, a meso-scale regional climate model is currently used at high spatial resolution (2 km) to quantify land surface feedbacks on atmospheric processes. ENSPAC is also involved in the EU-FP6 NitroEurope project where high spatial resolution satellite data are used to validate ecosystem models simulating nitrogen impacts on the greenhouse gas budget at landscape scale. Other model activities include the use of physical habitat models to predict climate impacts on stream ecological conditions, and the use of agro-hydrological models to assess climate effects on nitrate leaching in Denmark. The combined use of experimental and model studies is used to construct new eco-hydrological modelling tools which are urgently needed to design sustainable water resource management strategies in response to climate change.

ENSPAC is also involved in a climate research network in Africa related to the use of Earth observations for environmental monitoring, and research is being conducted on human responses to climate variations during the last 5000 years using geophysical, geochemical and pollen analyses. Environmental biologists at ENSPAC are doing research in climate effects on the invasion of marine species.

8.2.4.10 Aalborg University

At the University of Aalborg, research is carried out on the impact of climate changes on society, including regional perspectives on climate changes, the impact of climate changes on industrial and financial structures as well as human, political and rhetorical implications from the climate change discourse.

Furthermore, studies are carried out on the effects of climate changes on energy consumption in housing, the impact on architecture, building components and technologies as well as studies on the impact on everyday life and the indoor climate.

8.2.5 Economic research, including evaluation of climate change and possibilities for mitigation

It is important to take account of the economic consequences of the different ways to mitigate greenhouse gas emissions.

8.2.5.1 Technical University of Denmark (Risø DTU)

The Risø National Laboratory is involved in various research activities, primarily relating to policies and measures for reducing greenhouse gas emissions, and relating to emission scenarios for greenhouse gases. The activities include development and implementation of international methodological standards for cost and sustainability analyses of reduction policies, discussion and testing of baseline approaches and various project and sector studies for the energy, transport, and agricultural sectors. The research activities have also included support for the Climate Secretariat and capacity and training programmes in developing countries. In addition, Risø has research activities concerning the Kyoto Protocol's flexible mechanisms, Emission Trading (ET), Joint Implementation (JI) and Clean Development Mechanism (CDM).

8.2.5.2 *Aarhus University and NERI*

Research at Aarhus University is concentrated on the judicial and politological aspects of climate policy and legislation at UN, EU and national levels. Cooperating with researchers from the Aarhus School of Business, the University of Southern Denmark, the Royal Veterinary and Agricultural University, and NERI, and following up cooperation established with the Centre for Social Science Research on the Environment at Aarhus University (today at NERI), general competence is assured in cross-disciplinary research into law, politology and economics. Research focuses on interaction between traditional instruments - flexible mechanisms (JI and CDM agreements), the specific significance of the decision process, and the effects of economic instruments (taxes and quotas and credits). Moreover, researchers have thorough knowledge of environment and energy policy and legislation. Such competence forms the basis for cooperation on a new Masters degree in Environment and Energy Law, cf. Chapter 9.

NERI's Centre for Analysis of Environment, Economy and Society has general competence in setting up and evaluating mechanisms for reducing emissions and special competence within the agricultural, energy and transport sectors. In addition, it possesses general knowledge of the different aspects of the Kyoto Protocol, including research competence concerning Clean Development Mechanism and Joint Implementation. Latest activities include preparation of guidelines for economic assessment of adaptation to climate change.

8.2.5.3 *University of Southern Denmark*

The University of Southern Denmark in Odense carries out research on climatic, ecological and anthropogenic impacts on marine environments, particularly the North Sea and the Baltic Sea in the period 1500-2000.

8.2.5.4 *University of Copenhagen*

At the University of Copenhagen the main focus of climate research is the scientific aspects, but research is also being conducted in the climate field in an economic context, at the Department of Economics, for example.

8.2.5.5 *Roskilde University Centre*

At Roskilde University Centre, research is going on concerning scenario building within climate-stabilising policies, together with lifecycle analyses as a tool in economic evaluation of climate-stabilization strategies.

8.2.5.6 *DMI*

DMI is involved in various national and international research and networking projects for assessments of climate change impacts on economy, energy and agriculture sectors, as well as the cost of the climate changes. In these projects, DMI develops methodology for downscaling the climate change projections to the regions of interest, and provide expert advises for other partners of cross-cutting disciplines in the projects on applications of model projections and their uncertainties to assess the climate change impact and risk on various sectors.

8.2.5.7 Roskilde University, ENSPAC

Research includes economic assessment of hydrogen and fuel cell technology in passenger car transport in the EU project Regio Zero. The development of local and regional mitigation and adaptation strategies to climate change is another important research area which is conducted in cooperation with Danish municipalities. Research also addresses public lighting strategies, transitions to energy neutral and energy producing buildings, transitions to public transport and energy efficient vehicles. The implications for daily life, regional infrastructure planning and transport related taxation is evaluated.

8.2.5.8 Aalborg University

At the University of Aalborg focus of climate mitigation research is on how to reduce energy consumption from the build environment, especially the turn to low energy consumption housing, and the transportation sector. Economic assessment on energy consumption in housing and building renovation is prioritized.

Moreover, research is done on the relations between climate changes, design strategies and sustainability of industrial products, e.g. sustainable architecture in a new climate.

8.2.6 Research and development of technologies to reduce greenhouse gas emissions and to adapt to climate change

Aarhus University has establish the Coordination Unit for Research in Climate Change Adaptation (KFT) at the Department of Policy Analysis, NERI, in collaboration with the Danish Ministry of Climate and Energy. The University of Copenhagen, the Technical University of Denmark, the Geological Survey of Denmark and Greenland, and NERI are part of this collaboration. KFT supplies authoritative climate data and climate effect data as well as specific climate research results of relevance to climate adaptation. KFT maps climate adaptation research in Denmark, follows up on progress and results, and delivers status reports to a cross-ministerial coordination group.

Aarhus University (AU) is heavily involved in all university activities related to the environment, energy and climate-related issues. AU has broad competences within the topics: Future energy systems, Future climate and climate adaptation, and Competitive environmental technologies (Aarhus University, 2008)

At the Technical University of Denmark (DTU), the national laboratory for sustainable energy is basing their research on sustainable energy development and sustainable urban change, with energy savings and renewable energy as central parameters.

8.2.6.1 Energy research

Research and development activities in the field of energy are not motivated solely by climate issues, but are relevant to climate issues, since they contribute to determining the overall framework for the CO2 intensity of energy production and consumption in the future.

In 2008, the former Energy Research Programme (EFP) within the Ministry of Climate and Energy was replaced by the Energy Technology Development and Demonstration Programme (EUDP). EUDP is focussed on development and demonstration of new energy technologies. A board, nominated by the Minister, is responsible for the allocation of funds. The Board is served by a secretariat established in the Danish

Energy Agency. The overall objective of EUDP is to support the government's energy policy objective of providing cost-effective, environmentally friendly and safe energy supply, and to contribute to promoting the competitiveness of Danish enterprises in the field of energy. The activities are focussed on new efficient energy technologies. EUDP was established in 2008. Available funds in 2009 and 2010 are 227 million DKK and 409 million DKK. On average, 35 percent of the activities under the Programme are financed by EUDP.

Energy research and development and demonstration is supported by PSO funds (Public Service Obligation). The transmission system operator Energinet.dk also has a scheme for research and development in environmentally friendly power production technology, administering in 2009 support funds amounting to DKK 130 million. Under this scheme support is given to activities relating to fuel cells and renewable energy, for instance solar cells, biomass, hydropower and wave energy. Energinet.dk also administers a new programme in 2008-11 of yearly DKK 25 million for the deployment of new technologies.

Furthermore, on behalf of the power distribution companies, the Danish power association Dansk Energi administers a scheme of support to research and development within energy-efficient use of electricity. In 2009, DKK 25 million are available under the scheme, which aims at the development of energy-efficient products and processes in buildings, industry etc.

Activities relating to strategic energy research were increased in 2003. The activities are administered by the Strategic Research Council under the Ministry of Science, Technology and Innovation, and are aimed at strengthening the knowledge base within renewable energy and environment, including support to cross-disciplinary projects that involve technical, environmental, health, social, economic and political aspects. In the years 2009-10 available funding for the Ministry's energy research efforts is expected to be DKK 170 million and 304 million.

8.2.6.2 Aarhus University, Faculty of Agricultural Sciences (AU, DJF)

Research at Aarhus University, Faculty of Agricultural Sciences (AU, DJF) focuses on the agricultural sector's possibilities for adapting to climate change by changing the cultivation system, including changes in fertilisation and the use of pesticides and adapting soil tillage methods. The aim is to develop adaptation options that also reduce greenhouse gas emissions from the sector.

At AU, DJF the world's largest biogas plant for research purposes was commissioned in 2007. It can be used by scientists and private companies - Danish and foreign - for projects in biogas production and slurry separation. The plant cost 25 million DKK to build and is expanded on an ongoing basis. The purpose of the biogas plant is to enable researchers to study the biogas processes. The researchers have a unique opportunity to study in full scale the effect on the process of changes on factors, such as biomass composition, retention time, and temperature, on which several projects are ongoing. In addition the effects on biogas treatment of animal and green manure on the subsequent emission of nitrous oxide in the field are studied in detail.

AU, DJF has a long experience in developing dedicated energy crops with a low environmental impact and high net emission reduction. Most promising crops are perennial crops such as willow and miscanthus, the latter utilising the C4-photosynthetic pathway which will become increasingly effective in the warming climate. This research has paved the way for a large demonstration project in the catchment of Ringkøbing Fiord, where willow planting has started in spring 2009 with the aim of a total planting of 1,500 ha. The dual purpose is to produce more bioenergi and to reduce the loss of nutrients to the fiord.

As a consequence of the Kyoto agreement, Danish authorities have requested an assessment of the carbon stock and launched a 10 million € soil survey (http://www.dmu.dk/Udgivelser/DMUNyt/2008/7/Sinks.htm). Half of this is ear marked to the survey of the organic soils. AU, DJF participate in this initiative by mapping the extent of organic soils in Denmark using GIS and legacy soil information.

8.2.6.3 Aarhus University, NERI

NERI is working with the main drivers behind greenhouse gas emissions from the energy sector, the agricultural sector, and the transport sector. Forest & Landscape Denmark has competence in forestry, afforestation, etc. Together, these two institutions cover the aspects of land use in the open countryside for agricultural purposes, forestry and nature. Both institutions are looking at challenges related to use of biomass from agriculture and forestry as an energy source.

NERI makes general inventories of atmospheric emissions from all sectors and activities, including the greenhouse gases. The institution has special research competence in inventories from the agricultural sector, the transport sector, the industrial sector, and the energy sector. Forest & Landscape Denmark seeks generally to quantify how forestry and changes in land-use in relation to forests affect the forest ecosystems' carbon sinks and thus the potential binding of CO_2 in biomass and soil.

NERI has models for projecting greenhouse gas emissions, based for instance on projections of activities in relevant sectors.

NERI also has research competence in modelling of the dispersal of greenhouse gases locally and regionally, with special focus on Denmark, Europe, and Greenland. The Department for Atmospheric Environment is developing a CO_2 model (DEHM) for dispersal, transport, and surface movements. The model can be used to determine the size of sources and drains for CO_2 in Europe over specific areas and for estimating whether these areas comply with the Kyoto Protocol.

8.2.6.4 GEUS

GEUS is researching impacts on the Arctic environment, and the driving forces for natural climate variations in long-term perspectives.

In cooperation with other countries, GEUS participate in EU-funded projects (GESTCO, CASTOR, CO2SINK,ULCOS, EOCAPACITY), in which the possibilities for finding geological storage possibilities near the European power stations and large industrial CO_2 point sources are being studied. Technical-economic models are also being developed in this project for planning and price calculations of different combinations of sources of CO_2 emissions, transport, and types of geological storage. Several geological formations in Denmark are known to be suitable for deposition.

GEUS is also participating in the international research project CO2STORE, a continuation of the SACS project, in which CO_2 deposition from the Norwegian Sleipner gas field is being further developed. GEUS is studying the geological properties of the storage, including the extent of the sand formation, the tightness of the clay seal and the chemical effects of storing CO_2 in the form of carbonic acid where the acidity is very low.

In the CLIVAT project, GEUS is assessing the options for adaptation to climate change in rural agricultural areas of Tanzania.

8.2.6.5 Technical University of Denmark (Risø DTU)

Risø National Laboratory is carrying out research projects on the driving forces, emissions and possibilities for reduction, particularly in the developing countries.

8.2.6.6 Roskilde University, ENSPAC

ENSPAC is involved in the evaluation of technical, economic and environmental aspects of biofuel production. Research focuses on energy crops and algae cultivation for transformation to bio fuels. The research is based on utilizing sewage water to increase productivity, and it examines effects on CO_2 and nutrient removal. Activities include participation in the Baltic Sea Bio-Energy Promotion Programme (EU Interreg Programme with 36 partners) and in Cluster Biofuel Denmark which is a technology platform bridging the gap between private enterprises, universities and public authorities.

Another research theme is Climate Change and Innovation in the Building Sector which is conducted in cooperation with the Technical University and many others. In this context, the energy and environmental challenges for building and renovating in the future are addressed.

8.2.6.7 Aalborg University/SBi

The impact of climate changes on the build environment, especially the influence on the safety, health and quality of the build environment, is a central area of research. At the Danish Building Research Institute (SBi) at Aalborg University, work has been done on adaptation strategies for the build environment to climate changes, including safety of load-carrying structures, rainwater and wastewater management as well as indoor climate in a new climate.

Furthermore, research, analysis and case studies are carried out on renewable energy systems, particularly wind energy. Essential contributions are made on wind mills – onshore and offshore -, e.g. cost-effectiveness, reliability of structures and operation optimization.

8.3 SYSTEMATIC CLIMATE OBSERVATIONS

8.3.1 Atmospheric climate observations, including measurements of the composition of the atmosphere

DMI carries out continuous monitoring of key weather and climate parameters. In the climate monitoring programme, classic methods of measurement are used and new, satellite-based observation methods are being developed.

DMI operates around 200 automatic measuring stations in the Kingdom of Denmark (Denmark, Greenland and the Faroe Islands) with a broad measuring programme ranging from automatic sea level or precipitation stations that measure only one parameter, to stations with a full measuring programme, including automatic cloud height detectors and weather type detectors. In recent times, a separate network for climate observations has not been operated because of technological convergence between the climate and weather networks and a desire to rationalise the operational network. The net of stations is shown in the GCOS report, Annex H.

The past manual measuring network has now been almost fully replaced by automatic measuring stations. The aim was to eliminate sources of human errors, to realise a potential for rationalisation, and to significantly improve observation frequencies. Observations were previously taken every three hours, but, today, observations are required at 10-minute intervals from the new stations, which cannot be done manually. The purpose is to achieve greater coherency between the different types of stations so that the number of station types and spare parts can be reduced as much as possible without loss of quality.

To collect precipitation data DMI also 1 January 2009 operates a network of about 250 manual precipitation stations, which are mainly used to map the precipitation climatology. Measurements are collected daily via the telephone and are thus available very quickly after the measurements were taken.

Besides being of use for national programmes, the observations concern Denmark's international contribution in the form of observation components from Danish territory to the worldwide meteorological observation network WWW - World Weather Watch. Other international programmes for mapping weather and climate include the GCOS (Global Climate Observing System), coordinated by the World Meteorological Organisation (WMO).

The Danish observation network is characterised by high average data availability, as appears in Table 8.1.

TABLE 8.1 AVERAGE DATA ACCESSIBILITY IN 2008

Source: Danish Meteorological Institute

Type	**2008**
Automatic weather stations, incl. Greenland and the Faroe Islands	98.9%
Satellite reception	99.5%
Weather radar	98.4%
Radio sounding, Faroe Islands and Greenland	97.3%
Storm surge stations	99.3%

The meteorological observations are stored in DMI's database, and observations from many Danish stations are available in electronic form from 1872, water level measurements from 1890, and measurements of the surface temperature of the sea from 1931.

The meteorological observation systems that are of most interest in a climate context are:

- The surface observation system
- The radio sounding network
- The weather radar network
- Satellite data
- The ice observation service
- The measurement of polle and spores

Each of these systems is described in the following, together with DMI's stratospheric observations and oceanographic observations.

Surface observation network

For historical and practical reasons, the surface observation network consists of many different types of stations. Apart from the 250 manual precipitation stations and five airbases and airports where there are statutory requirements for manual observations, the network is 100% automated. Table 8.2 provides an overview of the network. DMI is receiving a growing number of observations from cooperation partners in all parts of the Realm, so these are included in Table 8.2.

TABLE 8.2 THE NETWORK OF SURFACE OBSERVATION STATIONS 1 JANUARY 2009

Source: Danish Meteorological Institute

Type	DMI			Cooperation partners		
	Denmark	Greenland	Faroe Islands	Denmark	Greenland	Faroe Islands
Weather stations	50	24	4	22	18	1
Automatic precipitation intensity stations				112		
Automatic acc. precipitation stations	41	6	1			
Manual acc. precipitation stations	243	3	5			
Surface radiation stations	26	3	1			
Sun recording stations		2				
Automatic sea level stations	15			62		

Besides the observations from the Danish land areas, DMI has an observation agreement with two Greenlandic ships, which carry out systematic observations (Automated Voluntary Observing Ships) in the waters around Greenland and between Greenland and Denmark. In addition, Denmark is a partner in the EGOS/SURFMAR cooperation on collection of weather observations from ships and drifting weather buoys in the North Atlantic, since DMI has strategically well placed satellite reception facilities in Kangerlussuaq (Greenland) and in Copenhagen. Observations from Denmark, Greenland and the Faroe Islands are also included, and are coordinated with EUCOS (European Coordinated Observation System), which is organised by EUMETNET (European Meteorological Network).

The radio sounding network

In radio sounding, a small, fully automatic weather station is sent up by balloon. The balloon can reach a height of about 35 kilometres, and all the way up it sends observations of temperature, pressure, humidity, and wind velocity via radio to a receiving station. Radio soundings provide measurement of the atmosphere's vertical profile for use in analyses of the condition of the atmosphere. They also enable measurement of ozone and radioactivity.

DMI operates radio sounding stations in Tórshavn on the Faroe Islands and in Danmarkshavn, Illoqqortoormiit, Tasiilaq, Narsarsuaq, and Aasiaat in Greenland. Soundings are also received from two so-called ASAP (Automated Shipboard Aerological Programme) containers, which are “portable” radio sounding stations designed for use on ships. DMI has had an agreement for many years with a Greenland shipping company on ship-borne radio soundings in the North Sea and the North Atlantic. The radio sounding stations and the ASAP units take two daily soundings, although the ASAP units do not take a sounding if they are near a land radio sounding station, such as the one in Tórshavn.

Weather radar network

With five radars in Sindal, Virring and on Stevns, Rømø and Bornholm, Denmark's network of weather radars provides 100% coverage, which enables comparison with ground-truth data from a network of land-based precipitation stations.

The weather radar network has a high spatial resolution and is therefore able to provide precipitation-climatological information at a very high degree of detail nationally, regionally, and locally. By calibrating radar data against surface-based point-precipitation measurements, the latest research results show that good absolute accuracy can be achieved. The present radar network has a data frequency of six data sets per hour and the spatial resolution is 2x2 km^2.

Satellite data

Denmark contributes to space-based observations through membership of the European Space Agency ESA and the European meteorological satellite organisation EUMETSAT, and DMI has facilities for receiving satellite data in Denmark and Greenland.

In cooperation with EUMETSAT, DMI is managing the so-called satellite Application Facility (SAF) for use of GPS data for weather and climate monitoring (GRAS-SAF) and is also participating in SAF for oceanography and sea-ice (O&SI SAF) and the SAF for ozone and atmospheric chemistry monitoring (O3M SAF).

Ice observation service

DMI is responsible for systematic monitoring of the ice conditions in the waters around Greenland. Observations of the ice conditions have been collected for about 135 years, and there is a very large quantity of data in graphic form such as monthly surveys, ice maps, etc. Since 1959 the waters south of Kap Farvel, in particular, have been intensively monitored with satelittes and aircrafts for provision of ice information to shipping. Ice maps are prepared and distributed frequently with detailed information on relevant ice conditions. All new ice maps are in vector and graphic form. Since 1999 weekly maps have been prepared showing the ice conditions all the way round Greenland. All offshore maps are based on satellite data DMI is carrying out research in sea ice modelling, satellite based iceberg detection and in mapping the extent of sea-ice through the past centuries.

Measurements of pollen and spores

In Denmark the Danish Asthma and Allergy Association and DMI are responsible for the pollen project and are operating two routine stations measuring pollen and spores in Copenhagen, Zealand, at the DMI (55°43´N, 12°34´E) and in Viborg, Jutland, at Viborg-Kjellerup Hospital (56°27´N, 9°24´E). The measurements started in Copenhagen in 1977 and are performed utilising Burkard traps placed 15 and 21 meters above ground level, respectively. The distance between the two stations is about 220 km. In periods campaign measurements have been performed at different stations in Denmark.

Trend analysis of the pollen season in Denmark shows a marked shift to an earlier season and a general increase in the pollen load – a consequence of warmer climate during the period. IPCC has recognised pollen as one climate indicator and in Denmark the Danish Forest and Nature Agency is much aware of the possible threat of a warmer climate introducing or strengthen new invasive plants, as ambrosia, to the Danish nature.

8.3.2 Stratospheric observations

DMI is engaged in studies of the physical processes resulting in changes of the ozone layer, and stratospheric monitoring of relevance to the climate of the future. The DMI research and systematic observations are underpinned by the recommendations of the Montreal Protocol and form part of the research to which Denmark is committed by its ratification of the Vienna Convention of 22 March 1985 for the Protection of the Ozone Layer.

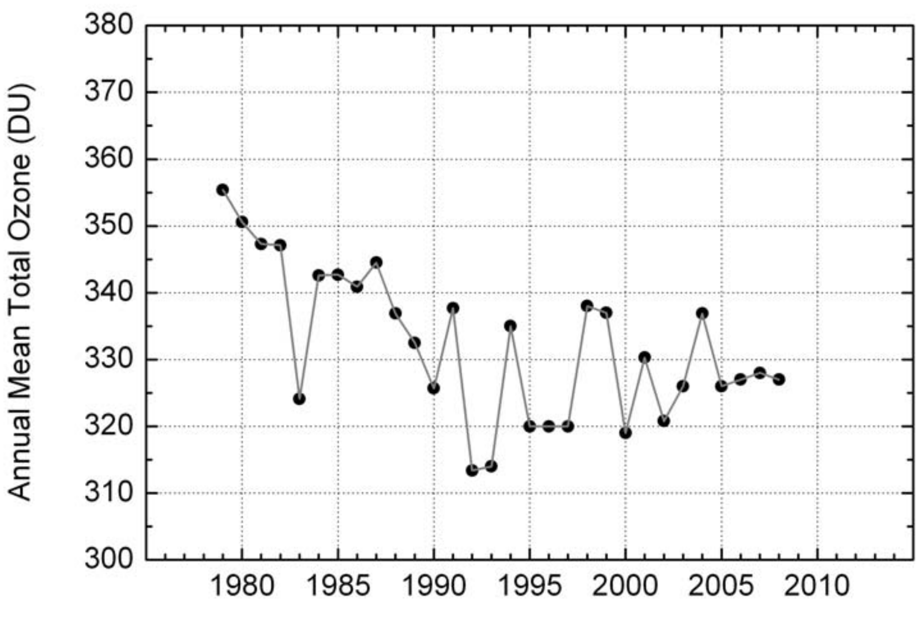
Measurements of the ozone layer and UV radiation are made at Copenhagen - see Figure 8.1 - and Kangerlussuaq (Søndre Strømfjord), using Brewer ozone spectrometers. At Pituffik (Thule) measurements are made of the ozone layer, UV radiation, global radiation, aerosols and stratospheric NO_2, using, respectively, a Dobson- and a SAOZ spectrometer, a UV spectro-radiometer, a pyranometer and an aerosol radiometer. In order to monitor the ozone depletion in the lower stratosphere in the winter and spring months, and with a view to establishing an ozone profile climatology, DMI has since 1989 launched ozone probes from a number of stations in Greenland. Since January 1993 ozone probes have been launched each week from Ittoqqortoormiit (Scoresbysund) on the east coast of Greenland where also measurements of UV radiation are performed.

The observatories operated by DMI in Greenland, Pituffik, Kangerlussuaq and Ittoqqortoormiit, are Arctic stations in the Network for Detection of Atmospheric Composition Change (NDACC), formerly known as the Network for the Detection of Stratospheric Change (NDSC). This is a worldwide network of measuring stations equipped with standardised instrumentation of verified high quality for monitoring the condition of the stratosphere and the processes that affect the ozone layer. DMI works with the National Center for Atmospheric Research (NCAR) in Boulder (FTIR instrument in Pituffik), with the Italian National Agency for New Technologies, Energy and the Environment (ENEA) and the Italian National Institute of Geophysics and Volcanology (INGV) (Lidar and mm-wave spectrometer in Pituffik), with the Health Protection Agency in the UK (UV radiometer in Pituffik) and with NASA (aerosol radiometer in Pituffik and Kangerlussuaq) and SRI-International, USA (Lidar in Kangerlussuaq). NDACC is supported by the International Ozone Commission (IOC), UNEP and WMO, and DMI takes part in the NDACC steering committee (http://www.ndacc.org). The stations in Pituffik and Kangerlussuaq are also part of Aeronet.

DMI's measurements are reported to the database of the Network for the Detection of Atmospheric Composition Change (NDACC) and the database of the World Ozone and UV-radiation Data Centre under the WMO programme Global Atmosphere Watch and are used to validate satellite data as well as to compare with results from climate models.

FIGURE 8.1 ANNUAL MEAN THICKNESS OF THE OZONE LAYER OVER DENMARK 1979-2008 IN DU (DOBSON UNITS). MEASUREMENTS UP TO AND INCLUDING 1992 FROM THE NASA TOMS INSTRUMENT, WHILE MEASUREMENTS AFTER 1992 ARE BY DMI'S BREWER-INSTRUMENT IN COPENHAGEN.

Source: Danish Meteorological Institute



8.3.3 Oceanographic climate observations

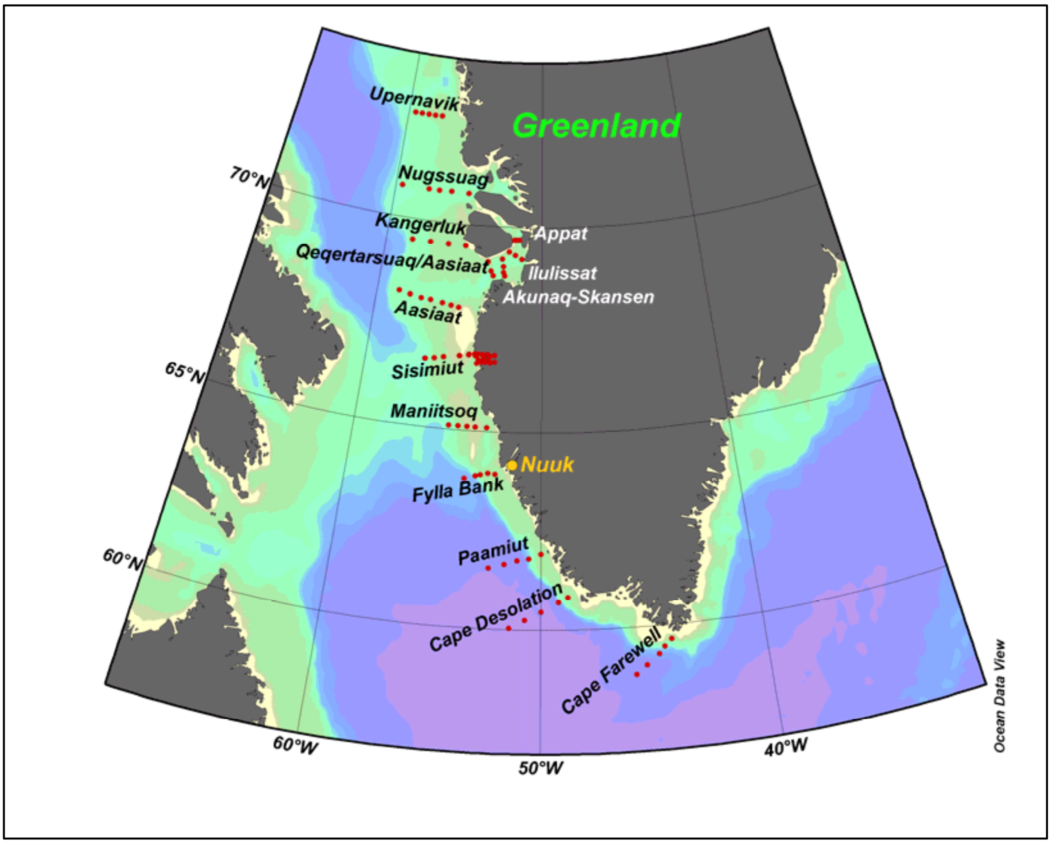
DMI cooperating with the Danish Coastal Authority, the Royal Danish Administration for Navigation and Hydrography and local authorities, monitors the sea level ata number of Danish localities.

Jointly with the Greenland Nature Institute, DMI carries out annual oceanographic observations in standard sections off the west coast of Greenland, aiming at monitoring climate change in the Greenland marine environment and using the data in assessments of the future fishery ressources. In recent years this programme has been extended to include stations in fiords near Sisimiut and NUUK in order to study effects of climate change on the marine ecology.

DMI is also processing oceanographic data from the annual trawl cruises made by the Greenland Nature Institute. Monitoring stations are shown in Figure 8.2.

FIGURE 8.2 STANDARD HYDROGRAPHIC SECTIONS OFF THE WEST COAST OF GREENLAND. SOUTHERN STATIONS – INCLUDING SISIMIUT – ARE OPERATED BY DMI, WHILE NORTHERN STATIONS ARE OPERATED BY THE GREENLAND NATURE INSTITUTE.

Source: Danish Meteorological Institute



8.3.4 Terrestrial observations related to climate changes

Monitoring of snow cover, sea-ice and surface radiation is reported in sections 8.3.1 and 8.3.2 and observations of the Greenland Inland Ice in section 8.3.5. Denmark does not carry out further terrestrial observations that can be related to climate change, but Denmark's climate related research (cf. 8.2) includes monitoring and studying the effect of terrestrial conditions.

8.3.5 Observations of the Greenland Inland Ice

Since 2007 one of the main tasks of GEUS has been to establish and run the Programme for Monitoring of the Greenland Ice Sheet Margin (PROMICE), funded by the Danish Ministry of Climate and Energy through the DANCEA programme. Partners are the Greenland Survey (ASIAQ) and the Danish National Space Centre at the Technical University of Denmark. The objective is to measure and model the climatic and dynamic mass loss of the Ice sheet.

The monitoring programme includes:

1. An extensive network of automatic mass-balance stations positioned in situ on the Greenland ice margin (established 2007 to 2010). At the stations measure the climate parameters and the melting of the ice sheet.
2. repeated airborne surveys of the entire ice margin to obtain surface elevation and ice thickness (2007 and 2010 planned)
3. an ongoing effort to process satellite radar data to determine ice sheet surface velocity (from 2009 onwards)
4. modelling of the climatic and dynamic mass loss of the Greenland ice sheet
5. maintenance of an open access database (from 2008 onwards)

As a part of the programme GEUS collaborate on a comprehensive environmental monitoring programme, Zackenberg Basic in Northeast Greenland. The GEUS is in charge of the most recent addition to the long-running monitoring programme, namely GlacioBasic, which will monitor the glaciated parts of the Zackenberg basin. The programme will be funded by the Danish Ministry of the Climate and Environment through the DANCEA programme.

Other programmes related to the PROMICE monitoring are: Participation in the worldwide effort to monitor land ice masses, Global Land Ice Measurements from Space – GLIMS. Within this framework, GEUS acts as the GLIMS Regional Centre for Greenland (RC1) and formally coordinates the GLIMS activities in Greenland through contact with regional stewards working in different parts of Greenland. GEUS actively works to submit data to the GLIMS database within the Programme for Monitoring of the Greenland Ice Sheet Margin (PROMICE).

GEUS submits a monthly land cover classification of the Greenland ice sheet, derived from MODIS imagery, to the EuroClim database. The EuroClim collaboration started as an EU-funded project where GEUS glaciologists participated in developing the algorithms and framework.

8.3.6 Development assistance for establishment and maintenance of observation and monitoring systems

From 1997 to 2004 DMI participated in a development project together with the meteorological institute of Ghana (Meteorological Services Department - MSD). The purpose of the project included re-establishing a network of meteorological stations in the country, thereby ensuring collection of data. At the same time, it was to improve communication and use of the collected data. The project was completed in 2004. At the end of the project, MSD had an efficient network of around 300 observation stations registering the usual meteorological parameters.

DMI also coordinated the project ‘Use of climatic seasonal forecasts to improve cultivation strategies for crops in West Africa’. The purpose of this project was to examine the possibilities for adapting cultivation practice for a selected agricultural crop (peanuts) in Ghana, using the best available seasonal forecasts for the climate. The project was funded by the Council for Developing Country Research (RUF).

In 2004 DMI and AGRHYMET in Niger prepared a proposal for a project on the use of satellite data and preparation of seasonal forecasts. However, contrary to expectations, the necessary project funds will probably not be available.

In 2009 DMI and ZMD in Zambia have prepared a proposal for a project which leads to a “Twinning arrangement” with respect to climate and climate change between the two institutions.

9 Education, training and public awareness

9 Education, training and public awareness

In Denmark there is an ongoing public debate in the media and elsewhere about climate change, anthropogenic greenhouse gas emissions and political reactions in terms of policies and measures. In 2009, the government published its new strategy for sustainable development – an update of the strategy from 2002. The Danish climate policy – including the Climate Strategy adopted in 2003 and the Danish strategy for adaptation to a changing climate from March 2008 - must be seen in the light of making a sustainable development of the Danish society. Part of the strategy is to involve the public and to practise openness about the strategy, decision-making and analyses. Denmark has a long tradition for involving the public and, in the environment field, this tradition was followed up by an international agreement - the Aarhus Convention from 1998. In the international UN negotiations on a common effort to mitigate the effect of climate changes, both Danish industry, and green and development-oriented organisations were represented in the Danish delegation. A considerable amount of information on climate change and Danish policies is provided on the websites of the Ministry of Climate end Energy (www.kemin.dk), the Danish Energy Agency (www.ens.dk), the Danish Meteorological Institute (www.dmi.dk), the Geological Survey of Denmark and Greenland (www.geus.dk) and on the websites of other relevant ministries and the institutions thereunder such as the Ministry of Finance (www.fm.dk), the Ministry of Transport (www.trm.dk), the Ministry of Food, Agriculture and Fisheries (www.fvm.dk), the Ministry of Taxation (www.skm.dk) and the Ministry of Foreign Affairs (www.um.dk)..

In 2008 and 2009, numerous new initiaties on education, training and public awareness regarding climate change issues have been taken with a view to support Denmark's role as host for the 15th Conference of the Parties to the UNFCCC 7-18 December 2009 in Copenhagen.

One example is that the new Danish web-site created for COP15 also contains information and relevant links to other web-sites about climate change issues that goes even beyond what has been possible to report in this Fifth Natonal Communication. The top levels of these 16 pages with further information on Denmark's efforts are reproduced in Annex D. Here you will able find more information about the Danish Government's decision to replace the traditional gifts or hand out conference kits to the conference participants with 11 so-called COP15 Climate Scholarships, because experience shows that the traditional gifts often end up in garbage bins at conferences venues and hotels. With these COP15 Climate

Scholarships 11 young people from all over the world have been able to start their climate studies at different master courses at Danish universities in 2009.

Anothor key feature in the Danish COP 15 web-site is the direct assess to the so-called "Climate Consortium Denmark". Climate Consortium Denmark is the official focal point for all Danish business-related activities leading up to the UN Climate Change Conference, COP15, in Copenhagen in 2009. On this website (http://en.cop15.dk/climate+consortium), you can find climate and environment related events in the calendar, find information about EnergyMap.dk - a complete web based guide to climate solutions, sign up for the newsletter and read more about the Climate Consortium's initiatives, work and organisational structure.

9.1 EDUCATION AND POSTGRADUATE EDUCATION PROGRAMMES

9.1.1 University of Copenhagen

Education in climate is an integral part of many educational programmes at University of Copenhagen, and the university already offers a range of relevant courses within sustainability and climate change, which are all described in the Climate Strategy 2010. In the coming years, the university will expand its portfolio of climate change and sustainability related educational programmes, especially by launching a new MSc programme in Climate Change: Impacts, Mitigation and Adaptation in 2010. The MSc will be in English, include an internet component and will have an expected minimum uptake of 40 national and international students. Other educational programmes with focus on climate are:

- EnvEuro, a two-year Master in Environmental Science, offered by the University of Copenhagen and three other leading European universities. The M.Sc. is focused on soil, water and biodiversity and features an introduction to environmental science, six different specialisations, and finally a Masters thesis in environmental science (http://www.enveuro.eu/).

- E-learning course in Climate Change Impacts, Adaptation and Mitigation offered by the University of Copenhagen in close cooperation with the Danish Meteorological Institute, UC Berkeley and Australian National University. Focus of the course is climate change impacts and the human response to climate change. The course is developed by a team of teachers who are international experts within their respective disciplines, including four members of the Intergovernmental Panel of Climate Change (IPCC). Through distance learning the course can be followed from everywhere in the world and it is open for MSc students and continuing education students with a relevant BSc background in natural science, social science and economics (www.climate-change.dk).

- Global Environmental Governance (GEG) is a cross-faculty specialization, with the objective is to equip the students with interdisciplinary skills, which will assist them in dealing with global environmental governance in an international and/or national context. Focus is on the global and international levels of governance, but with a view to how these levels interact with the regional and local levels.

- Summer schools are annually offered by University of Copenhagen within the area of climate change, and often in collaboration with other universities within IARU (http://klima.ku.dk/sommerskoler).

- Climate change is a central theme at Copenhagen Global Change Initiative (COGCI), which is a PhD school and research network established in cooperation between the University of Copenhagen, DMI, NERI, and GEUS. Presently the school has 22 registered PhD students. The programme comprises general and specialist courses, together with seminars and theme days. http://www.cogci.dk/

The universities disseminate widely the result of research, with the portals http://climate.ku.dk/ and http://climate.ku.dk/research/ as the main entry points. Here, 12 key areas of climate research are listed, including areas of study and contact persons. At the faculty/institute level, a wealth of climate activities within research and education are disseminated, e.g the Niels Bohr Institute's activities at the website http://www.fys.ku.dk/hco/presse/Formidling2002.htm and the Faculty of Life Sciences (http://www.life.ku.dk/forskning/Klimaforskning.aspx).

9.1.2 Aarhus University

There are climate related education programs at all the faculties. As examples one can mention educations related to the understanding of the climate system and mechanisms of climate change, agricultural production and the impact of this on the climate, courses on tropical ecosystems, management and development, global food production and climate change, global management and manufacturing, and environmental economics and climate change. Climate regulation at UN, EU and national levels (and associated lobbyism) is a key issue in the Master in Environment and Energy Law (MEEL). The degree is offered at Aarhus University in cooperating with University of Copenhagen and the University of Southern Denmark.

The Danish School of Education participates in the International Alliance of Leading Education Institute, who has conducted joint research on the role of education in relation to climate change and sustainable development. A new Regional Centre of Expertice on Education for Sustainable Development (RCE) under United Nation is established at this part of the university.

Climate change issues is highly integrated in the MSc study on Agroenvironmental Management at Faculty of Agricultural Sciences (DJF), which contains a course on Carbon Cycling and Climate Change. Climate change is also highly integrated in the SAFE PhD school and the STAiR international research education programme at DJF.

Aarhus School of Business (ASB) at Aarhus University will in the next three years set strategic focus on “sustainable growth through innovation” both in research, education, communication and cooperation with the business community. Already today more than 50 researchers are working with issues such as regulatory challenges, climate economics, strategies and business models, user behaviour, sustainable supply chain and logistics, responsible investment, CSR etc.

A BScB in Sustainability and a BScB in environmental law are developed as well as an international full time MBA with focus on sustainability and leadership is starting up in 2010. ASB is part of the MEEL programme mentioned above. ASB has signed up for the UN Global Compact programme and the UN Principles for Responsible Management Education (PRME) and these principles will be integrated in all programmes in the following yearsThe project is communicated at a special webportal at www.asb.dk and a variety of dissemination and networking initiatives is planned.

In addition Aarhus University carries out a considerable amount of public outreach, including numerous lectures at high schools and primary schools and for the general public. Courses on climate has been organised for school teachers and journalists, and AU has also presented number of papers for the general public, which may be used as teaching material.

9.1.3 Technical University of Denmark (DTU)

The climate change challenge and climate change technologies are addressed in a broad range of M.Sc. and PhD programmes at DTU, which is a university with a leading force within the technical and natural sciences. In addition, since 2008 DTU has offered two specific M.Sc. programmes in wind energy and sustainable energy.

DTU is a partner in The Nordic Five Tech alliance, which has developed special offers and services for its more than 60,000 engineering students; among these a new joint Nordic M.Sc. Program in Innovative Sustainable Energy Engineering. DTU has also established the Europeans Graduate school for sustainable energy technologies together with the Technical University of Munich.

9.1.4 Roskilde University, ENSPAC

Bachelor studies in natural and social sciences, humanities and technologies contain climate related components. Climate science, climate policy modules, energy production and social dynamics behind such issues are mandatory in the master studies in technological and socioeconomic planning and geography. Optional courses in the fields of environment and energy with climate related contents are available to the students of these subjects.

Roskilde University organises in collaboration with other Danish Ph.D. schools a quarter semester interdisciplinary Ph.D. course on climate science and climate policy: The physical science, impact and adaptation, mitigation and institutions. Climate change impacts are also important in relation to the GESS Ph.D. programme which focuses on how natural stresses (e.g., drought, temperature extremes, diseases) and stress deriving from human activities (e.g., toxic chemicals, habitat destruction) impact ecological systems, as well as in the SST Ph.D. programme relating to questions of technology, regulation and changes in everyday practices in mobility.

9.1.5 DMI

Members of DMI/Danish Climate Centre staff give lectures to high-school students, teachers, researchers and others. Staff members have, for instance, since 1998 taken part in annual national events as the Danish Science Festival and The Festival of Research, giving lectures around Denmark. 100,000 people take part in the festival's events and activities each year. Furthermore, primary/lower secondary and upper secondary students take part in special science training programmes in the Science Festival periods. For further information, visit http://www.formidling.dk/sw8773.asp and http://forsk.dk/forskningens-dogn/in-english.

DMI presents general information material on www.dmi.dk, offering both basic knowledge on climate and climate change issues, and topic themes/news, which is largely used in Danish schools.

DMI also welcomes students from the 9th and 10th class of the public shools in Denmark to participate in a short-term work experience. The program has a duration of one week and takes place five times a year. Among other things the students learn about climate by using an interactive climate model which is a simplefied version of real climate models. In addition they learn about ozon, weather forecasts etc.

9.1.6 Ministry of Education

In 2008-2009, the Ministry of Education has taken a series of initiatives for primary and lower secondary education, youth education programmes and tertiary education in order to put climate on the agenda. In the last two years the Danish Ministry of Education has made a special effort to encourage pupils/students, teachers and schools to put the climate on the agenda in the year 2008/09. It has happend through a series of initiatives for primary and lower secondary education, youth education programmes and relevant tertiary education.

The initiatives were based on five key perspectives which have been dealt with differently depending on educational programmes, the proficiency of students and teaching context:

- Knowledge perspective - what do we know about Earth's climate and factors that affect it?
- Action and behavioural perspective - what can be done to limit global warming?
- Technology and community perspective - which technologies / production forms in existence could help limit the greenhouse effect? What are the socio-economic conditions for the spread of these technologies / production forms?
- Future Perspective – future sustainable technologies, practices and dissemination
- Socio-economic perspective - issues connected to climate change, including

  a) how will climate change and efforts to improve the climate influence economic growth?

  b) security aspects of climate and energy policy.

The project included:

1. A national dissemination and networking project, which can be found at www.klimaundervisning.dk and which includes a learning tool database, a diary, network of climate teachers, network of climate facilitators (institutions offering advanced level programmes, museums, informal learning environments, enterprises etc.), conferences, teaching staff meetings etc.

2. A special climate topic on the EMU - Denmark's educational website portal – aiming at primary and secondary school, vocational training and education and the general upper secondary programmes, see http://www.emu.dk/tema/klima/.
3. Cooperation between the projects "Climate Education" and "Education for Sustainable Development" see for example www.ubuportalen.dk
4. Support for a number of educational projects, which will be published on www.klimaundervisning.dk, as they become ready for dissemination.

Further information on this project is contained in Annex D (subsection 12).

9.2 Climate information

9.2.1 Ministry of Climate and Energy

The websites of the Ministry of Climate and Energy (www.kemin.dk) and of the Danish Energy Agency (www.ens.dk) are updated regularly with the latest relevant information within the climate area, either directly in the form of press releases, documents, reports, etc. or through links to relevant professionals.

9.2.2 Aarhus University

The NERI at Aarhus University prepares regular reports about environmental issues. Technical Report No. 401 contains an evaluation of Denmark's need and possibilities for adapting to future climate changes. In connection with the report, a poster with illustrations has been published. The report is featured at NERI's website www.dmu.dk. A number of NERI's reports on climate are designed for use in the education sector, including Theme Report 29/1999 Where does air pollution come from? and Theme Report 31/2000 CO_2, where, why, how much?. The report “Danish adaptation to a changed climate” from NERI 2002 presents the expected climate changes in Denmark. The report shows that rational long-term planning may prevent much damage and many effects of probable climate changes. In 2009, NERI published a book – no. 16 in the series “The Environment Libery” - on “Greenhouse gases – sources, inventory methodologies and international commitments”(in Danish) for use in the education sector and for the public in general. This book describes in a non-technical language how greenhouse gas inventories and projections are made.

The Faculty of Science publishes several journals for public outreach. These journals include articles on various subjects within natural science, but climate-related subjects have a dominant role and several volumes of the journals have been dedicated to climate. In addition researchers from the Faculty of Science (and Aarhus University in general) publish findings, which are of interest to the general public, in various public outreach journals as well as on the internet (e.g. www.videnskab.dk).

Faculty of Agricultural Sciences (DJF) has prepared several reports on 1) greenhouse gas emissions from agriculture and how these emissions can be reduced, and 2) impacts of climate change on Danish and European agriculture. These reports are available at DJF’s website. DJF has also on its website added a special entry on climate change issues relevant for Danish agriculture. Here there are links to published articles and reports on the various topics.

The Aarhus School of Business (ASB) has developed a special website with focus on the business issues related to creating sustainable growth through innovation www.asb.dk/sustainableinnovation. The website includes videos with the newest research, press releases and links to research, blogs and facebook.

9.2.3 DMI

DMI/Danish Climate Centre disseminates knowledge on climate issues to the general public from an extensive website at www.dmi.dk. DMI also communicates through lectures and popular articles in newspapers and trade journals, through series of reports, and at theme days (Klimaforum). Furthermore, DMI holds conferences for teachers, communicators from the business life, consultants, and journalists. In 2008 DMI translated Pick's synthesis report into Danish and the translation can be obtained at www.dmi.dk. Finally, employees at DMI often take part in radio and TV interviews, and in interviews for the printed press.

At www.dmi.dk the Danish population can read the daily news which inform about new climate studies, new results from scientific work etc. Concerning the daily news, DMI works together with external collaborators such as the company Danish Electricity Savning Trust and the One Tonne Less Campaign run by the Ministry of Climate and Energy in order to encourage the Danes to take up the challenge and reduce their personal emissions.

DMI also takes part in UNFCCC's Conference of Parties. Thus, DMI participated in COP14 having a scientific exhibition together with the Geological Survey of Denmark and Greenland, the Danish Energy Agency and the Coordination Unit for Research in Climate Change Adaptation. The purpose of DMI's participation in COP14 was primarily to inform Danish negotiators, NGO's, the Press and participants from developing countries about DMI's work in the climate area. The themes of the exhibition were: global warming, the Artic is melting, sea level rise, life in the growing megacities and adapting to climate change. In addition, the staff at the stand made information of general interest available to the Danish public through regular blog at http://www.dmi.dk/dmi/index/klima/blog_fra_cop14.htm dmi.dk.

9.2.4 GEUS

GEUS participates in a number of international research projects and groups. The PROMICE monitoring is part of the AMAP, Arctic Monitoring and Assessment Programme. GEUS is furthermore involved in work at the following groups or organisations:

- International Arctic Science Committee-Working Group on Arctic Glaciers (IASC),
- World Glacier Monitoring Service (WGMS),
- GlobGlacier user group (ESA),
- Colorado University/CIRES station network,
- GC-Net and
- WMO.

9.2.5 Roskilde University, ENSPAC

In 2010, Roskilde University will be hosting two major COP15 follow-up conferences, “Sunrise 2010” and “Transitions to the 21st century energy and climate in the Zealand-Region (organized with Risø-DTU). ENSPAC is also regularly convening or co-convening international symposia on climate impacts on water resources through its organizational involvement in ICCLAS-IAHS (International Commission of the Coupled Land Surface-Atmosphere System/International Association of Hydrological Sciences).

9.3 DANISH PARTICIPATION IN INTERNATIONAL CLIMATE ACTIVITIES

9.3.1 DMI

DMI/the Danish Climate Centre participates in a number of international research projects with support primarily from the European Commission's framework research programmes. In addition, the Centre contributes to the work in the IPCC. This includes climate projections for several of the IPCC's SRES emission scenarios with a coupled atmosphere ocean model system and a regional climate model. These climate projections are available for impact studies in the IPCC's scenario database and in a European scenarios database hosted at DMI. Employees at DMI/ Danish Climate Centre have also participated in the preparation of the IPCC Assessment Reports as coordinating lead author and contributing author and as expert reviewers. DMI is also very active in communication the IPCC’s reports to the public through translations and popular articles/books. In addition, a number of foreign journalists have visited DMI to learn about climate and research activities at DMI.

9.3.2 Aarhus University (AU)

Aarhus University participates at expert level in the IPCC.

The Danish School of Education participates in the International Alliance of Leading Education Institute. A new Regional Centre of Expertice on Education for Sustainable Develeopment (RCE) under United Nation is established at this part of the university.

Faculty of Agricultural Sciences (DJF) has contributed with a lead author to the latest IPCC assessment reports. Researchers at DJF is actively involved in European and international research on:

1) quantifying greenhouse gas emissions from agriculture,

2) assessing efficiency of agricultural mitigation measures,

3) researching impacts of climate change on agriculture in Europe and in developing countries, and

4) evaluating measures and strategies for adaptation to climate change.

The results feeds into the IPCC emissions inventory guidelines and the IPCC assessment reports.

NERI works in different ways to popularise and communicate the content of e.g. TAR, the latest research results on climate effects, etc.

The Faculty of Science partakes in numerous international networks and research projects on understanding the climate system, causes for climate changes, consequences for ice sheets and ocean circulation as well as impact on ecosystems and biodiversity.

9.3.3 Roskilde University, ENSPAC

ENSPAC participates in the Baltic Sea Bio-Energy Promotion Programme which is an EU project and in the EU-FP6 integrated research project NitroEurope focusing on the nitrogen cycle and its influence on the European greenhouse gas balance. ENSPAC also contributes to climate education in the EU project (Intelligent Europe) Schools and Universities for Climate and Energy, and to international climate research communication by convening and co-convening international symposia on climate impacts on water resources through its organizational involvement in ICCLAS/IAHS (International Commission on the Coupled Land Surface-Atmosphere System – International Association of Hydrological Sciences).

9.3.4 Technical University of Denmark (Risø DTU)

The Risø National Laboratory participates at expert level in the IPCC. The UNEP Centre at Risø has contributed to the AR4 and special reports with five authors and a coordinating author. The UNEP Centre participates in a wide range of information activities in that connection with different policy possibilities in cooperation with e.g. DMI, NERI, and others.

9.3.5 University of Copenhagen, Faculty of Life Sciences

The DBL-Centre for Health Research and Development of the Department of Veterinary Disease Biology (DVDB), together with the Danish Development Research Network, Danish Water Forum and the Danish Research Network for International Health and partners from Soutrhern Africa has facilitated the establishment of the Southern Africa Climate Change Research Network (SACCNET). SACCNET which is a South-North network including researchers and practitioners from the African SADC region and Denmark is addressing research and knowledge sharing on the interlinkages between climate change impacts, human health, water and food security.

9.4 PUBLIC CAMPAIGNS

A number of initiatives are being carried out to promote environmentally sound behaviour in companies and households, particularly for climate reasons, and with respect to energy use. Labelling schemes, printed matter, information lines, media spots and similar are used to increase public knowledge of possibilities for action and knowledge of less environmentally harmful technologies.

9.4.1 Traffic, health and the environment.

In the last few years environment policy has increasingly focused on the fact that we all share responsibility for environmental problems and for helping to solve them. This strategy is now also penetrating in the transport sector.

A campaign focus on information of fuel consumption and CO_2 emission from passenger cars. These informations shall be informed according to EU law and the information has been given since 2000. However, the growth of fuel prices and the global financial crise has increased the public interest of the campaign.

In Denmark, the internet is actively used to spread the information, which are found on the homepage of the danish Road Safety and Transport Agency. On this homepage fuel consumption and CO_2 emission are provided for new as well as elder cars, and the danish anual environmental fee for owing a specific car is provided as well. The information is gathered in a booklet which are available from car dealers and libraries.

As part of the campaign and the EU law the car dealers must place a sheet showing information of fuel consumption, CO_2 emission and energy class (A-G) in or next to new cars. Similar sheets are used for household equipment like refrigirators etc. The sheet be downloaded from the homepage of the danish Road Safety and Transport Agency as well. During the last year it is observed that fuel consumption and CO_2 emission has become a factor in the market competion and that consumers seek this information.

9.4.2 The Climate Campaign “One Tonne Less”

In 2007 the Ministry of Climate and Energy launched the awareness-raising climate campaign ‘One Tonne Less’. The campaign that runs to the end of 2009 aims at informing every single Danish citizen that CO_2 emissions are caused by our way of life – and that we are all responsible for reducing our own CO_2 emissions. One of the fundamental messages of the campaign is that this can be done without waving goodbye to our modern way of life – all we need to do is to change some of our everyday habits.

Considering that it is necessary for people to understand that the personal climate challenge is concrete, measurable and controllable a program on the campaign’s website enables individuals to calculate their own CO_2 emissions, set up an action plan, and then see how much they can reduce their CO_2 emissions by implementing the plan. Where possible they will also be able to see how much the actions will cost and how much they can save.

The focal points for taking personal action are in the fields of electricity, heating, consumption and transportation, and a lot of people have welcomed the challenge of reducing their personal CO_2 emissions. By New Year 08/09 more than 75.000 Danish citizens had made a pledge on the campaign website to reduce their CO_2 emissions by one tonne the following year.

One of the unique features of the ‘One Tonne Less’ campaign is its partnerships with a range of companies, institutions, municipalities and NGOs. Through the conjoint effort in these public-private partnerships the campaign has managed to spread its message to areas that would otherwise have been hard to reach. The partnership model has been acknowledged by several external bodies – e.g. the expert panel on environmental communication of the EC.

Annexes

Annex A1 Greenhouse gas inventories 1990-2007

This Annex contains nine tables summarising the results of the latest greenhouse gas inventories for Denmark, Greenland and the Faroe Islands 1990-2007. The tables are based on the annual report under the Climate Convention and the Kyoto Protocol from April 2009 (NIR 2009, including the CRF).

TABLE A.1 (CRF TABLE 10S1): DENMARK'S EMISSIONS AND REMOVALS OF CARBON DIOXIDE (CO_2) IN THE PERIOD 1990-2007

TABLE A.2 (CRF TABLE 10S2): DENMARK'S EMISSIONS OF METHANE (CH_4) IN THE PERIOD 1990-2007

TABLE A.3 (CRF TABLE 10S3): DENMARK'S EMISSIONS OF NITROUS OXIDE (N_2O) IN THE PERIOD 1990-2007

TABLE A.4 (CRF TABLE 10S4): DENMARK'S EMISSIONS OF INDUSTRIAL GREENHOUSE GASES (HCFS, PFCS AND SF_6) IN THE PERIOD 1990-2007

TABLE A.5 (CRF TABLE 10S5): DENMARK'S TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

TABLE A.6 (CRF TABLE 10S5): GREENLAND'S TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

TABLE A.7 (CRF TABLE 10S5): FAROE ISLANDS' TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

TABLE A.8 (CRF TABLE 10S5): DENMARK'S AND GREENLAND'S TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

TABLE A.9 (CRF TABLE 10S5): DENMARK'S, GREENLAND'S AND FAROE ISLANDS' TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

Note references in the tables:

(1) The column "Base year" is filled with estimates for the base year under the Climate Convention which is 1990. This base year is used to calculate the percentage change in the final column of this table. Denmark's and Greenland's base year under the Kyoto Protocol was fixed in 2007 on the basis of the annual inventories reported in 2006 (see Chapter 3.5) and deviates from the base year under the Convention.

(2) Net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(3) Actual emissions estimates. Only in these rows are the emissions expressed as CO_2 equivalent emissions.

(4) In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions are eported for each relevant chemical. Note that the unit used for this row is Gg of CO_2 equivalent and appropriate notation keys have been entered in the cells for the individual chemicals.

(5) Includes net CO_2, CH_4 and N_2O from LULUCF.

The notation keys are as follows:
"NO" : Not Occurring,
"NE" : Not Estimated,
"NA" : Not Applicable,
"IE" : Included Elsewhere and
"C" : Confidential.

TABLE A.1 (CRF TABLE 10S1.1): DENMARK'S EMISSIONS AND REMOVALS OF CARBON DIOXIDE (CO_2) IN THE PERIOD 1990-2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**51.461,78**	**61.974,02**	**56.066,67**	**58.364,51**	**61.982,06**	**58.938,47**	**72.284,68**	**62.616,03**	**58.454,88**	**55.765,12**
A. Fuel Combustion (Sectoral Approach)	51.198,34	61.456,01	55.532,46	57.896,17	61.514,46	58.575,67	71.885,99	62.052,99	58.034,27	54.869,13
1. Energy Industries	26.173,20	35.113,22	30.082,25	31.627,29	35.351,77	31.934,16	44.320,89	35.084,13	31.276,91	28.231,12
2. Manufacturing Industries and Construction	5.423,69	5.944,19	5.768,87	5.609,13	5.768,64	5.891,36	6.080,67	6.123,52	6.153,77	6.221,75
3. Transport	10.528,09	10.904,05	11.101,68	11.224,72	11.712,26	11.852,02	12.109,30	12.302,59	12.274,57	12.270,78
4. Other Sectors	8.954,35	9.207,86	8.438,88	9.197,91	8.429,78	8.646,24	9.199,20	8.371,93	8.124,98	7.963,12
5. Other	119,01	286,69	140,79	237,13	252,01	251,89	175,92	170,83	204,03	182,35
B. Fugitive Emissions from Fuels	263,44	518,02	534,21	468,34	467,60	362,80	398,70	563,04	420,62	895,99
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	263,44	518,02	534,21	468,34	467,60	362,80	398,70	563,04	420,62	895,99
2. Industrial Processes	**1.152,16**	**1.324,26**	**1.442,94**	**1.462,16**	**1.487,33**	**1.494,80**	**1.601,06**	**1.768,30**	**1.707,84**	**1.686,07**
A. Mineral Products	1.073,21	1.246,16	1.365,58	1.382,84	1.406,08	1.406,59	1.515,54	1.685,28	1.620,24	1.599,73
B. Chemical Industry	0,80	0,80	0,80	0,80	0,80	0,80	1,45	0,87	0,56	0,58
C. Metal Production	28,45	28,45	28,45	30,97	33,50	38,56	35,19	35,01	42,19	43,04
D. Other Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	49,71	48,86	48,12	47,55	46,95	48,84	48,89	47,15	44,85	42,72
3. Solvent and Other Product Use	179,38	174,21	169,05	163,88	158,71	140,96	154,36	139,45	128,40	126,88
4. Agriculture										
A. Enteric Fermentation										
B. Manure Management										
C. Rice Cultivation										
D. Agricultural Soils										
E. Prescribed Burning of Savannas										
F. Field Burning of Agricultural Residues										
G. Other										
5. Land Use, Land-Use Change and Forestry[(2)]	**551,67**	**-1.688,16**	**-1.548,54**	**-1.157,00**	**-1.617,00**	**-1.669,23**	**-1.217,10**	**-1.179,30**	**-1.954,14**	**-1.234,83**
A. Forest Land	-2.830,67	-3.009,20	-3.000,80	-3.212,99	-3.102,55	-2.992,51	-3.069,15	-3.162,10	-3.319,98	-3.319,91
B. Cropland	3.287,48	1.228,40	1.361,37	1.969,70	1.401,93	1.232,78	1.767,65	1.909,20	1.297,25	2.015,81
C. Grassland	92,90	90,68	88,92	84,35	81,68	88,58	82,47	71,68	66,83	68,22
D. Wetlands	1,96	1,96	1,96	1,95	1,94	1,93	1,92	1,92	1,77	1,05
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**
A. Solid Waste Disposal on Land	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
B. Waste-water Handling										
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	NO	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**53.344,99**	**61.784,34**	**56.130,12**	**58.833,54**	**62.011,09**	**58.904,99**	**72.823,00**	**63.344,48**	**58.336,98**	**56.343,24**
Total CO_2 emissions excluding net CO_2 from LULUCF	**52.793,32**	**63.472,50**	**57.678,66**	**59.990,54**	**63.628,09**	**60.574,22**	**74.040,10**	**64.523,78**	**60.291,12**	**57.578,07**
Memo Items:										
International Bunkers	**4.823,30**	**4.394,45**	**4.580,16**	**5.958,34**	**6.646,69**	**6.927,68**	**6.773,80**	**6.413,77**	**6.573,23**	**6.445,41**
Aviation	1.736,10	1.632,12	1.693,19	1.658,84	1.817,70	1.867,05	1.971,08	2.010,44	2.158,98	2.290,07
Marine	3.087,20	2.762,33	2.886,97	4.299,50	4.828,99	5.060,63	4.802,71	4.403,33	4.414,25	4.155,35
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	4.640,89	5.032,95	5.321,34	5.574,45	5.533,46	5.868,80	6.295,78	6.542,43	6.491,97	6.857,21

TABLE A.1 (CRF TABLE 10S1.2): DENMARK'S EMISSIONS AND REMOVALS OF CARBON DIOXIDE (CO_2) IN THE PERIOD 1990-2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**51.090,60**	**52.839,50**	**52.442,48**	**57.755,88**	**52.091,08**	**48.524,96**	**56.327,40**	**51.493,70**	**0,06**
A. Fuel Combustion (Sectoral Approach)	50.498,05	52.208,25	51.909,62	57.207,93	51.484,65	48.085,02	55.902,59	51.127,06	-0,14
1. Energy Industries	24.957,79	26.414,87	26.584,35	31.401,90	25.406,03	22.139,63	29.868,70	25.132,33	-3,98
2. Manufacturing Industries and Construction	6.004,64	6.071,16	5.788,10	5.751,44	5.797,52	5.576,12	5.755,87	5.686,05	4,84
3. Transport	12.060,59	12.057,17	12.159,22	12.621,38	12.932,62	13.050,23	13.417,89	13.985,63	32,84
4. Other Sectors	7.364,49	7.568,17	7.289,17	7.341,22	7.109,46	7.048,25	6.733,67	6.148,19	-31,34
5. Other	110,53	96,87	88,78	91,98	239,02	270,80	126,46	174,87	46,93
B. Fugitive Emissions from Fuels	592,55	631,24	532,86	547,95	606,43	439,95	424,81	366,64	39,18
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Oil and Natural Gas	592,55	631,24	532,86	547,95	606,43	439,95	424,81	366,64	39,18
2. Industrial Processes	**1.701,26**	**1.702,65**	**1.700,75**	**1.569,31**	**1.688,48**	**1.604,34**	**1.649,24**	**1.647,03**	**42,95**
A. Mineral Products	1.620,19	1.616,66	1.660,33	1.531,22	1.647,74	1.548,17	1.609,57	1.606,93	49,73
B. Chemical Industry	0,65	0,83	0,55	1,05	3,01	3,01	2,18	2,16	169,63
C. Metal Production	40,73	46,68	NA,NO	NA,NO	NA,NO	15,58	NA,NO	NA,NO	-100,00
D. Other Production	NE	NE	NE	NE	NE	NE	NE	NE	0,00
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	39,70	38,49	39,86	37,03	37,73	37,59	37,49	37,94	-23,67
3. Solvent and Other Product Use	126,61	112,54	115,01	103,70	99,17	99,35	92,05	87,08	-51,46
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. Land Use, Land-Use Change and Forestry[(2)]	**1.630,64**	**-769,20**	**-1.978,74**	**-2.290,28**	**-824,36**	**161,14**	**-874,87**	**-1.127,13**	**-304,31**
A. Forest Land	-664,25	-3.551,13	-3.827,01	-3.547,21	-3.465,22	-1.796,67	-2.783,33	-2.977,03	5,17
B. Cropland	2.227,07	2.712,61	1.779,33	1.190,96	2.579,57	1.888,30	1.840,86	1.779,20	-45,88
C. Grassland	71,10	74,29	75,93	75,97	73,79	82,52	80,99	84,09	-9,49
D. Wetlands	-3,28	-4,97	-6,99	-10,00	-12,50	-13,01	-13,39	-13,39	-784,62
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	0,00
6. Waste	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**0,00**
A. Solid Waste Disposal on Land	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0,00
B. Waste-water Handling									
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	NA	NA	NA	NA	NA	NA	NO	NO	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CO_2 emissions including net CO_2 from LULUCF	**54.549,11**	**53.885,48**	**52.279,50**	**57.138,60**	**53.054,37**	**50.389,81**	**57.193,81**	**52.100,67**	**-2,33**
Total CO_2 emissions excluding net CO_2 from LULUCF	**52.918,47**	**54.654,68**	**54.258,24**	**59.428,88**	**53.878,73**	**50.228,66**	**58.068,68**	**53.227,80**	**0,82**
Memo Items:									
International Bunkers	**6.629,22**	**5.989,77**	**5.024,93**	**5.272,10**	**4.993,36**	**5.211,34**	**6.015,95**	**6.260,43**	**29,80**
Aviation	2.349,78	2.384,94	2.059,41	2.142,08	2.448,86	2.575,38	2.583,30	2.701,41	55,60
Marine	4.279,45	3.604,83	2.965,52	3.130,03	2.544,50	2.635,96	3.432,65	3.559,02	15,28
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass	7.169,29	7.902,41	8.429,61	9.452,90	10.142,31	10.888,72	11.330,51	12.106,13	160,86

TABLE A.2 (CRF TABLE 10S2.1): DENMARK'S EMISSIONS OF METHANE (CH_4) IN THE PERIOD 1990-2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	10,69	11,92	12,39	14,74	18,05	24,28	28,90	28,97	30,35	30,64
A. Fuel Combustion (Sectoral Approach)	8,80	9,64	10,22	12,35	15,50	21,34	26,07	25,85	27,23	27,07
1. Energy Industries	1,11	1,54	1,86	3,46	6,53	11,84	15,41	14,92	16,16	16,09
2. Manufacturing Industries and Construction	0,71	0,74	0,72	0,73	0,74	0,84	1,28	1,28	1,37	1,37
3. Transport	2,67	2,71	2,68	2,65	2,56	2,42	2,32	2,23	2,14	2,03
4. Other Sectors	4,31	4,63	4,96	5,50	5,67	6,21	7,05	7,40	7,55	7,57
5. Other	0,01	0,02	0,01	0,01	0,01	0,02	0,01	0,01	0,01	0,01
B. Fugitive Emissions from Fuels	1,89	2,28	2,17	2,39	2,55	2,94	2,83	3,12	3,12	3,56
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	1,89	2,28	2,17	2,39	2,55	2,94	2,83	3,12	3,12	3,56
2. Industrial Processes	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**
A. Mineral Products	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA
B. Chemical Industry	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C. Metal Production	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
3. Solvent and Other Product Use										
4. Agriculture	**190,96**	**192,95**	**193,39**	**197,73**	**191,32**	**190,50**	**190,59**	**186,01**	**187,64**	**181,06**
A. Enteric Fermentation	155,19	155,33	153,12	154,92	149,91	149,20	148,63	143,40	143,24	137,29
B. Manure Management	35,77	37,62	40,26	42,81	41,41	41,31	41,96	42,60	44,41	43,77
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,02**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Grassland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Wetlands	-0,03	-0,03	-0,03	-0,03	-0,03	-0,03	-0,03	-0,03	-0,03	-0,02
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**69,56**	**70,56**	**70,98**	**71,93**	**71,29**	**70,39**	**71,12**	**70,44**	**68,67**	**69,12**
A. Solid Waste Disposal on Land	63,58	64,72	65,20	65,86	64,05	61,96	61,50	58,63	56,64	57,84
B. Waste-water Handling	5,98	5,84	5,78	6,07	7,24	8,43	9,62	11,81	12,03	11,28
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	NO	0,00	0,00	0,00	0,00	0,00	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**271,19**	**275,40**	**276,73**	**284,38**	**280,63**	**285,14**	**290,58**	**285,38**	**286,64**	**280,80**
Total CH_4 emissions excluding CH_4 from LULUCF	**271,21**	**275,43**	**276,76**	**284,41**	**280,66**	**285,17**	**290,61**	**285,41**	**286,66**	**280,82**
Memo Items:										
International Bunkers	0,10	0,09	0,09	0,12	0,14	0,15	0,14	0,13	0,14	0,13
Aviation	0,03	0,03	0,03	0,03	0,03	0,04	0,04	0,04	0,04	0,04
Marine	0,07	0,06	0,06	0,09	0,10	0,11	0,11	0,10	0,10	0,09
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

TABLE A.2 (CRF TABLE 10S2.2): DENMARK'S EMISSIONS OF METHANE (CH_4) IN THE PERIOD 1990-2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	30,45	32,10	32,16	32,40	32,30	30,49	30,11	28,32	164,94
A. Fuel Combustion (Sectoral Approach)	26,64	28,28	28,22	28,38	27,47	25,68	23,95	22,21	152,30
1. Energy Industries	15,28	16,55	16,48	16,17	15,18	13,20	11,42	9,18	724,90
2. Manufacturing Industries and Construction	1,57	1,64	1,50	1,50	1,49	1,29	1,17	0,97	37,36
3. Transport	1,91	1,78	1,68	1,62	1,53	1,42	1,32	1,23	-53,88
4. Other Sectors	7,88	8,31	8,56	9,09	9,26	9,75	10,03	10,82	151,07
5. Other	0,01	0,01	0,00	0,01	0,01	0,01	0,01	0,01	44,86
B. Fugitive Emissions from Fuels	3,81	3,82	3,94	4,02	4,84	4,81	6,16	6,11	223,95
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Oil and Natural Gas	3,81	3,82	3,94	4,02	4,84	4,81	6,16	6,11	223,95
2. Industrial Processes	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**0,00**
A. Mineral Products	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	0,00
B. Chemical Industry	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C. Metal Production	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
3. Solvent and Other Product Use									
4. Agriculture	**181,81**	**186,11**	**183,50**	**181,76**	**178,52**	**176,19**	**174,44**	**182,60**	**-4,38**
A. Enteric Fermentation	136,37	138,94	135,59	133,53	129,05	127,37	124,81	132,69	-14,50
B. Manure Management	45,44	47,16	47,91	48,23	49,47	48,81	49,63	49,90	39,50
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	0,00
D. Agricultural Soils	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	0,00
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	0,00
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
5. Land Use, Land-Use Change and Forestry	**-0,02**	**-0,02**	**-0,02**	**-0,02**	**-0,02**	**-0,02**	**-0,02**	**-0,02**	**-17,33**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	0,00
B. Cropland	NA	NA	NA	NA	NA	NA	NA	NA	0,00
C. Grassland	NA	NA	NA	NA	NA	NA	NA	NA	0,00
D. Wetlands	-0,02	-0,02	-0,02	-0,02	-0,02	-0,02	-0,02	-0,02	-17,33
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	0,00
6. Waste	**68,22**	**68,59**	**69,77**	**70,38**	**64,69**	**63,73**	**63,31**	**62,80**	**-9,72**
A. Solid Waste Disposal on Land	57,87	57,57	54,99	56,08	51,60	51,27	51,49	50,62	-20,38
B. Waste-water Handling	10,34	11,02	14,78	14,30	13,08	12,45	11,82	12,18	103,62
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	0,00	0,00	0,00	0,00	0,00	0,00	NO	NO	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CH_4 emissions including CH_4 from LULUCF	**280,45**	**286,78**	**285,41**	**284,52**	**275,49**	**270,38**	**267,84**	**273,70**	**0,93**
Total CH_4 emissions excluding CH_4 from LULUCF	**280,47**	**286,80**	**285,43**	**284,54**	**275,52**	**270,40**	**267,86**	**273,72**	**0,92**
Memo Items:									
International Bunkers	0,14	0,12	0,11	0,11	0,11	0,11	0,13	0,14	45,21
Aviation	0,04	0,04	0,04	0,04	0,05	0,05	0,05	0,05	75,53
Marine	0,10	0,08	0,07	0,07	0,06	0,06	0,08	0,09	30,76
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass									

TABLE A.3 (CRF TABLE 10S3.1): DENMARK'S EMISSIONS OF NITROUS OXIDE (N_2O) IN THE PERIOD 1990-2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**1,28**	**1,42**	**1,37**	**1,42**	**1,47**	**1,49**	**1,69**	**1,60**	**1,54**	**1,53**
A. Fuel Combustion (Sectoral Approach)	1,28	1,41	1,36	1,41	1,46	1,49	1,69	1,59	1,53	1,51
1. Energy Industries	0,38	0,47	0,43	0,45	0,49	0,50	0,65	0,57	0,53	0,52
2. Manufacturing Industries and Construction	0,18	0,19	0,18	0,18	0,18	0,18	0,19	0,19	0,19	0,19
3. Transport	0,37	0,40	0,41	0,43	0,46	0,48	0,50	0,51	0,50	0,50
4. Other Sectors	0,34	0,35	0,33	0,35	0,32	0,33	0,34	0,32	0,30	0,30
5. Other	0,00	0,01	0,00	0,01	0,01	0,01	0,01	0,00	0,01	0,01
B. Fugitive Emissions from Fuels	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02
2. Industrial Processes	**3,36**	**3,08**	**2,72**	**2,56**	**2,60**	**2,92**	**2,69**	**2,74**	**2,60**	**3,07**
A. Mineral Products	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA
B. Chemical Industry	3,36	3,08	2,72	2,56	2,60	2,92	2,69	2,74	2,60	3,07
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
3. Solvent and Other Product Use	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
4. Agriculture	**29,03**	**28,51**	**27,56**	**26,84**	**26,16**	**25,50**	**24,41**	**24,17**	**24,08**	**22,63**
A. Enteric Fermentation										
B. Manure Management	2,21	2,20	2,21	2,20	2,14	2,07	2,07	2,07	2,10	2,03
C. Rice Cultivation										
D. Agricultural Soils	26,82	26,32	25,35	24,64	24,02	23,43	22,34	22,09	21,97	20,60
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Grassland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Wetlands	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**0,28**	**0,27**	**0,24**	**0,29**	**0,30**	**0,27**	**0,22**	**0,21**	**0,21**	**0,20**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0,28	0,27	0,24	0,29	0,30	0,27	0,22	0,21	0,21	0,20
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	NO	0,00	0,00	0,00	0,00	0,00	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**33,96**	**33,28**	**31,89**	**31,11**	**30,53**	**30,19**	**29,02**	**28,71**	**28,43**	**27,42**
Total N_2O emissions excluding N_2O from LULUCF	**33,96**	**33,28**	**31,89**	**31,11**	**30,53**	**30,19**	**29,02**	**28,71**	**28,43**	**27,42**
Memo Items:										
International Bunkers	**0,25**	**0,23**	**0,24**	**0,33**	**0,37**	**0,38**	**0,37**	**0,35**	**0,35**	**0,34**
Aviation	0,06	0,06	0,06	0,06	0,06	0,06	0,07	0,07	0,08	0,08
Marine	0,19	0,17	0,18	0,27	0,30	0,32	0,30	0,28	0,28	0,26
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

TABLE A.3 (CRF TABLE 10S3.2): DENMARK'S EMISSIONS OF NITROUS OXIDE (N_2O) IN THE PERIOD 1990-2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**1,47**	**1,49**	**1,48**	**1,53**	**1,48**	**1,44**	**1,52**	**1,48**	**15,33**
A. Fuel Combustion (Sectoral Approach)	1,46	1,48	1,48	1,52	1,47	1,43	1,51	1,47	15,49
1. Energy Industries	0,48	0,51	0,52	0,55	0,50	0,46	0,54	0,48	26,13
2. Manufacturing Industries and Construction	0,19	0,19	0,18	0,18	0,19	0,18	0,19	0,19	8,29
3. Transport	0,48	0,47	0,46	0,46	0,46	0,45	0,44	0,45	19,83
4. Other Sectors	0,30	0,31	0,31	0,32	0,31	0,33	0,34	0,35	1,99
5. Other	0,00	0,00	0,00	0,00	0,01	0,01	0,00	0,01	53,16
B. Fugitive Emissions from Fuels	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,00	-28,44
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Oil and Natural Gas	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,00	-28,44
2. Industrial Processes	**3,24**	**2,86**	**2,50**	**2,89**	**1,71**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**-100,00**
A. Mineral Products	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	0,00
B. Chemical Industry	3,24	2,86	2,50	2,89	1,71	NA,NO	NA,NO	NA,NO	-100,00
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	0,00
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
3. Solvent and Other Product Use	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,05	0,12	0,12	100,00
4. Agriculture	**21,82**	**21,33**	**20,58**	**19,82**	**20,18**	**20,09**	**19,11**	**20,12**	**-30,69**
A. Enteric Fermentation									
B. Manure Management	1,94	1,94	1,90	1,83	1,86	1,85	1,73	1,89	-14,41
C. Rice Cultivation									
D. Agricultural Soils	19,88	19,38	18,68	18,00	18,31	18,25	17,37	18,23	-32,03
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	0,00
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
5. Land Use, Land-Use Change and Forestry	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**-17,33**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	0,00
B. Cropland	NA	NA	NA	NA	NA	NA	NA	NA	0,00
C. Grassland	NA	NA	NA	NA	NA	NA	NA	NA	0,00
D. Wetlands	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-17,33
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	0,00
6. Waste	**0,21**	**0,18**	**0,19**	**0,16**	**0,17**	**0,16**	**0,16**	**0,15**	**-45,90**
A. Solid Waste Disposal on Land									
B. Waste-water Handling	0,21	0,18	0,19	0,16	0,17	0,16	0,16	0,15	-45,90
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	0,00	0,00	0,00	0,00	0,00	0,00	NO	NO	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total N_2O emissions including N_2O from LULUCF	**26,74**	**25,86**	**24,75**	**24,40**	**23,54**	**21,74**	**20,91**	**21,87**	**-35,59**
Total N_2O emissions excluding N_2O from LULUCF	**26,74**	**25,86**	**24,75**	**24,40**	**23,54**	**21,74**	**20,91**	**21,87**	**-35,59**
Memo Items:									
International Bunkers	**0,35**	**0,31**	**0,26**	**0,27**	**0,25**	**0,25**	**0,30**	**0,32**	**24,92**
Aviation	0,08	0,08	0,07	0,07	0,08	0,09	0,09	0,09	56,80
Marine	0,27	0,23	0,19	0,20	0,16	0,17	0,22	0,22	15,23
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass									

TABLE A.4 (CRF TABLE 10S4.1): DENMARK'S EMISSIONS OF INDUSTRIAL GREENHOUSE GASES (HFCS, PFCS AND SF_6) IN THE PERIOD 1990-2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Emissions of HFCs(3) - (Gg CO2 equivalent)	**NA,NE,NO**	**NA,NE,NO**	**3,44**	**93,93**	**134,53**	**217,73**	**329,30**	**323,75**	**411,19**	**502,98**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-32	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00	0,00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-125	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,00	0,00	0,01	0,02	0,02	0,03
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	NA,NE,NO	NA,NE,NO	0,00	0,07	0,10	0,15	0,20	0,17	0,21	0,23
HFC-152a	NA,NE,NO	NA,NE,NO	0,00	0,03	0,05	0,04	0,03	0,02	0,01	0,04
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,00	0,00	0,01	0,01	0,02	0,03
HFC-227ea	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed HFCs(4) - (Gg CO2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of PFCs(3) - (Gg CO2 equivalent)	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NO**	**0,05**	**0,50**	**1,66**	**4,12**	**9,10**	**12,48**
CF4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C2F6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C 3F8	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,00	0,00	0,00	0,00	0,00	0,00
C4F10	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
c-C4F8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C5F12	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C6F14	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs(4) - (Gg CO2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of SF6(3) - (Gg CO2 equivalent)	**44,45**	**63,50**	**89,15**	**101,17**	**122,06**	**107,34**	**60,96**	**73,06**	**59,42**	**65,36**
SF6	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00

TABLE A.4 (CRF TABLE 10S4.2): DENMARK'S EMISSIONS OF INDUSTRIAL GREENHOUSE GASES (HFCS, PFCS AND SF_6) IN THE PERIOD 1990-2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
Emissions of HFCs(3) - (Gg CO2 equivalent)	**604,64**	**647,32**	**672,06**	**695,48**	**748,96**	**795,00**	**814,90**	**840,00**	**100,00**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	100,00
HFC-32	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02	100,00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-125	0,04	0,05	0,05	0,05	0,06	0,07	0,07	0,07	100,00
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-134a	0,25	0,27	0,28	0,27	0,29	0,28	0,28	0,29	100,00
HFC-152a	0,02	0,01	0,01	0,00	0,01	0,00	0,00	0,00	100,00
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-143a	0,04	0,04	0,04	0,05	0,05	0,06	0,06	0,07	100,00
HFC-227ea	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Unspecified mix of listed HFCs(4) - (Gg CO2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Emissions of PFCs(3) - (Gg CO2 equivalent)	**17,89**	**22,13**	**22,17**	**19,34**	**15,90**	**13,90**	**15,68**	**15,36**	**100,00**
CF4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	100,00
C2F6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C 3F8	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
C4F10	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
c-C4F8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	100,00
C5F12	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C6F14	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Unspecified mix of listed PFCs(4) - (Gg CO2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Emissions of SF6(3) - (Gg CO2 equivalent)	**59,23**	**30,40**	**25,01**	**31,37**	**33,15**	**21,75**	**35,99**	**30,35**	**-31,73**
SF6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-31,73

TABLE A.5 (CRF TABLE 10S5.1): DENMARK'S TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)
CO2 emissions including net CO2 from LULUCF	53.344,99	61.784,34	56.130,12	58.833,54	62.011,09	58.904,99	72.823,00	63.344,48	58.336,98	56.343,24
CO2 emissions excluding net CO2 from LULUCF	52.793,32	63.472,50	57.678,66	59.990,54	63.628,09	60.574,22	74.040,10	64.523,78	60.291,12	57.578,07
CH4 emissions including CH4 from LULUCF	5.694,90	5.783,35	5.811,29	5.971,96	5.893,28	5.987,98	6.102,18	5.993,07	6.019,34	5.896,77
CH4 emissions excluding CH4 from LULUCF	5.695,50	5.783,95	5.811,89	5.972,56	5.893,87	5.988,57	6.102,77	5.993,66	6.019,92	5.897,26
N2O emissions including N2O from LULUCF	10.526,74	10.317,68	9.885,27	9.645,01	9.464,50	9.357,96	8.995,80	8.901,39	8.814,01	8.501,43
N2O emissions excluding N2O from LULUCF	10.526,65	10.317,59	9.885,18	9.644,92	9.464,42	9.357,87	8.995,71	8.901,30	8.813,92	8.501,35
HFCs	NA,NE,NO	NA,NE,NO	3,44	93,93	134,53	217,73	329,30	323,75	411,19	502,98
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,05	0,50	1,66	4,12	9,10	12,48
SF6	44,45	63,50	89,15	101,17	122,06	107,34	60,96	73,06	59,42	65,36
Total (including LULUCF)	**69.611,08**	**77.948,87**	**71.919,27**	**74.645,62**	**77.625,51**	**74.576,50**	**88.312,90**	**78.639,87**	**73.650,04**	**71.322,26**
Total (excluding LULUCF)	**69.059,92**	**79.637,55**	**73.468,32**	**75.803,12**	**79.243,02**	**76.246,23**	**89.530,50**	**79.819,67**	**75.604,67**	**72.557,51**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)
1. Energy	52.083,08	62.665,17	56.751,96	59.112,72	62.817,24	59.911,52	73.416,08	63.720,27	59.569,88	56.882,58
2. Industrial Processes	2.239,52	2.342,60	2.379,12	2.452,18	2.550,48	2.724,21	2.827,30	3.017,46	2.994,05	3.217,09
3. Solvent and Other Product Use	179,38	174,21	169,05	163,88	158,71	140,96	154,36	139,45	128,40	126,88
4. Agriculture	13.009,54	12.890,40	12.604,32	12.472,86	12.127,21	11.906,20	11.569,83	11.398,07	11.404,27	10.817,40
5. Land Use, Land-Use Change and Forestry(5)	551,16	-1.688,67	-1.549,05	-1.157,50	-1.617,51	-1.669,73	-1.217,60	-1.179,80	-1.954,63	-1.235,25
6. Waste	1.548,40	1.565,16	1.563,87	1.601,49	1.589,39	1.563,34	1.562,94	1.544,43	1.508,06	1.513,56
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)(5)	**69.611,08**	**77.948,87**	**71.919,27**	**74.645,62**	**77.625,51**	**74.576,50**	**88.312,90**	**78.639,87**	**73.650,04**	**71.322,26**

TABLE A.5 (CRF TABLE 10S5.2): DENMARK'S TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	(%)
CO2 emissions including net CO2 from LULUCF	54.549,11	53.885,48	52.279,50	57.138,60	53.054,37	50.389,81	57.193,81	52.100,67	-2,33
CO2 emissions excluding net CO2 from LULUCF	52.918,47	54.654,68	54.258,24	59.428,88	53.878,73	50.228,66	58.068,68	53.227,80	0,82
CH4 emissions including CH4 from LULUCF	5.889,37	6.022,32	5.993,60	5.974,84	5.785,34	5.677,96	5.624,65	5.747,60	0,93
CH4 emissions excluding CH4 from LULUCF	5.889,87	6.022,82	5.994,09	5.975,33	5.785,84	5.678,45	5.625,14	5.748,09	0,92
N2O emissions including N2O from LULUCF	8.288,16	8.017,00	7.672,99	7.562,69	7.296,49	6.739,35	6.482,33	6.779,85	-35,59
N2O emissions excluding N2O from LULUCF	8.288,08	8.016,93	7.672,91	7.562,62	7.296,42	6.739,27	6.482,26	6.779,78	-35,59
HFCs	604,64	647,32	672,06	695,48	748,96	795,00	814,90	840,00	100,00
PFCs	17,89	22,13	22,17	19,34	15,90	13,90	15,68	15,36	100,00
SF6	59,23	30,40	25,01	31,37	33,15	21,75	35,99	30,35	-31,73
Total (including LULUCF)	**69.408,40**	**68.624,65**	**66.665,32**	**71.422,32**	**66.934,20**	**63.637,77**	**70.167,37**	**65.513,83**	**-5,89**
Total (excluding LULUCF)	**67.778,17**	**69.394,27**	**68.644,48**	**73.713,03**	**67.758,98**	**63.477,05**	**71.042,66**	**66.641,38**	**-3,50**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	(%)
1. Energy	52.185,53	53.977,00	53.578,15	58.909,32	53.227,57	49.610,69	57.431,46	52.546,08	0,89
2. Industrial Processes	3.386,52	3.287,80	3.194,05	3.210,16	3.017,20	2.435,00	2.515,81	2.532,74	13,09
3. Solvent and Other Product Use	126,61	112,54	115,01	103,70	99,17	113,39	129,94	124,00	-30,88
4. Agriculture	10.581,54	10.519,17	10.233,91	9.962,00	10.003,39	9.929,16	9.585,98	10.072,34	-22,58
5. Land Use, Land-Use Change and Forestry(5)	1.630,22	-769,62	-1.979,16	-2.290,70	-824,78	160,72	-875,29	-1.127,55	-304,58
6. Waste	1.497,97	1.497,77	1.523,35	1.527,84	1.411,65	1.388,81	1.379,47	1.366,23	-11,77
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
Total (including LULUCF)(5)	**69.408,40**	**68.624,65**	**66.665,32**	**71.422,32**	**66.934,20**	**63.637,77**	**70.167,37**	**65.513,83**	**-5,89**

TABLE A.6 (CRF TABLE 10S5.1): GREENLAND'S TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)
CO2 emissions including net CO2 from LULUCF	625,18	610,44	596,13	545,86	495,66	533,47	596,23	616,93	578,83	593,04
CO2 emissions excluding net CO2 from LULUCF	625,18	610,44	596,13	545,86	495,66	533,47	596,23	616,93	578,83	593,04
CH4 emissions including CH4 from LULUCF	17,62	17,81	16,92	16,02	16,71	17,45	17,69	18,59	17,48	16,33
CH4 emissions excluding CH4 from LULUCF	17,62	17,81	16,92	16,02	16,71	17,45	17,69	18,59	17,48	16,33
N2O emissions including N2O from LULUCF	8,61	8,54	8,06	7,35	7,27	7,86	8,19	8,79	8,07	8,31
N2O emissions excluding N2O from LULUCF	8,61	8,54	8,06	7,35	7,27	7,86	8,19	8,79	8,07	8,31
HFCs	NA,NE,NO	NA,NE,NO	0,00	0,00	0,00	0,02	0,08	0,39	0,71	1,26
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,00	0,00	0,00	0,00	0,00	0,00
SF6	0,00	0,00	0,00	0,00	0,00	0,04	0,00	0,00	0,00	0,00
Total (including LULUCF)	**651,41**	**636,79**	**621,11**	**569,23**	**519,63**	**558,84**	**622,20**	**644,69**	**605,09**	**618,95**
Total (excluding LULUCF)	**651,41**	**636,79**	**621,11**	**569,23**	**519,63**	**558,84**	**622,20**	**644,69**	**605,09**	**618,95**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)
1. Energy	627,42	612,50	598,06	547,37	496,73	534,86	597,85	618,66	580,09	594,81
2. Industrial Processes	0,00	0,00	0,00	0,00	0,00	0,06	0,08	0,39	0,71	1,27
3. Solvent and Other Product Use	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
4. Agriculture	12,38	12,49	11,18	9,92	10,84	11,71	12,09	13,43	12,38	11,79
5. Land Use, Land-Use Change and Forestry(5)	0,11	0,12	0,12	0,12	0,12	0,13	0,13	0,14	0,14	0,14
6. Waste	11,50	11,68	11,75	11,82	11,94	12,08	12,05	12,08	11,78	10,93
7. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total (including LULUCF)(5)	**651,41**	**636,79**	**621,11**	**569,23**	**519,63**	**558,84**	**622,20**	**644,69**	**605,09**	**618,95**

TABLE A.6 (CRF TABLE 10S5.2): GREENLAND'S TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

GREENHOUSE GAS EMISSIONS	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Change from base to latest reported year**
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	**(%)**
CO2 emissions including net CO2 from LULUCF	665,73	616,35	577,57	647,34	634,78	633,62	657,01	649,15	3,83
CO2 emissions excluding net CO2 from LULUCF	665,73	616,35	577,57	647,34	634,78	633,62	657,01	649,15	3,83
CH4 emissions including CH4 from LULUCF	15,07	15,13	14,41	14,96	15,01	15,35	15,19	15,37	-12,74
CH4 emissions excluding CH4 from LULUCF	15,07	15,13	14,41	14,96	15,01	15,35	15,19	15,37	-12,74
N2O emissions including N2O from LULUCF	8,45	8,21	7,84	8,28	8,49	8,63	8,77	8,77	1,94
N2O emissions excluding N2O from LULUCF	8,45	8,21	7,84	8,28	8,49	8,63	8,77	8,77	1,94
HFCs	1,85	2,93	3,85	4,69	5,36	5,44	5,50	6,01	-
PFCs	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-
SF6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-
Total (including LULUCF)	**691,11**	**642,62**	**603,68**	**675,27**	**663,65**	**663,04**	**686,49**	**679,31**	**4,28**
Total (excluding LULUCF)	**691,11**	**642,62**	**603,68**	**675,27**	**663,65**	**663,04**	**686,49**	**679,31**	**4,28**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Change from base to latest reported year**
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	(%)
1. Energy	668,25	618,43	579,52	649,63	637,18	636,01	659,62	651,68	3,87
2. Industrial Processes	1,85	2,93	3,86	4,70	5,36	5,44	5,51	6,02	-
3. Solvent and Other Product Use	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-
4. Agriculture	11,46	11,58	11,00	11,16	11,76	12,25	12,01	12,26	-0,92
5. Land Use, Land-Use Change and Forestry(5)	0,15	0,24	0,26	0,26	0,26	0,26	0,27	0,27	137,12
6. Waste	9,39	9,44	9,05	9,53	9,09	9,09	9,09	9,09	-20,98
7. Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-
Total (including LULUCF)(5)	**691,11**	**642,62**	**603,68**	**675,27**	**663,65**	**663,04**	**686,49**	**679,31**	**4,28**

TABLE A.7 (CRF TABLE 10S5.1): FAROE ISLANDS' TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)
CO2 emissions including net CO2 from LULUCF	660,86	641,90	631,12	520,81	525,56	530,48	549,56	544,36	586,44	615,37
CO2 emissions excluding net CO2 from LULUCF	660,86	641,90	631,12	520,81	525,56	530,48	549,56	544,36	586,44	615,37
CH4 emissions including CH4 from LULUCF	17,83	17,11	17,27	17,31	18,18	18,19	18,07	18,05	17,89	17,97
CH4 emissions excluding CH4 from LULUCF	17,83	17,11	17,27	17,31	18,18	18,19	18,07	18,05	17,89	17,97
N2O emissions including N2O from LULUCF	23,60	23,05	23,30	21,66	22,01	22,23	22,35	22,37	22,83	23,18
N2O emissions excluding N2O from LULUCF	23,60	23,05	23,30	21,66	22,01	22,23	22,35	22,37	22,83	23,18
HFCs	NA,NE,NO	NA,NE,NO	0,00	0,00	0,02	0,02	0,06	0,66	1,22	3,29
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,00	0,00	0,00	0,00	0,00	0,00
SF6	0,00	0,00	0,12	0,13	0,14	0,15	0,16	0,18	0,19	0,09
Total (including LULUCF)	**702,28**	**682,05**	**671,81**	**559,91**	**565,91**	**571,08**	**590,19**	**585,62**	**628,57**	**659,90**
Total (excluding LULUCF)	**702,28**	**682,05**	**671,81**	**559,91**	**565,91**	**571,08**	**590,19**	**585,62**	**628,57**	**659,90**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)
1. Energy	665,87	646,51	635,87	524,13	529,14	534,20	553,12	547,29	588,82	617,68
2. Industrial Processes	NE, NA, NO	NE, NA, NO	0,12	0,13	0,16	0,18	0,22	0,83	1,41	3,38
3. Solvent and Other Product Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
4. Agriculture	32,04	31,16	31,36	31,51	32,61	32,62	32,45	32,44	32,22	32,28
5. Land Use, Land-Use Change and Forestry(5)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	4,38	4,38	4,46	4,14	4,00	4,08	4,40	5,05	6,12	6,57
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)(5)	**702,28**	**682,05**	**671,81**	**559,91**	**565,91**	**571,08**	**590,19**	**585,62**	**628,57**	**659,90**

TABLE A.7 (CRF TABLE 10S5.2): FAROE ISLANDS' TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

GREENHOUSE GAS EMISSIONS	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Change from base to latest reported year**
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	**(%)**
CO2 emissions including net CO2 from LULUCF	651,75	741,95	713,63	729,92	729,14	708,85	716,64	717,20	8,53
CO2 emissions excluding net CO2 from LULUCF	651,75	741,95	713,63	729,92	729,14	708,85	716,64	717,20	8,53
CH4 emissions including CH4 from LULUCF	18,15	18,40	18,39	18,37	18,23	17,89	17,69	17,72	-0,58
CH4 emissions excluding CH4 from LULUCF	18,15	18,40	18,39	18,37	18,23	17,89	17,69	17,72	-0,58
N2O emissions including N2O from LULUCF	23,62	24,54	24,52	24,59	24,63	24,30	24,31	24,34	3,14
N2O emissions excluding N2O from LULUCF	23,62	24,54	24,52	24,59	24,63	24,30	24,31	24,34	3,14
HFCs	4,35	6,93	8,69	10,20	11,39	11,19	11,65	12,00	-
PFCs	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-
SF6	0,08	0,08	0,09	0,08	0,19	0,15	0,14	0,13	-
Total (including LULUCF)	**697,94**	**791,90**	**765,32**	**783,16**	**783,58**	**762,38**	**770,44**	**771,40**	**9,84**
Total (excluding LULUCF)	**697,94**	**791,90**	**765,32**	**783,16**	**783,58**	**762,38**	**770,44**	**771,40**	**9,84**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Change from base to latest reported year**
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	**(%)**
1. Energy	654,35	745,35	716,82	733,73	733,41	712,97	720,82	720,43	8,19
2. Industrial Processes	4,42	7,00	8,78	10,28	11,58	11,34	11,79	12,13	-
3. Solvent and Other Product Use	NE	NE	NE	NE	NE	NE	NE	NE	-
4. Agriculture	32,45	32,64	32,68	32,66	32,53	32,14	31,90	31,96	-0,24
5. Land Use, Land-Use Change and Forestry(5)	NE	NE	NE	NE	NE	NE	NE	NE	-
6. Waste	6,71	6,91	7,04	6,49	6,07	5,93	5,92	6,88	57,10
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	-
Total (including LULUCF)(5)	**697,94**	**791,90**	**765,32**	**783,16**	**783,58**	**762,38**	**770,44**	**771,40**	**9,84**

TABLE A.8 (CRF TABLE 10S5.1): DENMARK'S AND GREENLAND'S TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)
CO2 emissions including net CO2 from LULUCF	53.970,18	62.394,78	56.726,25	59.379,41	62.506,75	59.438,47	73.419,23	63.961,40	58.915,81	56.936,28
CO2 emissions excluding net CO2 from LULUCF	53.418,51	64.082,94	58.274,79	60.536,40	64.123,75	61.107,69	74.636,33	65.140,70	60.869,95	58.171,10
CH4 emissions including CH4 from LULUCF	5.712,51	5.801,16	5.828,21	5.987,98	5.909,98	6.005,44	6.119,87	6.011,66	6.036,82	5.913,10
CH4 emissions excluding CH4 from LULUCF	5.713,11	5.801,76	5.828,81	5.988,58	5.910,57	6.006,02	6.120,46	6.012,25	6.037,40	5.913,60
N2O emissions including N2O from LULUCF	10.535,34	10.326,22	9.893,33	9.652,36	9.471,78	9.365,82	9.003,99	8.910,18	8.822,09	8.509,74
N2O emissions excluding N2O from LULUCF	10.535,25	10.326,13	9.893,24	9.652,27	9.471,69	9.365,73	9.003,90	8.910,09	8.822,00	8.509,66
HFCs	NA,NE,NO	NA,NE,NO	3,44	93,93	134,53	217,75	329,38	324,14	411,89	504,25
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,05	0,50	1,66	4,12	9,10	12,48
SF6	44,45	63,50	89,15	101,17	122,06	107,37	60,96	73,07	59,42	65,36
Total (including LULUCF)	**70.262,49**	**78.585,66**	**72.540,38**	**75.214,85**	**78.145,15**	**75.135,35**	**88.935,10**	**79.284,57**	**74.255,13**	**71.941,21**
Total (excluding LULUCF)	**69.711,33**	**80.274,33**	**74.089,43**	**76.372,36**	**79.762,65**	**76.805,07**	**90.152,70**	**80.464,37**	**76.209,76**	**73.176,45**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)
1. Energy	52.083,08	62.665,17	56.751,96	59.112,72	62.817,24	59.911,52	73.416,08	63.720,27	59.569,88	56.882,58
2. Industrial Processes	2.239,52	2.342,60	2.379,12	2.452,18	2.550,48	2.724,21	2.827,30	3.017,46	2.994,05	3.217,09
3. Solvent and Other Product Use	179,38	174,21	169,05	163,88	158,71	140,96	154,36	139,45	128,40	126,88
4. Agriculture	13.009,54	12.890,40	12.604,32	12.472,86	12.127,21	11.906,20	11.569,83	11.398,07	11.404,27	10.817,40
5. Land Use, Land-Use Change and Forestry(5)	551,16	-1.688,67	-1.549,05	-1.157,50	-1.617,51	-1.669,73	-1.217,60	-1.179,80	-1.954,63	-1.235,25
6. Waste	1.548,40	1.565,16	1.563,87	1.601,49	1.589,39	1.563,34	1.562,94	1.544,43	1.508,06	1.513,56
7. Other	651,41	636,79	621,11	569,23	519,63	558,84	622,20	644,69	605,09	618,95
Total (including LULUCF)(5)	**70.262,49**	**78.585,66**	**72.540,38**	**75.214,85**	**78.145,15**	**75.135,35**	**88.935,10**	**79.284,57**	**74.255,13**	**71.941,21**

TABLE A.8 (CRF TABLE 10S5.2): DENMARK'S AND GREENLAND'S TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	(%)
CO2 emissions including net CO2 from LULUCF	55.214,85	54.501,83	52.857,07	57.785,94	53.689,15	51.023,43	57.850,83	52.749,83	-2,26
CO2 emissions excluding net CO2 from LULUCF	53.584,20	55.271,03	54.835,81	60.076,22	54.513,51	50.862,28	58.725,70	53.876,96	0,86
CH4 emissions including CH4 from LULUCF	5.904,44	6.037,45	6.008,01	5.989,80	5.800,35	5.693,31	5.639,84	5.762,97	0,88
CH4 emissions excluding CH4 from LULUCF	5.904,94	6.037,95	6.008,50	5.990,29	5.800,85	5.693,80	5.640,34	5.763,46	0,88
N2O emissions including N2O from LULUCF	8.296,61	8.025,21	7.680,83	7.570,98	7.304,98	6.747,98	6.491,10	6.788,63	-35,56
N2O emissions excluding N2O from LULUCF	8.296,53	8.025,14	7.680,76	7.570,90	7.304,91	6.747,90	6.491,03	6.788,55	-35,56
HFCs	606,49	650,25	675,91	700,17	754,32	800,44	820,40	846,01	100,00
PFCs	17,89	22,13	22,17	19,34	15,90	13,90	15,68	15,36	100,00
SF6	59,23	30,40	25,01	31,38	33,15	21,76	36,00	30,35	-31,73
Total (including LULUCF)	**70.099,50**	**69.267,27**	**67.269,01**	**72.097,60**	**67.597,85**	**64.300,82**	**70.853,86**	**66.193,14**	**-5,79**
Total (excluding LULUCF)	**68.469,28**	**70.036,89**	**69.248,16**	**74.388,30**	**68.422,63**	**64.140,09**	**71.729,15**	**67.320,69**	**-3,43**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	(%)
1. Energy	52.185,53	53.977,00	53.578,15	58.909,32	53.227,57	49.610,69	57.431,46	52.546,08	0,89
2. Industrial Processes	3.386,52	3.287,80	3.194,05	3.210,16	3.017,20	2.435,00	2.515,81	2.532,74	13,09
3. Solvent and Other Product Use	126,61	112,54	115,01	103,70	99,17	113,39	129,94	124,00	-30,88
4. Agriculture	10.581,54	10.519,17	10.233,91	9.962,00	10.003,39	9.929,16	9.585,98	10.072,34	-22,58
5. Land Use, Land-Use Change and Forestry(5)	1.630,22	-769,62	-1.979,16	-2.290,70	-824,78	160,72	-875,29	-1.127,55	-304,58
6. Waste	1.497,97	1.497,77	1.523,35	1.527,84	1.411,65	1.388,81	1.379,47	1.366,23	-11,77
7. Other	691,11	642,62	603,68	675,27	663,65	663,04	686,49	679,31	4,28
Total (including LULUCF)(5)	**70.099,50**	**69.267,27**	**67.269,01**	**72.097,60**	**67.597,85**	**64.300,82**	**70.853,86**	**66.193,14**	**-5,79**

TABLE A.9 (CRF TABLE 10S5.1): DENMARK'S, GREENLAND'S AND FAROE ISLANDS' TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)
CO2 emissions including net CO2 from LULUCF	54.631,03	63.036,67	57.357,37	59.900,22	63.032,31	59.968,95	73.968,79	64.505,76	59.502,25	57.551,65
CO2 emissions excluding net CO2 from LULUCF	54.079,36	64.724,83	58.905,91	61.057,22	64.649,31	61.638,18	75.185,89	65.685,06	61.456,39	58.786,47
CH4 emissions including CH4 from LULUCF	5.730,34	5.818,27	5.845,48	6.005,29	5.928,16	6.023,63	6.137,94	6.029,71	6.054,71	5.931,07
CH4 emissions excluding CH4 from LULUCF	5.730,94	5.818,87	5.846,08	6.005,89	5.928,75	6.024,21	6.138,53	6.030,30	6.055,30	5.931,57
N2O emissions including N2O from LULUCF	10.558,94	10.349,27	9.916,63	9.674,02	9.493,78	9.388,04	9.026,34	8.932,55	8.844,92	8.532,92
N2O emissions excluding N2O from LULUCF	10.558,85	10.349,18	9.916,54	9.673,93	9.493,69	9.387,95	9.026,26	8.932,46	8.844,83	8.532,84
HFCs	NA,NE,NO	NA,NE,NO	3,44	93,93	134,54	217,78	329,44	324,80	413,11	507,54
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,05	0,50	1,66	4,12	9,10	12,48
SF6	44,45	63,50	89,27	101,30	122,20	107,53	61,13	73,24	59,61	65,45
Total (including LULUCF)	**70.964,77**	**79.267,71**	**73.212,20**	**75.774,76**	**78.711,06**	**75.706,43**	**89.525,29**	**79.870,18**	**74.883,70**	**72.601,11**
Total (excluding LULUCF)	**70.413,61**	**80.956,39**	**74.761,24**	**76.932,27**	**80.328,56**	**77.376,15**	**90.742,89**	**81.049,98**	**76.838,34**	**73.836,36**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)
1. Energy	52.083,08	62.665,17	56.751,96	59.112,72	62.817,24	59.911,52	73.416,08	63.720,27	59.569,88	56.882,58
2. Industrial Processes	2.239,52	2.342,60	2.379,12	2.452,18	2.550,48	2.724,21	2.827,30	3.017,46	2.994,05	3.217,09
3. Solvent and Other Product Use	179,38	174,21	169,05	163,88	158,71	140,96	154,36	139,45	128,40	126,88
4. Agriculture	13.009,54	12.890,40	12.604,32	12.472,86	12.127,21	11.906,20	11.569,83	11.398,07	11.404,27	10.817,40
5. Land Use, Land-Use Change and Forestry(5)	551,16	-1.688,67	-1.549,05	-1.157,50	-1.617,51	-1.669,73	-1.217,60	-1.179,80	-1.954,63	-1.235,25
6. Waste	1.548,40	1.565,16	1.563,87	1.601,49	1.589,39	1.563,34	1.562,94	1.544,43	1.508,06	1.513,56
7. Other	1.353,69	1.318,84	1.292,92	1.129,14	1.085,54	1.129,92	1.212,39	1.230,31	1.233,66	1.278,85
Total (including LULUCF)(5)	**70.964,77**	**79.267,71**	**73.212,20**	**75.774,76**	**78.711,06**	**75.706,43**	**89.525,29**	**79.870,18**	**74.883,70**	**72.601,11**

TABLE A.9 (CRF TABLE 10S5.2): DENMARK'S, GREENLAND'S AND FAROE ISLANDS' TOTAL EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN THE PERIOD 1990-2007

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	(%)
CO2 emissions including net CO2 from LULUCF	55.866,59	55.243,78	53.570,70	58.515,86	54.418,28	51.732,27	58.567,47	53.467,03	-2,13
CO2 emissions excluding net CO2 from LULUCF	54.235,95	56.012,98	55.549,44	60.806,14	55.242,65	51.571,13	59.442,34	54.594,16	0,95
CH4 emissions including CH4 from LULUCF	5.922,59	6.055,85	6.026,40	6.008,17	5.818,58	5.711,20	5.657,53	5.780,69	0,88
CH4 emissions excluding CH4 from LULUCF	5.923,08	6.056,34	6.026,89	6.008,66	5.819,08	5.711,69	5.658,03	5.781,18	0,88
N2O emissions including N2O from LULUCF	8.320,23	8.049,76	7.705,36	7.595,57	7.329,62	6.772,28	6.515,42	6.812,97	-35,48
N2O emissions excluding N2O from LULUCF	8.320,16	8.049,68	7.705,28	7.595,49	7.329,54	6.772,21	6.515,34	6.812,89	-35,48
HFCs	610,83	657,17	684,60	710,37	765,71	811,63	832,05	858,01	100,00
PFCs	17,89	22,13	22,17	19,34	15,90	13,90	15,68	15,36	100,00
SF6	59,31	30,48	25,10	31,45	33,33	21,91	36,14	30,48	-31,43
Total (including LULUCF)	**70.797,44**	**70.059,17**	**68.034,33**	**72.880,76**	**68.381,43**	**65.063,20**	**71.624,29**	**66.964,54**	**-5,64**
Total (excluding LULUCF)	**69.167,22**	**70.828,79**	**70.013,48**	**75.171,46**	**69.206,21**	**64.902,47**	**72.499,58**	**68.092,09**	**-3,30**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO2 equivalent (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	CO2 eq. (Gg)	(%)
1. Energy	52.185,53	53.977,00	53.578,15	58.909,32	53.227,57	49.610,69	57.431,46	52.546,08	0,89
2. Industrial Processes	3.386,52	3.287,80	3.194,05	3.210,16	3.017,20	2.435,00	2.515,81	2.532,74	13,09
3. Solvent and Other Product Use	126,61	112,54	115,01	103,70	99,17	113,39	129,94	124,00	-30,88
4. Agriculture	10.581,54	10.519,17	10.233,91	9.962,00	10.003,39	9.929,16	9.585,98	10.072,34	-22,58
5. Land Use, Land-Use Change and Forestry(5)	1.630,22	-769,62	-1.979,16	-2.290,70	-824,78	160,72	-875,29	-1.127,55	-304,58
6. Waste	1.497,97	1.497,77	1.523,35	1.527,84	1.411,65	1.388,81	1.379,47	1.366,23	-11,77
7. Other	1.389,05	1.434,52	1.369,00	1.458,44	1.447,22	1.425,42	1.456,93	1.450,71	7,17
Total (including LULUCF)(5)	**70.797,44**	**70.059,17**	**68.034,33**	**72.880,76**	**68.381,43**	**65.063,20**	**71.624,29**	**66.964,54**	**-5,64**

Annex A2 Summary of reporting of the Supplementary information under Article 7, paragraph 2, of the Kyoto Protocol in the NC5

The table below allows identifying the Kyoto Protocol elements that are allocated in different sections of the report.

TABLE: SUMMARY OF REPORTING OF THE SUPPLEMENTARY INFORMATION UNDER ARTICLE 7, PARAGRAPH 2, OF THE KYOTO PROTOCOL IN THE NC5.

Information reported under Article 7, paragraph 2	**NC5 section**
National systems in accordance with Article 5, paragraph 1	3.3
National registries	3.4
Information on base year, assigned amount and total greenhouse gas emission trend under the Kyoto Protocol	3.5 and 3.6
Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17	5.3
Policies and measures in accordance with Article 2	4.3
Legislative arrangements and enforcement and administrative procedures	4.2
Information under Article 10	7.5
Art 10a	3.3
Art 10b	4.2 and 6.3
Art 10c	7.4
Art 10d	8
Art 10e	9
Financial resources	7.1-7.3

Annex A3 Supplementary information on the allowance scheme in Denmark

This Annex consists of the following two sub-annexes:

Annex A3.1: Installations covered by the Danish National Allocation Plan 2008-12.

List including overview of installations covered by the Danish implementation of the EU Allowances Directive, and the size of the quota allocated to each installation for the period 2008-12 as of 1 February 2005.

Annex A3.2: Information on Denmark's national CO_2 emissions trading registry

1. Information on the registry administrator
2. Cooperation with other countries concerning operation of the registry
3. Standards for data exchange
4. Procedures for administration and operation of the emissions trading registry
5. Safety standards
6. Information available to the public
7. Internet address for the registry
8. Protection, maintenance and recreation of data

Annex A.3.1: Installations covered by the Danish National Allocation Plan 2008-12.

Note: The reserves stated in the table are government reservations of allowances for new enterprises and for auctioning

ID	Installation ID in register	Name of installation	Permit Identifier	allocation 2008	allocation 2009	allocation 2010	allocation 2011	allocation 2012	Period allocation	Reserve
1832	2	Brøndby Strand Fjernvarmecentral	DK-33269315-1003039578-1832-20041001	502	501	501	501	501	2506	2870823
293	3	Viborg Kraftvarme A/S	DK-10046769-1010771680-0293-20041001	674	674	674	674	674	3370	
295	4	Viborg Kraftvarme A/S	DK-10046769-1010771699-0295-20041001	978	975	975	975	975	4878	
1069	5	Viborg Kraftvarme A/S	DK-10046769-1003740497-1069-20041001	145079	145077	145077	145077	145077	725387	
992	6	Lygten Varmeværk	DK-64942212-1009120080-0992-20041001	502	499	499	499	499	2498	
994	7	Østre varmecentral	DK-64942212-1004416316-0994-20041001	929	925	925	925	925	4629	
995	8	Sundholm varmecentral	DK-64942212-1010415213-0995-20041001	4862	4860	4860	4860	4860	24302	
161	9	Hinnerup Fjernvarme	DK-10411912-1002895495-0161-20041001	636	633	633	633	633	3168	
945	10	Brædstrup Totalenergianlæg A/S	DK-10419034-1000073954-0945-20041001	18282	18282	18282	18282	18282	91410	
102	11	Farum Fjernvarme	DK-10663210-1002899982-0102-20041001	2736	2732	2732	2732	2732	13664	
103	12	Farum Fjernvarme	DK-10663210-1002899994-0103-20041001	1597	1594	1594	1594	1594	7973	
24	13	Maribo Varmeværk	DK-11135617-1000187343-0024-20041001	0	0	0	0	0	0	
575	14	Værløse Varmeværk	DK-11899412-1000295548-0575-20041001	712	712	712	712	712	3560	
298	15	Ishøj Kommunes Varmeforsyning	DK-11931316-1003272783-0298-20041001	229	228	228	228	228	1141	
452	16	Silkeborg Kommunale Varmeforsyning	DK-12015607-1003359737-0452-20041001	1477	1476	1476	1476	1476	7381	
453	17	Silkeborg Kommunale Varmeforsyning	DK-12015607-1010671732-0453-20041001	2903	2902	2902	2902	2902	14511	
26	18	Oksbøl Varmeværk	DK-12787111-1000445617-0026-20041001	13287	13283	13283	13283	13283	66419	
249	19	Brørup Fjernvarme	DK-13551472-1000584343-0249-20041001	10831	10830	10830	10830	10830	54151	
338	20	Lem Varmeværk	DK-15763515-1000974476-0338-20041001	14107	14106	14106	14106	14106	70531	
586	22	Lyngvej Central	DK-16130990-1010513924-0586-20041001	1159	1156	1156	1156	1156	5783	
587	23	Svendborgvej Central	DK-16130990-1010513894-0587-20041001	2333	2333	2333	2333	2333	11665	
588	24	Borgmester Jørgensensvej Central	DK-16130990-1010513908-0588-20041001	321	320	320	320	320	1601	
974	25	Højvang Varmecentral	DK-16130990-1010513932-0974-20041001	182	181	181	181	181	906	
1638	26	Gasværksvej Varmecentral	DK-16130990-1010513975-1638-20041001	8695	8691	8691	8691	8691	43459	
499	27	Støvring Varmeværk	DK-16276111-1001070704-0499-20041001	22046	22042	22042	22042	22042	110214	
987	28	Bjerringbro Kraftvarmeværk (motor 1-4)	DK-16634972-1001133672-0987-20041001	36754	36750	36750	36750	36750	183754	
381	29	Nørre-Aaby Kraftvarmeværk A.M.B.A.	DK-16838314-1001169236-0381-20041001	8773	8769	8769	8769	8769	43849	
265	30	Jetsmark Energiværk A.m.b.a.	DK-17000888-1001201570-0265-20041001	15672	15668	15668	15668	15668	78344	
313	31	Kolding Varmeværk Syd	DK-17010131-1010738926-0313-20041001	1800	1800	1800	1800	1800	9000	
315	32	Kolding Varmeværk Dampcentralen	DK-17010131-1010738888-0315-20041001	602	598	598	598	598	2994	
317	33	Kolding Varmeværk Skovparken	DK-17010131-1010738896-0317-20041001	127	126	126	126	126	631	
321	34	Kolding Varmeværk Strandhuse	DK-17010131-1010738934-0321-20041001	1900	1900	1900	1900	1900	9500	
1632	35	Fredericia Varmeværk, Erritsø	DK-17010131-1010738977-1632-20041001	2170	2170	2170	2170	2170	10850	
1635	36	Vejle Varmeværk Nørremarkens Kedelcent	DK-17010131-1010738993-1635-20041001	206	203	203	203	203	1018	
1636	37	Vejle Varmeværk Søndermarkens Kedelce	DK-17010131-1010739000-1636-20041001	241	241	241	241	241	1205	
52	38	Bjerringbro Varmeværk	DK-17256319-1001252921-0052-20041001	1170	1168	1168	1168	1168	5842	
1063	39	Sønderborg Kraftvarme I/S	DK-17310747-1001263648-1063-20041001	72627	72624	72624	72624	72624	363123	
786	40	Jægerspris Kraftvarme	DK-18155141-1001441676-0786-20041001	15427	15427	15427	15427	15427	77135	
269	42	Avedøreværket	DK-18936674-1000605248-0269-20041001	1763673	1763671	1763671	1763671	1763671	8818357	
270	43	DTU Kraftvarmeværk	DK-18936674-1004258440-0270-20041001	88580	88576	88576	88576	88576	442884	
271	44	Vattenfall A/S Helsingør Kraftvarmeværk	DK-18936674-1004267619-0271-20041001	115228	115225	115225	115225	115225	576128	
272	45	Vattenfall A/S Hillerød Kraftvarmeværk	DK-18936674-1004267632-0272-20041001	201864	201862	201862	201862	201862	1009312	
274	47	Kyndbyværket	DK-18936674-1007920594-0274-20041001	34389	34386	34386	34386	34386	171933	
277	48	Asnæsværket	DK-18936674-1002105572-0277-20041001	1765318	1765314	1765314	1765314	1765314	8826574	
278	49	Stigsnæsværket	DK-18936674-1002982001-0278-20041001	389526	389524	389524	389524	389524	1947622	
279	50	Slagelse Kraftvarmeværk	DK-18936674-1004267723-0279-20041001	0	0	0	0	0	0	
280	51	Masnedøværket	DK-18936674-1003922902-0280-20041001	306	302	302	302	302	1514	
330	52	Vattenfall A/S Amagerværket	DK-18936674-1003253755-0330-20041001	1250995	1250992	1250992	1250992	1250992	6254963	
331	53	H.C. Ørstedsværket	DK-18936674-1003256274-0331-20041001	318976	318974	318974	318974	318974	1594872	
332	54	Svanemølleværket	DK-18936674-1003253883-0332-20041001	332663	332659	332659	332659	332659	1663299	
426	55	Ringsted Kraftvarmeværk	DK-18936674-1004267711-0426-20041001	30380	30376	30376	30376	30376	151884	
736	56	Køge Kraftvarmeværk	DK-18936674-1010717341-0736-20041001	3125	3123	3123	3123	3123	15617	
1494	57	Maribo-Sakskøbing Kraftvarmeværk	DK-18936674-1005231580-1494-20041001	79	77	77	77	77	387	
346	58	Løgstør Fjernvarmeværk	DK-19201414-1001510235-0346-20041001	11059	11055	11055	11055	11055	55279	
967	59	Sakskøbing Fjernvarme	DK-19739112-1002997847-0967-20041001	246	246	246	246	246	1230	
407	60	Otterup Kommunale Fjernvarmeforsyning	DK-19854418-1003317001-0407-20041001	275	273	273	273	273	1367	
124	61	Frederikssund Kraftvarmeværk	DK-25580230-1010775449-0124-20041001	34400	34398	34398	34398	34398	171992	
1731	62	DTU Kedelcentral	DK-25580230-1010775414-1731-20041001	2868	2864	2864	2864	2864	14324	
38	63	Østervrå Varmeværk	DK-20245417-1001521893-0038-20041001	6528	6525	6525	6525	6525	32628	
1068	64	Smørum Kraftvarme	DK-21445711-1001535455-1068-20041001	20561	20559	20559	20559	20559	102797	
505	65	Svendborg Fjernvarmecentral	DK-22113410-1003007911-0505-20041001	2717	2716	2716	2716	2716	13581	
506	66	Svendborg Fjernvarmecentral A.m.b.a.	DK-22113410-1003007923-0506-20041001	1505	1504	1504	1504	1504	7521	
88	67	Ebeltoft Fjernvarmeværk	DK-22703714-1003010765-0088-20041001	0	0	0	0	0	0	
1042	68	Silkeborg Kraftvarmeværk A/S	DK-25453506-1004368727-1042-20041001	226802	226802	226802	226802	226802	1134010	
251	69	Vattenfall A/S Fynsværket	DK-10153158-1005171544-0251-20041001	1331051	1331048	1331048	1331048	1331048	6655243	

Annex A.3.1

Annex A.3.1: Installations covered by the Danish National Allocation Plan 2008-12.

ID	Installation ID in register	Name of installation	Permit Identifier	allocation 2008	allocation 2009	allocation 2010	allocation 2011	allocation 2012	Period allocation	Reserve
257	70	DONG Energy Generation A/S, Grenå Kraf	DK-10153158-1003065199-0257-20041001	78752	78749	78749	78749	78749	393748	
259	71	DONG Energy Generation A/S, Studstrupv	DK-10153158-1003065217-0259-20041001	1574675	1574675	1574675	1574675	1574675	7873375	
282	72	DONG Energy Generation A/S, Skærbækv	DK-10153158-1003050386-0282-20041001	653087	653085	653085	653085	653085	3265427	
288	73	DONG Energy Generation A/S, Herningvæ	DK-10153158-1008477988-0288-20041001	176939	176936	176936	176936	176936	884683	
290	74	Ringkøbing Kraftvarmeværk	DK-25460715-1010337603-0290-20041001	18570	18568	18568	18568	18568	92842	
291	75	Skjern Kraftvarmeværk	DK-25460715-1010337646-0291-20041001	22568	22565	22565	22565	22565	112828	
520	76	DONG Energy Generation A/S, Enstedvær	DK-10153158-1002980617-0520-20041001	1397043	1397041	1397041	1397041	1397041	6985207	
635	77	Frederikshavn Kraftvarmeværk	DK-25460715-1003043318-0635-20041001	42889	42889	42889	42889	42889	214445	
636	78	Vattenfall A/S Nordjyllandsværket	DK-10153158-1005247303-0636-20041001	1103702	1103698	1103698	1103698	1103698	5518494	
637	79	Hirtshals Kraftvarmeværk	DK-25460715-1003043343-0637-20041001	20213	20209	20209	20209	20209	101049	
990	80	DONG Energy Generation A/S, Esbjergvær	DK-10153158-1008477821-0990-20041001	1051489	1051487	1051487	1051487	1051487	5257437	
415	81	Energi Randers Produktion A/S	DK-25481984-1007759963-0415-20041001	192097	192096	192096	192096	192096	960481	
416	82	Energi Randers Produktion A/S	DK-25481984-1009623945-0416-20041001	1154	1152	1152	1152	1152	5762	
960	83	Energi Randers Produktion A/S	DK-25481984-1009623953-0960-20041001	341	341	341	341	341	1705	
1490	84	Energi Randers Produktion A/S	DK-25481984-1009257612-1490-20041001	3369	3365	3365	3365	3365	16829	
289	85	Måbjergværket A/S	DK-25495977-1007775284-0289-20041001	8028	8027	8027	8027	8027	40136	
283	86	Horsens Kraftvarmeværk A/S	DK-25496086-1007775373-0283-20041001	44477	44475	44475	44475	44475	222377	
154	87	KVV Grønningen/Central 2	DK-25525795-1010757467-0154-20041001	18960	18957	18957	18957	18957	94788	
988	88	KVV Tårnvej	DK-25525795-1007789161-0988-20041001	34344	34344	34344	34344	34344	171720	
365	89	Nyborg Forsyning og Service	DK-25535456-1003314105-0365-20041001	432	432	432	432	432	2160	
326	90	Korsør Varme A/S	DK-25673840-1003294517-0326-20041001	19710	19706	19706	19706	19706	98534	
40	91	Østkraft	DK-25798929-1008145764-0040-20041001	54250	54250	54250	54250	54250	271250	
192	92	EnergiGruppen Jylland, Holstebrovej	DK-25809807-1010775309-0192-20041001	2414	2410	2410	2410	2410	12054	
193	93	EnergiGruppen Jylland, Nord	DK-25809807-1010775341-0193-20041001	1676	1675	1675	1675	1675	8376	
1244	94	EnergiGruppen Jylland, Vest	DK-25809807-1010775392-1244-20041001	31	29	29	29	29	147	
216	95	Vestforsyning Varme A/S	DK-26704065-1010775961-0216-20041001	1644	1643	1643	1643	1643	8216	
217	96	Vestforsyning Varme A/S	DK-26704065-1010775988-0217-20041001	397	393	393	393	393	1969	
218	97	Vestforsyning Varme A/S	DK-26704065-1010776046-0218-20041001	1277	1275	1275	1275	1275	6377	
219	98	Vestforsyning Varme A/S	DK-26704065-1010776011-0219-20041001	957	953	953	953	953	4769	
220	99	Vestforsyning Varme A/S	DK-26704065-1010776003-0220-20041001	2484	2483	2483	2483	2483	12416	
129	100	Faaborg Fjernvarme A/S	DK-26721059-1003311702-0129-20041001	22598	22596	22596	22596	22596	112982	
571	101	Vojens Fjernvarme	DK-28032617-1010752325-0571-20041001	20790	20786	20786	20786	20786	103934	
10	102	Albertslund Varmeværk	DK-29808228-1003267160-0010-20041001	1639	1637	1637	1637	1637	8187	
529	103	Thisted Varmeforsyning	DK-30992512-1003030685-0529-20041001	1204	1200	1200	1200	1200	6004	
567	104	Vinderup Varmeværk	DK-31220912-1001672876-0567-20041001	14259	14258	14258	14258	14258	71291	
565	105	Videbæk energiforsyning	DK-31242711-1001673227-0565-20041001	200	198	198	198	198	992	
566	106	Videbæk Energiforsyning	DK-31242711-1010767063-0566-20041001	17767	17766	17766	17766	17766	88831	
423	107	Ringe Fjernvarmeselskab	DK-32476813-1003037642-0423-20041001	14681	14677	14677	14677	14677	73389	
536	108	Tranbjerg Varmeværk	DK-33016719-1001698824-0536-20041001	96	92	92	92	92	464	
459	109	Skagen Varmeværk	DK-33507410-1001705973-0459-20041001	1361	1360	1360	1360	1360	6801	
1449	110	Skagen Kraftvarmeværk	DK-33507410-1010581539-1449-20041001	23264	23261	23261	23261	23261	116308	
207	111	Hjallerup Fjernvarmeselskab	DK-34681228-1001723737-0207-20041001	14752	14751	14751	14751	14751	73756	
388	112	Odense Kommune VC Bellinge	DK-35209115-1010757157-0388-20041001	718	714	714	714	714	3574	
389	113	Odense Kommune VC Billedskærervej	DK-35209115-1010757165-0389-20041001	2216	2215	2215	2215	2215	11076	
390	114	Odense Kommune VC Bolbro	DK-35209115-1010757211-0390-20041001	1324	1321	1321	1321	1321	6608	
392	115	Odense Kommune VC Centrum	DK-35209115-1010757807-0392-20041001	2004	2004	2004	2004	2004	10020	
393	116	Odense Kommune VC Dyrup	DK-35209115-1010757866-0393-20041001	365	365	365	365	365	1825	
395	117	Odense Kommune VC Dalum	DK-35209115-1010757815-0395-20041001	991	991	991	991	991	4955	
398	118	Odense Kommune VC Korup	DK-35209115-1010757904-0398-20041001	689	686	686	686	686	3433	
400	119	Odense Kommune VC Næsby	DK-35209115-1010757955-0400-20041001	833	833	833	833	833	4165	
402	120	Odense Kommune VC Pårup	DK-35209115-1010757998-0402-20041001	1185	1182	1182	1182	1182	5913	
403	121	Odense Kommune VC Sanderum	DK-35209115-1010758005-0403-20041001	827	825	825	825	825	4127	
405	122	Odense Kommune VC Sydøst	DK-35209115-1010758021-0405-20041001	844	842	842	842	842	4212	
406	123	Odense Kommune VC Vollsmose	DK-35209115-1010758048-0406-20041001	1062	1061	1061	1061	1061	5306	
104	124	Fredericia Fjernvarme	DK-35478116-1003045929-0104-20041001	207	206	206	206	206	1031	
105	125	Fredericia Fjernvarme	DK-35478116-1003045930-0105-20041001	115	112	112	112	112	563	
511	126	Sønderborg Fjernvarme	DK-35602313-1009505527-0511-20041001	124	122	122	122	122	612	
515	127	Sønderborg Fjernvarme	DK-35602313-1003046196-0515-20041001	960	958	958	958	958	4792	
556	128	Varmecentral Søndermarken	DK-35607919-1010774108-0556-20041001	615	614	614	614	614	3071	
557	129	Varmecentral Toften	DK-35607919-1010774116-0557-20041001	3173	3170	3170	3170	3170	15853	
577	130	Aabenraa Fjernvarme	DK-36152710-1010792963-0577-20041001	1008	1004	1004	1004	1004	5024	
578	131	Aabenraa Fjernvarme	DK-36152710-1010792955-0578-20041001	296	296	296	296	296	1480	
580	132	Aabenraa Fjernvarme	DK-36152710-1010792947-0580-20041001	284	280	280	280	280	1404	
443	133	Rødekro Fjernvarmecentral	DK-36154012-1001742170-0443-20041001	716	713	713	713	713	3568	
545	134	Tønder Fjernvarmeselskab Amba	DK-36421312-1001745454-0545-20041001	986	983	983	983	983	4918	
339	135	Lemvig Varmeværk	DK-36892412-1001749941-0339-20041001	1629	1625	1625	1625	1625	8129	
246	137	Billund Varmeværk II	DK-37251518-1001753730-0246-20041001	22136	22133	22133	22133	22133	110668	

Annex A.3.1

Annex A.3.1: Installations covered by the Danish National Allocation Plan 2008-12.

ID	Installation ID in register	Name of installation	Permit Identifier	allocation 2008	allocation 2009	allocation 2010	allocation 2011	allocation 2012	Period allocation	Reserve
425	138	Rindum Værket	DK-37560219-1003054010-0425-20041001	22312	22310	22310	22310	22310	111552	
296	139	I/S Vildbjerg Varmeværk	DK-37683310-1001758574-0296-20041001	17685	17682	17682	17682	17682	88413	
63	140	Brovst Fjernvarme	DK-37809217-1001759685-0063-20041001	12999	12999	12999	12999	12999	64995	
461	141	Skanderborg Fjernvarme	DK-37949019-1001761239-0461-20041001	372	372	372	372	372	1860	
95	142	Hedelund Spidslastcentral	DK-39877511-1010774698-0095-20041001	453	451	451	451	451	2257	
97	143	Hjerting Varmeværk	DK-39877511-1010774701-0097-20041001	132	128	128	128	128	644	
98	144	Gjesing Varmecentral	DK-39877511-1010774728-0098-20041001	1390	1388	1388	1388	1388	6942	
99	145	Sædding Varmeværk	DK-39877511-1010774736-0099-20041001	1496	1496	1496	1496	1496	7480	
361	146	Nakskov Fjernvarme	DK-40734511-1003302364-0361-20041001	0	0	0	0	0	0	
523	147	Tarm Varmeværk A.m.b.a.	DK-40893113-1001802909-0523-20041001	0	0	0	0	0	0	
215	148	Hobro Varmeværk	DK-41429615-1001810468-0215-20041001	1213	1213	1213	1213	1213	6065	
188	149	Hedensted Fjernvarme	DK-41529911-1001812204-0188-20041001	9852	3284	9852	9852	9852	42692	
80	150	Dagnæs-Bækkelund Varmeværk	DK-41540214-1003064635-0080-20041001	144	143	143	143	143	716	
430	151	Roskilde Varmeforsyning	DK-42162019-1003287705-0430-20041001	2277	2276	2276	2276	2276	11381	
432	152	Roskilde Varmeforsyning	DK-42162019-1003288415-0432-20041001	1365	1361	1361	1361	1361	6809	
156	153	Gråsten Fjernvarme Amba	DK-43005154-1003322971-0156-20041001	13289	13288	13288	13288	13288	66441	
152	154	Grenå Varmeværk	DK-43774417-1003079965-0152-20041001	358	356	356	356	356	1782	
939	155	Bredstrup Varmeværk	DK-43774417-1003079977-0939-20041001	206	206	206	206	206	1030	
357	156	Mølholm Varmeværk	DK-44424010-1001852238-0357-20041001	73	72	72	72	72	361	
673	157	Hundige Fjernvarmeværk A.m.b.a.	DK-44492350-1001853489-0673-20041001	421	420	420	420	420	2101	
301	158	Jyderup Varmeværk	DK-44835010-1003297590-0301-20041001	13320	13318	13318	13318	13318	66592	
203	159	Frederiksgade Varmecentral	DK-44887118-1010701992-0203-20041001	2020	2019	2019	2019	2019	10096	
204	160	Ullerød Varmecentral	DK-44887118-1009303940-0204-20041001	650	649	649	649	649	3246	
205	161	Kgs. Vænge Varmecentral	DK-44887118-1010702034-0205-20041001	480	476	476	476	476	2384	
206	162	Elmegaarden Varmecentral	DK-44887118-1010702018-0206-20041001	528	524	524	524	524	2624	
17	163	Ikast El- og Varmeværk	DK-25161513-1003083171-0017-20041001	1948	1944	1944	1944	1944	9724	
25	164	Nykøbing S. Varmeværk	DK-46917928-1001888952-0025-20041001	18521	18520	18520	18520	18520	92601	
308	165	Kerteminde Kommunale Varmeforsyning	DK-46953614-1003312485-0308-20041001	542	540	540	540	540	2702	
385	166	Nørresundby Fjernvarmeforsyning	DK-50530213-1001950220-0385-20041001	243	0	0	0	0	243	
1070	167	Brønderslev Kraftvarme	DK-52080312-1009740313-1070-20041001	61480	61479	61479	61479	61479	307396	
1959	168	Svendborg Fjernvarmecentral	DK-54802013-1008705484-1409-20041001	36306	36803	36803	36803	36803	183518	
258	169	Århusværket	DK-55133018-1009490503-0258-20041001	752	750	750	750	750	3752	
591	170	Århus Kommunale Værker Risskov Varme	DK-55133018-1010680383-0591-20041001	212	212	212	212	212	1060	
597	171	Århus Kommunale Værker Jens Juuls Vej	DK-55133018-1010680359-0597-20041001	2460	2459	2459	2459	2459	12296	
598	172	Århus Kommunale Værker Viby Varmecen	DK-55133018-1010680375-0598-20041001	171	167	167	167	167	839	
604	173	Århus Kommunale Værker Gjellerup	DK-55133018-1010680367-0604-20041001	675	674	674	674	674	3371	
554	174	I/S Vamdrup Fjernvarme	DK-55946817-1002041931-0554-20041001	9048	9048	9048	9048	9048	45240	
419	175	Ribe Fjernvarmecentral	DK-57205628-1010706714-0419-20041001	1512	1509	1509	1509	1509	7548	
420	176	Ribe Kraftvarmeværk	DK-57205628-1002058838-0420-20041001	23905	23902	23902	23902	23902	119513	
372	177	Nykøbing Mors Fjernvarmeværk	DK-57494115-1002063337-0372-20041001	17848	17845	17845	17845	17845	89228	
169	178	Haderslev Fjernvarme	DK-58061212-1003123407-0169-20041001	4212	4212	4212	4212	4212	21060	
170	179	Haderslev Fjernvarme	DK-58061212-1003123419-0170-20041001	13448	13446	13446	13446	13446	67232	
247	180	Brande Fjernvarmecentral	DK-58176613-1002075632-0247-20041001	15233	15229	15229	15229	15229	76149	
62	182	Broager Fjernvarmeselskab	DK-59352318-1002097051-0062-20041001	10599	10599	10599	10599	10599	52995	
457	183	Sindal Varmeforsyning	DK-59426915-1002097944-0457-20041001	13758	13754	13754	13754	13754	68774	
304	184	Kjellerup Fjernvarme	DK-60247412-1002110216-0304-20041001	0	0	0	0	0	0	
2	185	Assens fjernvarme Amba	DK-61877215-1003147413-0002-20041001	0	0	0	0	0	0	
50	186	Bramming Fjernvarme A.m.b.a.	DK-63446319-1002170663-0050-20041001	30416	30414	30414	30414	30414	152072	
533	187	Toftlund Fjernvarmecentral	DK-63690619-1002175112-0533-20041001	12694	12691	12691	12691	12691	63458	
509	188	Sæby Varmeværk	DK-64429418-1002189756-0509-20041001	33049	33047	33047	33047	33047	165237	
543	189	Taars Varmeværk Amba	DK-64463411-1002190406-0543-20041001	8721	8721	8721	8721	8721	43605	
190	190	Helsingør Kommunale Værker	DK-64502018-1010657128-0190-20041001	593	589	589	589	589	2949	
191	191	Helsingør Kommunale Værker	DK-64502018-1003280037-0191-20041001	1818	1814	1814	1814	1814	9074	
209	192	Hjørring Varmeforsyning	DK-64544616-1003156575-0209-20041001	467	467	467	467	467	2335	
210	193	Hjørring Varmeforsyning	DK-64544616-1003156630-0210-20041001	88079	88079	88079	88079	88079	440395	
214	194	Hjørring Varmeforsyning	DK-64544616-1003156587-0214-20041001	1053	1050	1050	1050	1050	5253	
574	195	Vrå Varmeværk	DK-64771728-1002195366-0574-20041001	7650	7650	7650	7650	7650	38250	
146	196	Glostrup Kommunale Varmeforsyning	DK-65120119-1010748883-0146-20041001	107	103	103	103	103	519	
227	197	Horsens Varmeværk	DK-66166228-1003161700-0227-20041001	2587	2583	2583	2583	2583	12919	
228	198	Horsens Varmeværk	DK-66166228-1003161712-0228-20041001	339	336	336	336	336	1683	
172	199	Hadsten Varmeværk	DK-67750411-1002257575-0172-20041001	239	238	238	238	238	1191	
335	200	Langeskov Kommunale Fjernvarme	DK-67892615-1003312783-0335-20041001	260	256	256	256	256	1284	
33	201	Vejle Fjernvarmeselskab a.m.b.a.	DK-67932218-1002261339-0033-20041001	702	702	702	702	702	3510	
463	202	I/S Skive Fjernvarme	DK-68326214-1003169877-0463-20041001	36338	36336	36336	36336	36336	181682	
464	203	I/S Skive Fjernvarme	DK-68326214-1003169890-0464-20041001	594	593	593	593	593	2966	
475	204	SK-Varme A/S	DK-27736904-1010782941-0475-20041001	893	890	890	890	890	4453	
478	205	SK-Varme A/S	DK-27736904-1010782917-0478-20041001	764	764	764	764	764	3820	

Annex A.3.1

Annex A.3.1: Installations covered by the Danish National Allocation Plan 2008-12.

ID	Installation ID in register	Name of installation	Permit Identifier	allocation 2008	allocation 2009	allocation 2010	allocation 2011	allocation 2012	Period allocation	Reserve
970	206	Solrød Fjernvarmeværk a.m.b.a.	DK-69330428-1002294343-0970-20041001	505	502	502	502	502	2513	
991	207	Hvide Sande Fjernvarme	DK-69914128-1002309201-0991-20041001	18134	18130	18130	18130	18130	90654	
373	208	Næstved Varmeværk	DK-69995713-1003173770-0373-20041001	208	205	205	205	205	1028	
376	209	Næstved Varmeværk	DK-69995713-1003173800-0376-20041001	1184	1183	1183	1183	1183	5916	
125	210	Frederiksværk Kommunale Varmeværker	DK-70097117-1009059608-0125-20041001	2357	2357	2357	2357	2357	11785	
572	211	Bødkervænget Varmecentral	DK-70921219-1004013689-0572-20041001	937	934	934	934	934	4673	
73	212	CTR, Nybrovej Centralen	DK-74132111-1010668456-0073-20041001	1438	1434	1434	1434	1434	7174	
74	213	CTR, Spidslastcentral Phistersvej	DK-74132111-1010668464-0074-20041001	1955	1954	1954	1954	1954	9771	
121	215	Frederiksberg Varmecentral	DK-74132111-1003253834-0121-20041001	12925	12921	12921	12921	12921	64609	
646	216	Høje Gladsaxe Varmecentral	DK-74132111-1010668480-0646-20041001	3307	3304	3304	3304	3304	16523	
1351	217	Gladsaxe Spidslastanlæg	DK-74132111-1010668499-1351-20041001	1866	1862	1862	1862	1862	9314	
1551	218	CTR, Utterslev Varmecentral	DK-74132111-1010668502-1551-20041001	548	545	545	545	545	2728	
250	219	Næstved Kraftvarmeværk	DK-65278316-1010642945-0250-20041001	24418	24414	24414	24414	24414	122074	
547	220	Tørring Kraftvarmeværk	DK-28709714-1003023952-0547-20041001	11841	11838	11838	11838	11838	59193	
1826	221	Lystrup Fjernvarme Amba	DK-42125814-1001820693-1826-20041001	57	54	54	54	54	273	
370	222	Nykøbing F. Kommunale Varmeforsyning	DK-64707612-1010771745-0370-20041001	1331	1331	1331	1331	1331	6655	
371	223	Nykøbing F. Kommunale Varmeforsyning	DK-64707612-1010771737-0371-20041001	5083	5083	5083	5083	5083	25415	
1841	224	Holme Lundshøj Fjernvarme amba	DK-39901811-1001789264-1841-20041001	13	9	9	9	9	49	
1057	225	Gram Fjernvarme	DK-36294515-1001743992-1057-20041001	12337	12333	12333	12333	12333	61669	
238	226	Høng Varmeværk	DK-29096716-1001640777-0238-20041001	607	607	607	607	607	3035	
386	227	Odder Varmeværk	DK-64704710-1003157078-0386-20041001	402	400	400	400	400	2002	
1825	228	Svogerslev Fjernvarmecentral	DK-50187128-1001944117-1825-20041001	620	618	618	618	618	3092	
1824	229	Høje Tåstrup	DK-13057117-1002933753-1824-20041001	109	108	108	108	108	541	
1833	230	Avedøre Fjernvarme A.m.b.a	DK-14250905-1000707406-1833-20041001	396	396	396	396	396	1980	
122	231	Frederikshavn Kommunale Varmeforsyning	DK-23179652-1010749189-0122-20041001	2691	2687	2687	2687	2687	13439	
123	232	Frederikshavn Kommunale Varmeforsyning	DK-23179652-1010749219-0123-20041001	2442	2441	2441	2441	2441	12206	
1828	233	Hvidovre Midt	DK-76343616-1003191352-1828-20041001	622	622	622	622	622	3110	
53	234	Bogense Forsyningsselskab	DK-64831712-1002196453-0053-20041001	13116	13115	13115	13115	13115	65576	
1830	235	Brøndbyøster Fjernvarmecentral	DK-33269315-1003039608-1830-20041001	743	742	742	742	742	3711	
1831	236	Brøndbyvester Fjernvarmecentral	DK-33269315-1003039566-1831-20041001	988	985	985	985	985	4928	
1847	237	Middelfart Fjernvarme, Hovedcentral	DK-13545812-1000583372-1847-20041001	1244	1242	1242	1242	1242	6212	
1855	240	Rønne Vand og Varmeforsyning Amba, re	DK-25227832-1003308258-1855-20041001	99	95	95	95	95	479	
285	241	I/S Vestforbrænding	DK-10866111-1003387416-0285-20041001	913	909	909	909	909	4549	
1857	242	Hedegårdens varmecentral (I/S Vestforbra	DK-10866111-1010800834-1857-20041001	137	133	133	133	133	669	
1827	243	Fjernvarmecentralen Avedøre Holme	DK-22340417-1001545710-1827-20041001	3322	3321	3321	3321	3321	16606	
1713	244	Colas, Glostrup	DK-10246415-1010232089-1713-20041001	1646	1642	1642	1642	1642	8214	
1714	245	Colas, Herfølge	DK-10246415-1010232100-1714-20041001	1127	1126	1126	1126	1126	5631	
1715	246	Colas, Horsens	DK-10246415-1010232070-1715-20041001	1562	1561	1561	1561	1561	7806	
1716	247	Colas, Vinderup	DK-10246415-1002889095-1716-20041001	1236	1232	1232	1232	1232	6164	
1729	248	DanSteel	DK-10092922-1002313890-1729-20041001	66369	66369	66369	66369	66369	331845	
1752	249	Nybro Gasbehandlingsanlæg	DK-27210538-1009932840-1752-20041001	19898	19895	19895	19895	19895	99478	
1742	250	Grundejerforeningen Smørmosens Kraftva	DK-25917979-1008304072-1742-20041001	24109	24105	24105	24105	24105	120529	
1705	251	Amtssygehuset i Glostrup	DK-16189006-1003259066-1705-20041001	8800	8800	8800	8800	8800	44000	
1745	252	NCC Roads A/S, asfalt	DK-69894011-1003173381-1745-20041001	4493	4491	4491	4491	4491	22457	
1747	254	NCC Roads A/S, asfalt	DK-69894011-1002981273-1747-20041001	2190	2187	2187	2187	2187	10938	
1748	255	NCC Roads A/S, asfalt	DK-69894011-1003173228-1748-20041001	2601	2601	2601	2601	2601	13005	
1854	257	NCC Roads Trige	DK-69894011-1003173307-1854-20041001	2659	2655	2655	2655	2655	13279	
1753	258	Nybro Tørreri	DK-24247279-1001614949-1753-20041001	15798	15796	15796	15796	15796	78982	
1759	259	Palsgaard A/S	DK-26447038-1003084051-1759-20041001	5967	5967	5967	5967	5967	29835	
928	260	Knud Jepsen A/S	DK-11757278-1000270481-0928-20041001	12805	12803	12803	12803	12803	64017	
1084	261	Alfred Pedersen og Søn	DK-19146847-1003102851-1084-20041001	26458	26454	26454	26454	26454	132274	
1088	262	Kronborg Aps.	DK-16932108-1001187219-1088-20041001	10714	10712	10712	10712	10712	53562	
783	263	Masnedø Gartnerier A/S	DK-27496636-1010285905-0783-20041001	27389	27389	27389	27389	27389	136945	
922	264	Varpelev Tomater A/S	DK-15692995-1000961770-0922-20041001	20982	20982	20982	20982	20982	104910	
1704	265	Akzo Nobel Salt A/S	DK-17030744-1002986147-1704-20041001	17184	17181	17181	17181	17181	85908	
1720	266	Damolin Fur A/S	DK-37322318-1003052766-1720-20041001	9236	9236	9236	9236	9236	46180	
1721	267	Damolin Mors A/S	DK-37322318-1003064271-1721-20041001	23690	23686	23686	23686	23686	118434	
1725	268	Danish Crown Ringsted	DK-21643939-1003174352-1725-20041001	8585	8581	8581	8581	8581	42909	
1796	269	Danish Crown Horsens	DK-21643939-1010316592-1796-20041001	11934	11934	11934	11934	11934	59670	
1717	270	Daka Proteins Løsning	DK-45613410-1003084683-1717-20041001	18028	18024	18024	18024	18024	90124	
1718	271	Daka Bio-industries Ortved	DK-45613410-1003174303-1718-20041001	15094	15094	15094	15094	15094	75470	
1719	272	Daka Bio-industries Randers	DK-45613410-1003084713-1719-20041001	15991	15987	15987	15987	15987	79939	
1783	273	Tulip Food Company Vejle	DK-14003606-1002950285-1783-20041001	5272	5271	5271	5271	5271	26356	
116	274	Fiskernes Fiskeindustri	DK-53686214-1002006832-0116-20041001	50054	50052	50052	50052	50052	250262	
1737	275	Hanstholms Fiskemelsfabrik A/S	DK-10830281-1000138566-1737-20041001	13082	13082	13082	13082	13082	65410	
1781	276	TripleNine Fish Protein Thyborøn	DK-14981918-1003043173-1781-20041001	45227	45227	45227	45227	45227	226135	
1782	277	Triplenine Fish Protein, Esbjerg	DK-14981918-1000839411-1782-20041001	43572	43570	43570	43570	43570	217852	

Annex A.3.1

Annex A.3.1: Installations covered by the Danish National Allocation Plan 2008-12.

ID	Installation ID in register	Name of installation	Permit Identifier	allocation 2008	allocation 2009	allocation 2010	allocation 2011	allocation 2012	Period allocation	Reserve
754	278	AarhusKarlshamn Denmark A/S	DK-15672099-1000958332-0754-20041001	98702	98702	98702	98702	98702	493510	
926	279	Arla Foods Energy A/S. Afd AKAFA	DK-87469816-1003024807-0926-20041001	31982	31982	31982	31982	31982	159910	
1091	280	Arla Foods Energy A/S. Afd. Danmark Prot	DK-87469816-1001971408-1091-20041001	37538	37538	37538	37538	37538	187690	
1101	281	Arla Foods Energy A/S, Arinco Afdeling	DK-87469816-1003029585-1101-20041001	40884	40883	40883	40883	40883	204416	
1102	282	Arla Foods Energy A/S, Afd. HOCO	DK-87469816-1003024856-1102-20041001	38484	38480	38480	38480	38480	192404	
1722	284	Dangrønt Ribe	DK-17919679-1001873142-1722-20041001	10745	10745	10745	10745	10745	53725	
1723	285	Dangrønt Ringkøbing	DK-17919679-1003064829-1723-20041001	17171	17168	17168	17168	17168	85843	
500	287	Danisco Sugar, Nykøbing Sukkerfabrik	DK-11350356-1003073438-0500-20041001	83926	83925	83925	83925	83925	419626	
740	288	Danisco Sugar, Nakskov Sukkerfabrik	DK-11350356-1003073359-0740-20041001	107293	107292	107292	107292	107292	536461	
742	289	Danisco Sugar, Assens Sukkerfabrik	DK-11350356-1003073426-0742-20041001	58883					58883	
1799	290	Danisco Gørlev	DK-11350356-1003073505-1799-20041001	13814					13814	
760	291	CP Kelco ApS	DK-21210285-1001573553-0760-20041001	91081	91081	91081	91081	91081	455405	
1730	292	V&S Danmark A/S, V&S Distillers Aalborg	DK-21409677-1003073529-1730-20041001	7526	7525	7525	7525	7525	37626	
734	293	Carlsberg Danmark A/S	DK-25508386-1003138695-0734-20041001	28105	28104	28104	28104	28104	140521	
1403	294	Carlsberg A/S	DK-25508386-1000619820-1403-20041001	22769	22769	22769	22769	22769	113845	
1568	295	Danish Malting Group	DK-16993409-1001199629-1568-20041001	29567	29563	29563	29563	29563	147819	
1087	296	Dragsbaek Maltfabrik A/S	DK-71174611-1002336930-1087-20041001	33991	33987	33987	33987	33987	169939	
1738	297	Harboes Bryggeri A/S	DK-43910515-1001845554-1738-20041001	6902	6901	6901	6901	6901	34506	
1732	299	EGETÆPPER A/S	DK-38454218-1001767559-1732-20041001	5397	5394	5394	5394	5394	26973	
364	300	Novopan Træindustri A/S	DK-11766110-1002911982-0364-20041001	17162	17160	17160	17160	17160	85802	
743	301	Dalum Papir A/S	DK-20284196-1003138658-0743-20041001	52024	52024	52024	52024	52024	260120	
782	302	Dalum Papir Maglemølle	DK-20284196-1003138646-0782-20041001	6005	6005	6005	6005	6005	30025	
1772	304	Skjern Papirfabrik A/S	DK-83031212-1003207862-1772-20041001	12153	12151	12151	12151	12151	60757	
744	305	Brødrene Hartmann A/S	DK-63049611-1003151998-0744-20041001	72836	72833	72833	72833	72833	364168	
1	306	Shell Raffinaderiet Fredericia	DK-10373816-1002893194-0001-20041001	433099	433096	433096	433096	433096	2165483	
1773	307	Statoil Raffinaderiet	DK-28142412-1003022853-1773-20041001	431357	431356	431356	431356	431356	2156781	
1775	308	Sun Chemical A/S	DK-21420018-1001535091-1775-20041001	13711	13710	13710	13710	13710	68551	
1751	309	Novozymes A/S	DK-10007127-1007675476-1751-20041001	15916	15912	15912	15912	15912	79564	
1396	311	Cheminova A/S	DK-12760043-1000441076-1396-20041001	78507	78505	78505	78505	78505	392527	
1750	313	Novo Nordisk A/S	DK-24256790-1007676162-1750-20041001	4589	4587	4587	4587	4587	22937	
1736	314	Haldor Topsøe A/S	DK-41853816-1003065230-1736-20041001	23791	23787	23787	23787	23787	118939	
1109	315	Roulunds Energy A/S	DK-27364926-1001760037-1109-20041001	18330	18330	18330	18330	18330	91650	
1766	317	Ardagh Glass Holmegaard A/S	DK-18445042-1003465733-1766-20041001	61473	61470	61470	61470	61470	307353	
1770	318	Saint Gobain Isover A/S	DK-11933238-1000301355-1770-20041001	12003	9485	9485	9485	9485	49943	
1702	319	A/S Bachmanns Teglværk	DK-31978017-1001683002-1702-20041001	4941	4940	4940	4940	4940	24701	
1711	320	Carl Matzens Teglværk A/S	DK-42125210-1001820681-1711-20041001	4487	4484	4484	4484	4484	22423	
1734	321	Gråsten Teglværk	DK-40294619-1001794437-1734-20041001	6383	7995	7995	7995	7995	38363	
1739	322	Helligsø Teglværk A/S	DK-36967110-1001750470-1739-20041001	5712	5710	5710	5710	5710	28552	
1741	323	Højslev Tegl A/S	DK-67863828-1003550278-1741-20041001	6232	6232	6232	6232	6232	31160	
1743	324	Lafarge Roofing A/S - Volstrup Teglværk	DK-31310113-1002934402-1743-20041001	4746	4745	4745	4745	4745	23726	
1744	325	LUNDGÅRD TEGLVÆRK A/S	DK-38016210-1001761987-1744-20041001	9741	9740	9740	9740	9740	48701	
1749	326	Nordtegl A/S	DK-75922019-1002474738-1749-20041001	3542	0	0	0	0	3542	
1761	328	PETERSEN TEGL EGERNSUND A/S	DK-28672012-1001634638-1761-20041001	9703	9699	9699	9699	9699	48499	
1762	329	PETERSMINDE TEGLVÆRK A/S	DK-33778716-1000268567-1762-20041001	11503	11500	11500	11500	11500	57503	
1763	330	Pipers Teglværker A/S Gandrup Teglværk	DK-23998513-1003013090-1763-20041001	15521	15517	15517	15517	15517	77589	
1764	331	PIPERS TEGLVÆRKER A/S Hammershøj Te	DK-23998513-1003013089-1764-20041001	13857	13854	13854	13854	13854	69273	
1780	332	Ydby Teglværk A/S	DK-81664315-1007655432-1780-20041001	6157	6156	6156	6156	6156	30781	
1784	333	Tychsen's Teglværk A/S	DK-15517077-1000937672-1784-20041001	4105	4102	4102	4102	4102	20513	
1785	334	Vedstaarup Teglværk A/S	DK-48791018-1001920902-1785-20041001	13758	13755	13755	13755	13755	68778	
1786	336	Vesterled Teglværk A/S	DK-82753915-1002654599-1786-20041001	11607	11605	11605	11605	11605	58027	
1544	337	Villemoes Teglværk	DK-45231216-1001865577-1544-20041001	4655	4652	4652	4652	4652	23263	
1788	338	Vindø Teglværk A/S	DK-32232515-1001687185-1788-20041001	7426	7426	7426	7426	7426	37130	
1760	339	Pedershvile Teglværk	DK-10502306-1002997604-1760-20041001	8952	8950	8950	8950	8950	44752	
1765	340	Prøvelyst Teglværk	DK-10502306-1002997598-1765-20041001	9207	0	9204	9204	9204	36819	
1789	341	WIENERBERGER A/S	DK-10502306-1002896764-1789-20041001	4788	4784	4784	4784	4784	23924	
7	342	Aalborg Portland A/S	DK-14244441-1002952999-0007-20041001	2567181	2567177	2567177	2567177	2567177	12835889	
1733	343	Faxe Kalk, Ovnanlægget Stubberup	DK-20882182-1005184196-1733-20041001	99777	99777	99777	99777	99777	498885	
1726	344	Danogips	DK-54050313-1003103433-1726-20041001	21037	21036	21036	21036	21036	105181	
1735	345	Gyproc A/S	DK-27237916-1001610372-1735-20041001	17085	17085	17085	17085	17085	85425	
1727	346	DANSK ETERNIT A/S	DK-58711713-1002086335-1727-20041001	0	0	0	0	0	0	
1777	348	Munck Asfalt A/S	DK-10977193-1002905302-1777-20041001	2216	2216	2216	2216	2216	11080	
1778	349	Munck Asfalt A/S	DK-10977193-1002905326-1778-20041001	2810	2807	2807	2807	2807	14038	
1779	350	Munck Asfalt A/S	DK-10977193-1002905314-1779-20041001	2582	2579	2579	2579	2579	12898	
1767	351	Rockwool A/S Doense	DK-42391719-1003070026-1767-20041001	48867	48867	48867	48867	48867	244335	
1769	353	Rockwool A/S, Vamdrup	DK-42391719-1003070014-1769-20041001	58123	58119	58119	58119	58119	290599	
1728	354	Maxit, Hinge	DK-59983016-1003135246-1728-20041001	53828	53827	53827	53827	53827	269136	
1756	355	Maxit, Ølst	DK-12841736-1002931142-1756-20041001	53328	53328	53328	53328	53328	266640	

Annex A.3.1

Annex A.3.1: Installations covered by the Danish National Allocation Plan 2008-12.

ID	Installation ID in register	Name of installation	Permit Identifier	allocation 2008	allocation 2009	allocation 2010	allocation 2011	allocation 2012	Period allocation	Reserve
1395	356	Danfoss	DK-20165715-1002999115-1395-20041001	24865	24865	24865	24865	24865	124325	
1754	357	ODENSE STAALSKIBSVÆRFT A/S	DK-45739910-1003085393-1754-20041001	14795	14792	14792	14792	14792	73963	
753	358	Maricogen P/S	DK-20683341-1004449186-0753-20041001	100716	100716	100716	100716	100716	503580	
929	359	Fællinggaard Varmeforsyning Aps	DK-73731410-1002410978-0929-20041001	16165	16165	16165	16165	16165	80825	
81	360	Danisco, Grindsted	DK-11350356-1003073542-0081-20041001	49555	49551	49551	49551	49551	247759	
1798	361	Duferco Danish Steel	DK-27450431-1010437772-1798-20041001	10272	10272	10272	10272	10272	51360	
1755	362	Odense Universitets Hospital	DK-40556311-1003309680-1755-20041001	6063	6063	6063	6063	6063	30315	
1853	363	Arkil asfalt	DK-15070544-1002965976-1853-20041001	1902	1898	1898	1898	1898	9494	
1793	364	LMK Vej A/S Randers Asfaltfabrik	DK-18298503-1007635792-1793-20041001	884	884	884	884	884	4420	
1794	365	LMK Vej A/S Ølstykke Asfaltfabrik	DK-18298503-1007635695-1794-20041001	1465	1463	1463	1463	1463	7317	
75	367	Gentofte Hospital	DK-16189006-1003258812-0075-20041001	2397	2396	2396	2396	2396	11981	
1858	368	DONG Energy kedler ved SCA	DK-25460715-1010839943-1858-20041001	0	0	0	0	0	0	
1829	369	Hvidovre Hospital	DK-18143534-1003256912-1829-20041001	1515	1514	1514	1514	1514	7571	
1801	370	Dan feltet omfattende anlæg på platformen	DK-22757318-0000000000-1801-20041001	647752	647750	647750	647750	647750	3238752	
1802	371	Gorm feltet omfattende anlæg på platforme	DK-22757318-0000000000-1802-20041001	446895	446894	446894	446894	446894	2234471	
1803	372	Harald feltet omfattende anlæg på platform	DK-22757318-0000000000-1803-20041001	37979	37977	37977	37977	37977	189887	
1804	373	Tyra feltet omfattende anlæg på platformer	DK-22757318-0000000000-1804-20041001	620823	620821	620821	620821	620821	3104107	
1806	374	Halfdan feltet omfattende anlæg på platfor	DK-22757318-0000000000-1806-20041001	92484	92482	92482	92482	92482	462412	
1805	375	Siri feltet omfattende anlæg på Siri platform	DK-73349613-0000000000-1805-20041001	226446	226445	226445	226445	226445	1132226	
1800	376	Syd Arne feltet omfattende anlæg på Syd A	DK-73589118-0000000000-1800-20041001	208086	208084	208084	208084	208084	1040422	
276	377	Haslev Kraftvarmeværk	DK-18936674-1004303224-0276-20041001	0	0	0	0	0	0	
254	378	Helsinge Fjernvarme	DK-42760218-1001830583-0254-20041001	26194	26194	26194	26194	26194	130970	
1870	379	Vorskla Steel Denmark A/S	DK-27749836-1010580397-1870-20050314	3174	3809	3809	3809	3809	18410	
1877	380	Colas Sundholmen, Nørresundby	DK-10246415-1002889071-1877-20050322	0	0	0	0	0	0	
1891	381	Effektpartner - 25 MW Gasturbine	DK-20705833-1011336716-1891-20051103	9875	9875	9875	9875	9875	49375	
1893	382	Effektmarked DK I/S	DK-29144850-1011767989-1893-20060206	5137	5137	5137	5137	5137	25685	
1130	383	Gartneriet Hjortebjerg Kraftvarme I/S	DK-16622486-1003846915-1130-20060518	5138	5134	5134	5134	5134	25674	
1906	384	LMK VEJ A/S - Vandel Asfaltfabrik	DK-18298503-1004835379-1906-20060131	0	0	0	0	0	0	
525	385	Thisted Varmeforsyning	DK-30992512-1003030727-0525-20060710	1000	1000	1000	1000	1000	5000	
1917	387	CTR, KLC2 - Københavns Lufthavn	DK-74132111-1012536441-1917-20061013	6000	6000	6000	6000	6000	30000	
1934	388	Energi Fyn Produktion Kratholm	DK-27471870-1012476848-1892-20060825	7595	7595	7595	7595	7595	37975	
4	389	Aulum Fjernvarme A.m.b.a.	DK-39042010-1001775537-0004-07032007	291	290	290	290	290	1451	
5	390	Aulum Fjernvarme A.m.b.a.	DK-39042010-1012884571-0005-07032007	8603	6068	8603	8603	8603	40480	
1940	391	Energi Fyn Produktion Assens	DK-29839999-1013068263-1940-20070622	0	0	0	0	0	0	
1939	392	Østermose Bioenergi	DK-29977089-1012711901-1939-20070615	0	0	0	0	0	0	
1946	393	Vækst&Miljø Regulerkraft Vojens	DK-12257899-1013486650-1946-20070802	0	0	0	0	0	0	
1949	394	Skou Hansen I/S Tønder	DK-30134885-1013497865-1949-20070928	0	0	0	0	0	0	
262	396	Nibe Varmeværk	DK-68726018-1002279450-262-20071102	10342	7634	10342	10342	10342	49002	
1950	397	Flex Energi A/S Sønderborg	DK-30082680-1013481292-1950-20071107	0	0	0	0	0	0	
1948	398	MPM Invest Aps	DK-29831459-1013483740-1948-20070914	0	0	0	0	0	0	
1952	399	Syd Energi Regulerkraftanlæg Esbjerg	DK-25118359-1013752164-1952-20071116	0	0	0	0	0	0	
1969	400	DK plant aps	DK-15283343-1000895826-1969-20080401	0	15017	8581	8581	8581	40760	
1973	401	Regulerkraft Ikast ApS	DK-29845867-1014369135-1973-20080430	0	0	0	0	0	0	

Annex A.3.2: Information on Denmark's national CO_2 allowance registry

1. Information on the registry administrator
The Danish Energy Agency
Amaliegade 44
DK-1256 Copenhagen K
Tel. : +45 33 92 75 11
Fax: +45 33 11 47 43
e-mail: ens@ens.dk

2. Cooperation with other countries concerning the operation of the registry
Denmark does not cooperate with other countries concerning the administration or operation of the Danish CO_2 emissions trading registry.

3. Standards for data exchange
The Danish registry system follows the UN Data Exchange Standards Technical Specifications (version 1.1.1).

4. Procedures for administration and operation of the emissions trading registry
The procedures are described in the Commission regulation (EC) no. 994/2008 for a standardised and secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and Decision No 280/2004/EC of the European Parliament and of the Council Denmark is in compliance with the procedures stated in the regulation.

5. Safety standards
The registry is safeguarded with a Cisco FireWall. Software is updated as required. The entire system is monitored regularly and all security violations are recorded and corrected as soon as possible. As regards the network, administrative access to the machines from the Ministry's internal network is secure. The Registry can only be accessed via the programme through WEB-Services. These WEB-Services can be accessed either through an open part (the initial communication) or a secure part (the register software application itself).The secure part of the system is based on SSL. Similarly the system is designed so as to make it impossible to use the same password more than once in the system. The Registry's production system consists of 2 servers, a WEB server and a database server. The servers are configured so that a single disc error will not stop the system. Furthermore as regards the disc, the DB server is set up so that the transaction log and the database are physically located on separate discs. Everyone who registers as users of the registry receives their own username and password and is instructed to ensure that these remain confidential. If a user discovers that an unauthorized person has gained access to his/her password, the password must be changed in the registry immediately and the registry administration must be notified. The registry automatically disconnects when access as been inactive for some time. You must log on again using your username and password.

6. Information available to the public
Only the information stated in article 9 and the corresponding appendices in the Commission regulation (EC) no. 994/2008 for a standardised and secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and Decision No 280/2004/EC of the European Parliament and of the Council is available to the public.

7. Internet address for the registry
https://www.kvoteregister.dk/

8. Protection, maintenance and recreation of data
A total back-up is carried out on a nightly basis to a remote disk. The system is configured with a high error tolerance level. Furthermore the configuration of the system makes it possible to re-install it at a different physical location. The registry is covered by the general emergency plan for the Danish Ministry of the Environment.

Only persons authorised by the ministry will be granted access to the production environment.

Only representatives appointed by the administrator of the registry and a small number of employees in the host organisation have access to all data in the registry system. All of these persons are covered by a duty of non-disclosure. Any physical or technical access to the system from the system administrator (the host organisation) will be logged. The registry administrators change their passwords every three months and when needed.

Emergency plan for the Danish CO_2 Emissions Trading Registry:
The description below includes a check list to be used in the event of an emergency situation affecting the Danish Emissions Trading Registry. The check list is to be used if the telephone company's (TDC) service centre is out of order, or if the equipment the system uses is damaged. The check list refers to the general system documentation for the Danish Emissions Trading Registry, which includes a detailed description of procedures. The starting point for reinstallation is to give priority to actions so as to ensure that an operative system is established as soon as possible and that users, including CITL/ITL, experience as little down time as possible.

Check list:

1. Contact the hardware group of the Centre for Corporate Management to get a server/PC.
2. Place the server/PC in the hub at the Centre for Corporate Management, IT Services, Rentemestervej 8, building A, first floor.
3. Install Microsoft Windows 2003 on the server.
4. Install Microsoft SQL2000 on the server.
5. Install Microsoft Internet Information Server on the server.
6. Install Backup client on the server.
7. Install the ETR system and adapt it to Danish conditions (menu bar, the EPA logo, EPA fonts and colours, conditions etc.).
8. Set up user on the SQL server.
9. Re-establish the certificate for a secure connection between CITL and the Danish ETR.
10. Read in a backup of the Danish ETR database.
11. Start Register services on the server.

The Danish ETR will now run on a temporary installation, and work to re-establish a new permanent production system will be continued.

Annex B1 The Effort Analysis

Summary

Since 1990, a broad range of national policies and measures have been implemented in Denmark that have impacted on emissions of greenhouse gases. Some initiatives have been implemented with CO_2 reduction as the primary aim, while other initiatives have been motivated by other aims.

The *Effort Analysis*[68] reports on Denmark's effort related to the reduction of greenhouse gas emissions undertaken on national level in the period 1990-2001, and the costs of this effort.

Under the Kyoto Protocol and the EU's subsequent Burden Sharing Agreement, Denmark has undertaken to reduce greenhouse gas emissions by 21% in 2008-2012, compared to 1990 levels[69]

One of the additional requirements of the Kyoto Protocol is that the use of flexible mechanisms must be supplemental to domestic action. The calculation of the total Danish effort is relevant in this connection.

It is therefore relevant to consider the effects of Denmark's efforts both in relation to the Kyoto accounting, and in relation to the total effect - regardless of whether the emissions reductions have been in Denmark or abroad.

In relation to the Kyoto accounting, which is based on the CO_2 impact associated with the specific emissions in Denmark, it is expected that part of the effect of the energy sector initiatives will be offset by increased electricity exports. This means that the CO_2 emissions linked to the exported electricity component have a negative impact on Denmark's Kyoto accounting, rather than on that of the electricity importing country.

Choice of measures

The *Effort Analysis* report aimed to include the most important environment and energy policy measures implemented in the period 1990-2001 that have had a significant effect on greenhouse gas emissions.

Please note that many of the measures have not been planned and adopted with the aim of contributing to the fulfilment of Denmark's Kyoto obligation, but derive from the political objective from 1990 (in the "*Energy 2000* action plan) of reducing CO_2 emissions from Denmark's energy consumption by 20% between 1988 and 2005. Thus the *Effort Analysis* does not evaluate the implemented initiatives against their original objective, but rather in relation to reducing greenhouse gases, and how much the implemented initiatives will contribute to the binding Kyoto objectives that exist today.

The chronological definition of the initiatives is not always straightforward. Some initiatives were introduced prior to 1990, but the implementation (and associated reduction in greenhouse gas emissions) has taken place after 1990. This is the case, for example, for the conversion to natural gas and for Action Plan for the Aquatic Environment I. The calculations in the *Effort Analysis* only include the CO_2 reductions that have taken place after 1990.

Denmark's effort in the period 1990-2001

The *Effort Analysis* evaluates the effects of measures implemented in the period 1990-2001 in relation to the actual emissions in 2001, and in relation to the expected average annual emissions in 2008-2012, as laid down in the base projection used as a basis for the Danish climate strategy from February 2003 (i.e. the previous 'with measures' projection, which only took into account the effects of measures implemented or adopted before the Climate Strategy). Initiatives adopted after 2001 are

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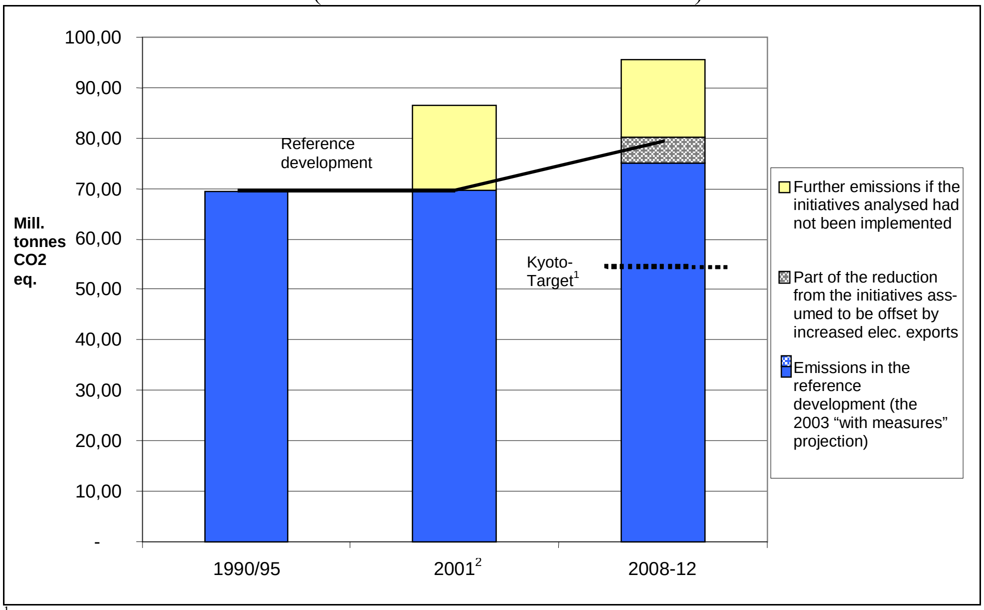
[68] The Effort Analysis is published in the report "Danmarks udledning af CO_2 – indsatsen i perioden 1990-2001 og omkostningerne herved (Denmark's CO_2 Emissions – Efforts in the Period 1990-2001 and the costs involved) – Main and Annex Report, Statement from the Danish EPA no. 2 and 3, 2005 (in Danish).

[69] However, in 2002 the (Environment) Council and the Commission adopted a political declaration stating that the calculation of the assigned amounts (measured in tonnes) in 2006 shall take into account Denmark's statement in connection with the Burden Sharing Agreement in 1998, i.a. stating that Denmark's reductions shall be seen in relation to an adjusted 1990 level, and that the adoption of additional common European measures is assumed.

therefore not included in the results of the *Effort Analysis*, and hence these results cannot be used as a total status report for the Danish efforts in relation to the Kyoto target.

The *Effort Analysis* reports on and calculates the Danish initiatives by considering their total effect, regardless of whether they have resulted in reductions in emissions in Denmark or abroad. However, the analysed initiatives have also been assessed in relation to Denmark's international obligations under the Kyoto Protocol, based on the CO_2 impact associated with the specific emissions in Denmark. Figure B2-1 illustrates how much greater Denmark's CO_2 emissions would have been in 2001 and in 2008-12 if the initiatives analysed had not been implemented.

FIGURE B2-1: DEVELOPMENTS IN TOTAL CO_2 EQUIVALENT EMISSIONS, WITH AND WITHOUT THE MEASURES UNDER ANALYSIS (PRODUCTION-BASED CALCULATION)



[1] The reduction requirement in the figure has been calculated as Denmark's legal obligation. i.e. the figure has not been corrected for the particularly large electricity imports in the 1990 base year. However, in 2002 the (Environment) Council and the Commission adopted a political declaration stating that the calculation of the assigned amounts (measured in tonnes) in 2006 shall take into account Denmark's statement in connection with the Burden Sharing Agreement in 1998, e.g. stating that Denmark's reductions shall be seen in relation to an adjusted 1990 level. When this factor is taken into account, the reduction requirement would be reduced by up to 5 million tonnes annually.

[2] The reduction calculated in 2001 includes the full effects, i.e. it includes the CO_2 reductions that domestic actions have led to in other countries.

As Figure B2-1 shows, the initiatives under consideration are estimated to give rise to CO_2 reductions of approx. 20.6 million tonnes per year in the 2008-12 period. This expresses the total effect of Denmark's effort in the 1990-2001 period. It also shows (see below) that part of the effect of energy sector initiatives is expected to be offset by increased electricity exports, such that in relation to the Kyoto emission accounting, the initiatives under consideration are estimated to lead to CO_2 reductions of approx. 15.6 million tonnes per year in the 2008-12 period.

A number of the initiatives implemented have been aimed at reducing CO_2 emissions from Danish electricity consumption. However, Danish electricity production is integrated into the Northern European electricity market, and the effect of initiatives in the electricity sector are – and are expected to continue to be – partially offset by increased exports of fossil fuel electricity production from Denmark. Estimation of the size of this effect is subject to extreme uncertainty. Based on a rudimentary assumption that 50% of the effects of the electricity sector initiatives will be offset by electricity exports, approx. 5.0 of the 20.6 million tonnes of CO_2 will be offset by increased electricity exports. This estimate is subject to significant uncertainty and depends, for example, on the future expansion of production capacity in the Scandinavian countries (cf. the background report, "*Energy policy initiatives in the 1990's: Costs and CO_2 effects*[70])

[70] Danish Energy Authority 2005, Published electronically in May 2005 on the Authority's website (http://www.ens.dk/graphics/Publikationer/Energipolitik/Energipolitiske_tiltag_i_1990erne/pdf/energipol_tiltag_CO2effekt.pdf)

The *Effort Analysis'* 'without measures' calculation of CO_2 emissions per sector is shown in Table B2-1.

TABLE B2-1: OVERVIEW OF TOTAL GREENHOUSE GAS EMISSIONS AND THE TOTAL REDUCTIONS DIVIDED BY SECTOR (FOLLOWING THE SECTOR DIVISION OF THE CLIMATE STRATEGY) IN MILLIONS OF TONNES OF CO_2 EQUIVALENTS PER YEAR

Sector	**1990/95**[1]	**2001**			***2008-12***		
	Base[2]	**Current emissions**[2]	**Reductions from measures**	**Emissions without measures**	**Emission projection**[2]	**Reductions from measures**	**Emissions without measures**
Energy	42.7	43.2	13.5	56.8	53.1	11.0/16.0[3)]	64.1
Transport	10.7	12.6	1.3	13.9	14.6	1.7	16.3
Industry	0.3	0.7	0.0	0.7	0.7	0.4	1.1
Agriculture	14.4	11.7	1.6	13.3	10.8	1.9	12.7
Waste	1.3	1.2	0.2	1.4	0.9	0.5	1.4
Total	**69.5**	**69.6**	**16.7**[3]	**86.2**	**80.1**	**15.6 /20.6**[4]	**95.6**

[1] 1990/95 indicates the emissions in the base year. CO_2, CH_4 and N_2O emissions have 1990 as the base year, while the industrial gases have 1995 as the base year. No corrections have been made for electricity imports/exports.
[2] Source: Emissions figures (base, current in 2001 and projections for 2008-12: Danish Ministry of the Environment 2003)
[3] These 16.7 million tonnes CO_2 per year include the full effects, i.e. they include the CO_2 reductions that domestic actions have led to abroad.
[4] For the energy sector measures the full reduction is specified. The Danish Energy Authority estimates that approx. 5.0 of these 20.6 million tonnes CO_2 annually will be offset by increased electricity exports based on the calculation assumptions of the climate strategy.

The *Effort Analysis* estimates that Denmark's "without measures CO_2 emissions in 2008-12 would have been 95.7 million tonnes CO_2 annually. Denmark's legal reduction obligation of 21% in relation to 1990 levels corresponds to emissions in 2008-2012 being reduced to approx. 54.9 million tonnes CO_2 annually[20]. Denmark would have therefore fallen short of this goal by 40.7 million tonnes CO_2 annually in 2008-2012 if the initiatives analysed had not been implemented.

In summary, the effect between 2008-2012 of the initiatives analysed would be 15.6 million tonnes annually, after taking into account that 50% of the electricity sector initiatives are expected to be offset by electricity exports.

As mentioned above, the total reduction effects, in Denmark and abroad, from the implemented domestic initiatives can be estimated at 20.6 million tons annually. Therefore it can be concluded that Denmark has already made significant progress domestically.

Extensive Danish electricity imports from Norway and Sweden in the 1990 base year led to unusually low Danish emissions. If the effects of these imports are compensated for, it would allow Denmark to reduce Danish emissions by approx. 5 million tonnes less than specified above.

In 2002, the (Environment) Council and the Commission adopted a political declaration stating that the calculation of the permitted emission volumes (measured in tonnes) in 2006 shall take into account Denmark's statement in connection with the Burden Sharing Agreement in 1998, e.g. stating that Denmark's reductions shall be seen in relation to an adjusted 1990 level.

Costs of measures

The costs of the CO_2 reduction have also been estimated in the *Effort Analysis*, but only for selected measures. The choice of these measures has largely been governed by which measures CO_2 costs had previously been calculated for.

The estimate is based on a cost-benefit analysis of the total costs and benefits for each measure, excluding the value of the reduction in CO_2 emissions.

An expression of the total socio-economic costs per tonne of reduced CO_2 emissions (also called the initiative's CO_2 shadow price) can be found by comparing the total net costs of the initiative against the estimated resultant CO2 reduction. The total CO_2 reduction has been used, i.e. regardless of whether this CO_2 reduction took place in Denmark or abroad (consumption-based calculation).

This corresponds to the method used in previous analyses carried out by the Danish Ministry of Finance and others in 2001, by the Economic Council in 2002, and in cost estimations used in the Government's climate strategy from 2003.

Please note that the introduction of the EU's CO_2 allowance scheme (EU-ETS) from 2005 changes the framework conditions for large parts of the energy sector and energy-intensive industry, such that the calculation method cannot be used to assess future measures within these areas where quotas have been imposed. The introduction of the allowance scheme means that CO_2 emissions from the sectors subject to allowances, including electricity production, will be unequivocally determined by the total amount of allowances accounted in accordance with the Kyoto Protocol. The calculations of the shadow values for the areas subject to allowances, up until the 2008-12 period where the new Kyoto regime will have entered into force, thus serve purely illustrative purposes.

The introduction of the open international electricity market since the late 1990s means it is no longer certain that for example such as the expansion of renewable energy will reduce CO_2 emissions from Danish electricity producers correspondingly, as it may be an advantage for producers to export electricity rather than reduce production. Where this is the case, CO_2 emissions will be reduced in other countries instead. This is a major issue in relation to calculating how great an effect the measures will have in relation to the base projection.

Please note that the CO_2 allowance scheme will increase the European electricity price and thus increase the profitability of electricity savings compared to the situation today.

Note that no attempt has been made in the *Effort Analysis* to incorporate any positive effects on security of supply, technology development and commercial development, nor has it been possible to include the value of all environmental impacts. This is due to the difficulty of quantifying and valuing these effects, which in principle should be included.

The value of the reductions in SO_2 and NO_x emissions resulting from the measures has been included, but the valuation of these physical reductions is very uncertain. This report uses the same valuations as the climate strategy. Since the calculations were carried out, the National Environmental Research Institute, Denmark (NERI) has published new, higher valuations for the cost of the negative impacts of SO_2 and NO_x emissions. Using these new, updated assumptions from NERI – and with nothing else changed – the calculations would have resulted in lower CO_2 shadow prices for several measures.

TABLE B2-2: HISTORICAL CO_2 SHADOW PRICES FOR SELECTED MEASURES (CONSUMPTION-BASED CALCULATION)

Sector	Measure	Average annual CO_2 reduction for 2008-2012 Mill. tonnes CO_2 per year	Socio-economic cost[1] per tonne CO_2 DKK/tonne CO_2 (2002 prices)
Energy	Grants to private wind turbines	3.4	275
	Electricity generation plant expansion using wind turbines	0.9	250
	Expansion in decentralised cogeneration of heating and power	2.1	100
	Agreement on use of biomass for electricity production	1.1	325
	Grants for energy savings in businesses	0.9	275
	Grant to cover CO_2 tax (agreement scheme)	0.6	0
	Grant for conversion of old dwellings to cogenerated heat and power	0.2	1,925[2]
	Grant to promote connection to coal-fired CHP	0.1	850
	Grants for solar heating, heat pumps, biomass	0.1	1,500[3]
	Building labelling	0.4	1,300
Tax measures	Changes to taxes on energy products[4]	1.5	325
	Increased taxes on fuel[4]	1.2	775[5]
Industry	Regulation of industrial gases	0.4	200[6]

[1] The shadow price has been calculated based on the total CO_2 reduction.
[2] This measure has also lead to improved comfort for those who have changed to CHP. This is believed to have been part of the political motive for the measure. However, no attempt has been made to value this gain.
[3] Weighted average. This shadow price covers three initiative areas with very different shadow prices. Solar heating (DKK 5,700 /tonne CO_2), Heat pumps (DKK 650/tonne CO_2) and Biomass (DKK 600/tonne CO_2).
[4] The effect and the shadow price have been estimated for 2001 based on the nominal tax increase from 1990 to 2001. Assuming there are no changes in demand, and constant real prices and taxes, it will also be possible to use this estimate for the 2008-12 period. Note that these assumptions are not fully compatible with the assumptions about changes to fuel prices associated with the energy measures.
[5] The CO_2 reduction has been calculated for all fuel consumption, i.e. fuel consumption for both passenger cars and trucks. However the shadow price has only been calculated for fuel consumption in passenger cars, corresponding to the calculations carried out in connection with the Government's 2003 Climate Strategy.

[6] Industrial gases are used for many purposes. The illustrated shadow price has been calculated, as an example, for the costs of replacing HFC gases with more environmentally-friendly refrigerants in industrial refrigeration plant, the biggest consumption group within the affected industrial gases.

Table B2-2 shows that the shadow costs for the selected measures vary substantially, and for most of the measures are higher than the indicator of DKK 120 per tonne CO_2 specified in the Government's climate strategy. In the energy sector, the "Grant for conversion of apartments for the aged to cogenerated heat and power, "Grants for solar heating, heat pumps, and biomass and "Building labelling measures are estimated to have been associated with the highest costs in relation to their CO_2 reduction, while the "Grant to cover CO_2 tax (agreement scheme) and "Expansion in decentralised cogeneration of heating and power have been associated with the lowest costs.

Note that the calculations are generally subject to significant uncertainty and it has not been possible to include all the socio-economic effects in the calculations. For example, the benefit of increased comfort associated with the transition to CHP has not been included in the calculation of the net costs for the "Grant for conversion of old dwellings to cogenerated heat and power initiative. Many of the measures will also have a positive effect on the security of the energy supply, which has not been valued.

Please refer to the annex report to the *Effort Analysis* and to "*Energy policy measures in the 1990s: Costs and CO_2 effects* for further description of the conditions and assumptions underlying the calculation of the shadow price for each measure.

Uncertainty and sensitivity analyses

Both the CO_2 reductions and shadow costs for the analysed measures are subject to significant uncertainty due to the complexity and scope of the calculations alone. The following key issues in relation to the uncertainty of the results should be highlighted:

- It is not unequivocally clear how the demarcation of an initiative should be carried out. This applies both to choosing which measures to include and, in certain cases, how to define each initiative. Demarcation influences both the CO_2 reduction and shadow cost.
- The CO_2 reductions have been calculated separately for each initiative. There may be certain consequential effects from an initiative that are not included in the analysis of another initiative. Caution should therefore be exercised when comparing the shadow costs of various measures and across sectors.

In addition to the uncertainty associated with determining the expected reductions, there is also significant uncertainty linked to determining the socio-economic prices for the various effects included in such an analysis. With regard to the socio-economic energy prices, the same fuel price assumptions have generally been used as were used in the Government's 2003 Climate Strategy.

To give an indication of the significance of central assumptions, table B2-3 contains a few examples showing how much the shadow price varies in response to potential changes to the key background parameters. For a more complete and systematic presentation of the sensitivity analyses for the individual measures, please refer to "*Energy policy measures in the 1990s: Costs and CO_2 effects*".

TABLE B2-3: SENSITIVITY ANALYSES FOR SELECTED MEASURES – EXAMPLES

Measure	**Change in parameter**	**Result of base calculation Shadow price reduction in 2008-12**	**Result of sensitivity analysis**
Grants to private wind turbines	A discount rate of 3 % instead of 6 % p.a.	3.4 million tonnes CO_2 / year DKK 275/tonne CO_2	- DKK 175/tonne CO_2 (- DKK 100/tonne)
Grants to private wind turbines	Change in the electricity price from 2005 of - DKK 0.02/kWh	3.4 million tonnes CO_2 / year DKK 275/tonne CO_2	- DKK 295/tonne (+ DKK 20/tonne)
Increases to fuel taxes [1]	Demand elasticity halved from -0.6 to -0.3 (passenger vehicles) and -0.2 to -0.1 (trucks)	1.2 million tonnes CO_2 / year DKK 775/tonne CO_2	0.6 million tonnes/year (-0.6 mill. tonnes/year) DKK 575/tonne (- DKK 200/tonne)

[1] The CO_2 reduction has been calculated for all fuel consumption, i.e. fuel consumption for both passenger cars and trucks. However the shadow price has only been calculated for fuel consumption in passenger cars, corresponding to the calculations carried out in connection with the Government's 2003 Climate Strategy. This factor also applies to the sensitivity analysis for "Increases to fuel taxes.

Effects

Estimate of reductions

So as to estimate the effect an initiative has had on greenhouse gas emissions, the change compared to a reference scenario must be assessed. The reference scenario is based on the base projection of CO_2 emissions carried out in connection with the Danish climate strategy from February 2003. As a rule this projection is assumed to reflect the effect of the initiatives analysed. As regards the individual initiatives, how great the increase in emissions would have been if the initiative in question had not been introduced has thus been estimated.

The initiatives have typically been assessed individually, i.e. in some cases the interaction effects between some initiatives have not been taken fully into account. Reductions in energy consumption due to tax increases, for example, can have effect the use of energy production from wind turbines and vice versa. Furthermore please note that all initiatives in the energy area have been calculated based on one and the same reference development (base projection from February 2003). The base projection is characterised by all calculations being based on a world with existing regulation, including e.g. existing taxes and duties. In principle calculations should also take into account the order in which the different initiatives have been – or will be – introduced as each initiative may affect the other initiatives both with regard to effect and costs. This has not been possible to do within the scope of *the Effort Analysis*.

The emission inventory method under the Kyoto Protocol uses the energy *production* or the actual emission of CO_2 in Denmark, as opposed to in the Energy 2000 emission inventory, which is based on CO_2 impacts caused by energy *consumption* in Denmark. This is a crucial difference as regards initiatives that either affect the demand for electricity or the production of environmentally-friendly electricity. Electricity production (and therefore CO_2 emissions) in Denmark is determined by the price development in the electricity market and cannot be controlled directly through national initiatives.

One of the additional requirements of the Kyoto Protocol is that the use of flexible mechanisms has to be supplemental to domestic action. Therefore two estimates of Danish efforts are in principle relevant – one estimate on achieved emission reductions in Denmark compared to the inventory calculations under the Kyoto Protocol, and one estimate of *the total effect* of the Danish efforts under the Kyoto Protocol, regardless of whether an initiative has led to reductions in emission in Denmark or abroad.

With the introduction of the open international electricity market in the late 1990s, it is not a given fact that for example extension of renewable energy will reduce CO_2 emissions from *Danish* electricity producers correspondingly, as it may be an advantage for Danish electricity producers to export electricity instead of limiting their production. To the extent that this is the case, CO_2 emissions will decrease in other countries instead of in Denmark. This is a central issue of concern as regards calculating how great the effect of initiatives will be when compared to the base projections.

The Danish electricity production in the Northern European electricity market, and the effect of initiatives for limiting the need for fossil electricity production is – and is expected to be – partially countered by an increase in exports of fossil electricity production from Denmark. Estimation of the size of this effect is subject to extreme uncertainty. A rudimentary assumption is that, 50% of the effects of the electricity sector initiatives will be offset by electricity exports. This estimate is subject to significant uncertainty and depends, for example, on the future expansion of production capacity in the Scandinavian countries (cf. the background report, Energy policy initiatives in the 1990's: Costs and CO_2 effects (Danish Energy Authority, 2005).

Emission reductions

The estimated reductions for measures for the year 2001 and the annual average in the period 2008-12 is presented in table B2-4 below. Please note that CO_2 reductions in the period 2008-2012 are expressed both from an energy consumption and energy production angle. The energy consumption angle ia based on the assumption that all CO_2 reductions will be allotted to Denmark, while reductions based on the energy production angle alone concern changes in actual emissions from Danish areas.

TABLE B2-4 OVERVIEW OF REDUCTION CONTRIBUTIONS OF MEASURES IN 2001 AND EXPECTED CONTRIBUTIONS AS ANNUAL AVERAGE REDUCTION IN THE PERIOD 2008-2012 (MILLION TONNES CO2 EQUIVALENTS)

Sector	Measure	CO_2 reduc. in 2001 Million tonnes CO_2	Av. annual CO_2 reduc. for 2008-2012 - Million tonnes CO_2	
			Energy consumption angle	Energy production angle
Energy	Grants to private wind turbines	2.6	3.4	1.7
	Electricity generation plant expansion using wind turbines	0.4	0.9	0.5
	Expansion in decentralised cogeneration of heating and power	2.2	2.1	0.4
	Agreement on use of biomass for electricity production	0.2	1.1	1.1
	Grants for energy savings in businesses	1.1	0.9	0.9
	Grant to cover CO_2 tax (agreement scheme)	0.3	0.6	0.6
	Grant for conversion of old dwellings to cogenerated heat and power	0.2	0.2	0.2
	Grant to promote connection to coal-fired CHP	0.1	0.1	0.1
	Grants for renewable energy	0.1	0.1	0.1
	Building labelling	0.2	0.4	0.4
	Changes to taxes on energy products[2]	1.5	1.5	1.0
	Further energy measures	4.6	4.6	4.0
	Total energy	**13.5**	**16.0**	**11.0**
Industry	Taxes on and regulation of use of industrial gases	0.0	0.4	0.4
	Total industry	**0.0**	**0.4**	**0.4**
Transport	Increased fuel taxes[2]	1.2	1.2	1.2
	Diverse measure to improve energy efficiency in Danish vehicles[1]	0.2	0.6	0.6
	Total transport	**1.3**	**1.7**	**1.7**
Agriculture	Action plans for agriculture[3]	1.6	1.9	1.9
	Total agriculture	**1.6**	**1.9**	**1.9**
Waste	Collection of methane from landfills	0.2	0.2	0.2
	Ban on landfilling of waste suitable for incineration	0.0	0.3	0.3
	Total waste	**0.2**	**0.5**	**0.5**
All	**Total**	**16.7**	**20.6**	**15.6**

[1] In addition to the voluntary agreement with the automobile industry, measure include the green owner tax, information campaigns, energy labelling etc.
[2] Reductions as a consequence of the increased taxes on both energy products and fuel are estimated for 2001. Reductions for 2008-12 are based on the assumption that taxes and fuel prices actually remain unchanged and that demands do not change.
[3] Includes the NPO action plan from 1990, Action Plan for the Aquatic Environment I from 1987, Action plan for sustainable agriculture from 1991 and Action Plan for the Aquatic Environment II from 1998. See NERI, 2003 for a more detailed description of the action plans and their effects.

Table B2-4 includes a row with further energy measures.

Table B2-5 includes a number of initiatives without cost estimates that also significantly affect Denmark's CO_2 emissions. These measures have not been studied in more detail in connection with *the Effort Analysis* - either because their overall objective has not been to reduce CO_2 emissions or because insufficient data were available for a proper assessment of the measure's effects within the budget framework. In another context how much these additional measures would contribute to CO_2 reductions in 2008-12 has been assessed. The effect 2008-12 is estimated on the basis of energy statistics from 2001 combined with assumptions used in calculations for the Climate Strategy. The results of this assessment can be seen in table B2-5.

TABLE B2-5 OVERVIEW OF THE ESTIMATE OF CO2 REDUCTIONS FROM FURTHER ENERGY MEASURES

Measure[1]	**Estimate of CO_2 reductions in 2008-12 (million tonnes CO_2)**	**Estimate of CO_2 reductions in 2008-12 from energy policy of 1990s (million tonnes CO_2)**
Central CHP (coal-CHP) as replacement for individual oil-fired heating	1.8	0
Conversion from central electricity production from coal to natural gas	1.4	1.4
Establishment of other decentralised CHP that are not included under the measure Expansion in decentralised cogeneration of heating and power (including industrial CHP, biogas CHP and waste CHP)[2]	2.7	1.2
Separate district heating production from biomass	0.7	0.7
Utilisation of industrial surplus heat for district heating	0.3	0.1
Separate district heating production from waste	0.4	0
Natural gas supply for heating of individual buildings	1.2	0.6
Natural gas supply for industrial processes	1.1	0.6
Total	**9.6**	**4.6**

[1] It has been assumed that these measures are primarily fully implemented and that 2001 reductions correspond to the reduction stated for 2008-12.
[2] This measure entails an increase in emissions of the greenhouse gas methane. In the estimate of CO_2 reductions for 2008-12, an increase in methane corresponding to 0.3 million tonnes CO_2 equivalents has been included. The estimate of CO_2 reductions in 2008-12 from the energy policy of the 1990s includes an increase in methane corresponding to 0.1 million tonnes CO_2 equivalents.

The measures analysed are assessed to have reduced approx. 16.7 million tonnes CO_2 in total in 2001. Furthermore it is assessed that Denmark – seen from the so-called energy production angle – would have emitted approx. 15.6 million tonnes CO_2 more on average per year in the period 2008-12, is the measures analysed had not been implemented. Moreover the measures analysed will lead to further reductions in 2008-12 of approx. 5.0 million tonnes CO_2 per year, however this will be countered by the emissions from the increased electricity exports made possible by the measures implemented. The total emission of CO_2 seen from the so-called energy consumption angle would thus have been approx. 20.6 million tonnes greater without the measures.

Annex B2 Measures

Taxes and Duties

TD-1	Mineral-oil Tax Act
TD-2	Gas Tax Act
TD-3	Coal Tax Act
TD-4	Electricity Tax
TD-5	Carbondioxide tax on energy products
TD-6	Green Owner Tax
TD-7	Registration Tax Act

Energy

EN-1	Energy development and demonstration
EN-2	Biomass Agreement (Agreement on the use of biomass in electricity production)
EN-2	Biomass Agreement (Agreement on the use of biomass in electricity production)
EN-3	Price supplement and subsidies for renewable energy production
EN-4	Tenders for offshore wind turbines
EN-5	Scrapping scheme for old wind turbines
EN-6	Energy development and demonstration
EN-7	National CO2 allowance scheme for electricity producers
EN-8a	Subsidy to electricity generation (Renewable Energy)
EN-8b	Subsidies for electricity generation (wind turbines)
EN-9	Priority for electricity from CHP plants
EN-10	Requirement for offshore wind turbines
EN-11	Scrapping scheme for old, badly located wind turbines
EN-12	Renewable energy island - Samsø
EN-13	Construction subsidy for renewable energy
EN-14	Subsidy for investment in energy savings by industry
EN-15	Subsidy for conversion of old housing to CHP
EN-16	Subsidy to promote connection to coal CHP
EN-17	State subsidy for energy savings measures in housing for pensioners

Transport

TR-1	Information campaign on fuel consumption of new cars
TR-2	Energy-correct driving technique
TR-3	Initiative on enforcing speed limits
TR-4	Establishment of intermodal installations
TR-5	Promotion of environmentally friendly goods transport
TR-6	Reduced travel times for public transport
TR-7	Spatial planning

Business Sector

BU-1	Agreements on energy efficiency with business
BU-2	Savings activities by elec. grid, gas, oil and district heating companies (consump. of final energy excl. Transp.)
BU-3	Tax on HFCs, PFCs and SF6
BU-4	Regulation of use of HFCs, PFCs and SF6 (phasing out most of the uses)
BU-5	The enterprise scheme on HFCs
BU-6	Circular on energy-efficiency in state institutions
BU-7	Electricity Saving Trust – campaigns to promote electricity efficient appliances (promotes markeds and behavioral changes)

Agriculture and Forestry

AF-1	Action Plan for the Aquatic Environment I+II and Action Plan for Sustainable Agriculture
AF-2	Action Plan for the Aquatic Environment III
AF-3	Ban on burning straw on fields
AF-4a	Ammonia action plan and the new statutory order on manure: Optimisation of manure handling during housing.
AF-4b	Ammonia action plan and the new statutory order on manure: Rules on covering storage facilities.
AF-4c	Ammonia action plan and the new statutory order on manure: Ban on surface spreading of manure
AF-4d	Ammonia action plan and the new statutory order on manure: Reduction of the time on field surfaces.
AF-4e	Ammonia action plan and the new statutory order on manure: Ban on ammonia treatment of straw.
AF-4f	Environmental Approval Act for Livestock Holdings
AF-5	Planting of windbreaks
AF-6	Biogas plants
AF-7	Subsidies scheme for private afforestation on agricultural land (increase the forest area in Denmark)
AF-8	Public afforestation (state, counties and municipalities)

Domestic sector

DO-1	Energy labelling of small and large buildings (incl. public sector and business)
DO-2	Energy labelling of electric appliances

Waste

WA-1	Obligation to send combustible waste to incineration (in practice a ban on landfilling).
WA-2	The waste tax
WA-3	Weight-and-volume-based packaging taxes
WA-4	Subsidy programme – Enterprise Scheme (special scheme for businesses)
WA-5	Increased recycling of waste plastic packaging
WA-6	Implementation of the EU landfill directive
WA-7	Support for (construction of facilities for) gas recovery at landfill sites
WA-8	Subsidy programme for cleaner products

TD-1	Mineral-oil Tax Act	
1	**Sector:**	Energy, Transport, Business Sector, Domestic Sector, Agriculture etc. (Fuel Consumption)
2	**Name*:**	Mineral-oil Tax Act
3	**Origin:**	
4	**Legal basis:**	Act no. 297 of 3 April 2006 on energy taxes of mineral oil products etc., and amendments.
5	**Domestic compliance and enforcement:**	Fines and/or up to 2 years of imprisonment
6	**Description:**	Tax on mineral oil products in Denmark. The tax is: Gas oil and diesel oil used as motor fuel: DKK 2.888 per litre Other gas oil and disel oil: DKK 1.924 per litre Light diesel oil (sulphur content max. 0,05%): DKK 2.785 per litre Diesel, low in sulphur (sulphur content max. 0,005%): DKK 2.598 per litre Diesel, sulphur free (sulphur content max. 0,001%): DKK 2.598 per litre Fuel oil: DKK 2.168 per kilogramme Heating tar: DKK 1.957 per kilogramme Petroleum used as fuel: DKK 2.888 per litre Other petroleum: DKK 1.924 per litre Petrol, with "lead": DKK 4.632 per litre Petrol, lead-free: DKK 3.959 per litre Petrol, "with Lead" and vap. recovery: DKK 4.47 per litre Petrol, lead-free and vap. recovery: DKK 3.82 per litre Auto gas (LPG): DKK 1.809 per litre Other liquified gas (LPG), used as motor fuel: DKK 3.327 per kilogramme Other liquified gas (LPG) (refinery gas): DKK 2.465 per kilogramme Carburettor liquid: DKK 4.218 per litre
7	**Objective:**	Restructuring of existing acts on oil and gas taxes and later also reduction of consumption of polluting fuels as part of the energy policy. The tax rate is indexed with 1,8 pct. pr. year in the period 2008-2015
8	**Greenhouse gas(es) affected:**	CO_2
9	**Type of measure:**	Fiscal (tax)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 January 1993
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Taxation
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-2,7 (-1,5 & -1,2) (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-2,7 (-1,5 & -1,2) (a)
23	**2015 or (2013-2017)/5:**	-3,7 = [-2,7 (-1,5 & -1,2) (a)] + [0,98 (b)]
24	**2020:**	-3,7 = [-2,7 (-1,5 & -1,2) (a)] + [0,98 (b)]
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	1100 (325+775) DKK per tonnes CO2-equivalent (a)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5, the Effort Analysis(1) and the estimates shown above
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	http://www.retsinfo.dk/index/SKA/AN000053.htm (1) http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) The effects and socio-economic costs related to tax raises since 1990 shown here are from the Effort Analysis where the estimate includes the total effect of tax raises since 1990 on all oil products. Reductions related to mineral oil tax on petrol and diesel have been estimated separately, but are now included in the estimate showing the total effect. (b) The effect of the indexation of energy taxes described in chapter 4.

TD-2	Gas Tax Act	
1	**Sector:**	Business Sector and Domestic Sector (Consumption of Gas)
2	**Name*:**	Gas Tax Act
3	**Origin:**	
4	**Legal basis:**	Act no. 298 of 3 April 2006 on energy taxes of natural gas and town gas, and amendments.
5	**Domestic compliance and enforcement:**	Fines and/or up to 2 years of imprisonment
6	**Description:**	Tax on consumption of natural gas and town gas in Denmark. The tax amount to: DKK 2.116 per Nm^3.
7	**Objective:**	In order to have a tax level on this fuel which match the tax level on other fuels. The tax rate is indexed with 1,8 pct. pr. year in the period 2008-2015
8	**Greenhouse gas(es) affected:**	CO_2
9	**Type of measure:**	Fiscal (tax)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 January 1996
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Taxation
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-2,7 (-1,5 & -1,2) (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-2,7 (-1,5 & -1,2) (a)
23	**2015 or (2013-2017)/5:**	-3,7 = [-2,7 (-1,5 & -1,2) (a)] + [0,98 (b)]
24	**2020:**	-3,7 = [-2,7 (-1,5 & -1,2) (a)] + [0,98 (b)]
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	1100 (325+775) DKK per tonnes CO2-equivalent (a)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5, the Effort Analysis(1) and the estimates shown above
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	http://www.retsinfo.dk/index/SKA/CR041986.htm (1) http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) The effects and socio-economic costs related to tax raises since 1990 shown here are from the Effort Analysis where the estimate includes the total effect of tax raises since 1990 on all oil products. Reductions related to mineral oil tax on petrol and diesel have been estimated separately, but are now included in the estimate showing the total effect. (b) The effect of the indexation of energy taxes described in chapter 4.

TD-3	Coal Tax Act	
1	**Sector:**	Energy and Business Sector (Consumption of coal)
2	**Name*:**	Coal Tax Act
3	**Origin:**	
4	**Legal basis:**	Act no. 1068 of 30. October 2006 on energy taxes of coal, lignite and coke etc., and amendments.
5	**Domestic compliance and enforcement:**	Fine and/or up to 2 years of imprisonment
6	**Description:**	Tax rated after the calorific value of coal, coke, furnace coke, coke gravel, crude coke, lignite briquettes and lignite, tall oil, wood tar, vegetable pitch etc. The tax amount to DKK 53,8 per GJ
7	**Objective:**	At its introduction the objective was both fiscal and reductions in energy use. Later, CO2 reduction also became an objective. The tax rate is indexed with 1,8 pct. pr. year in the period 2008-2015
8	**Greenhouse gas(es) affected:**	CO_2
9	**Type of measure:**	Fiscal (tax)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 July 1982
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Taxation
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-2,7 (-1,5 & -1,2) (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-2,7 (-1,5 & -1,2) (a)
23	**2015 or (2013-2017)/5:**	-3,7 = [-2,7 (-1,5 & -1,2) (a)] + [0,98 (b)]
24	**2020:**	-3,7 = [-2,7 (-1,5 & -1,2) (a)] + [0,98 (b)]
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	1100 (325+775) DKK per tonnes CO2-equivalent (a)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5, the Effort Analysis(1) and the estimates shown above
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	http://www.retsinfo.dk/index/SKA/AN000050.htm (1) http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) The effects and socio-economic costs related to tax raises since 1990 shown here are from the Effort Analysis where the estimate includes the total effect of tax raises since 1990 on all oil products. Reductions related to mineral oil tax on petrol and diesel have been estimated separately, but are now included in the estimate showing the total effect. (b) The effect of the indexation of energy taxes described in chapter 4.

TD-4	Electricity Tax	
1	**Sector:**	Business Sector and Domestic Sector (Consumption of electricity)
2	**Name*:**	Electricity Tax
3	**Origin:**	
4	**Legal basis:**	Act no. 421 of 3. May 2006 on electricity tax, and amendments.
5	**Domestic compliance and enforcement:**	Fine and/or up to 2 years of imprisonment
6	**Description:**	Tax on consumption of elektricity. The tax amount to DKK 0.529 per kWh for electricity consumption over 4000 kWh in buildings heated by electric panels. Tax the on all other consumption of electricity amount to DKK 0,596 øre per kWh.
7	**Objective:**	At its introduction in 1977, the objective was both fiscal and reductions in energy use. Since the beginning of the 1990s, amentments also have had CO2 reduction as an objective.The tax rate is indexed with 1,8 pct. pr. year in the period 2008-2015.
8	**Greenhouse gas(es) affected:**	CO_2
9	**Type of measure:**	Fiscal (tax)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 April 1977
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Taxation
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-2,7 (-1,5 & -1,2) (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-2,7 (-1,5 & -1,2) (a)
23	**2015 or (2013-2017)/5:**	-3,7 = [-2,7 (-1,5 & -1,2) (a)] + [0,98 (b)]
24	**2020:**	-3,7 = [-2,7 (-1,5 & -1,2) (a)] + [0,98 (b)]
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	1100 (325+775) DKK per tonnes CO2-equivalent (a)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5, the Effort Analysis(1) and the estimates shown above
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	http://www.retsinfo.dk/index/SKA/AN000057.htm (1) http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) The effects and socio-economic costs related to tax raises since 1990 shown here are from the Effort Analysis where the estimate includes the total effect of tax raises since 1990 on all oil products. Reductions related to mineral oil tax on petrol and diesel have been estimated separately, but are now included in the estimate showing the total effect. (b) The effect of the indexation of energy taxes described in chapter 4.

TD-5	Carbondioxide tax on energy products	
1	**Sector:**	Business Sector and Domestic Sector (CO_2 emissions from energy consumption)
2	**Name*:**	Carbondioxide tax on energy products
3	**Origin:**	
4	**Legal basis:**	Act no. 889 of 17 August 2006 on carbondioxide taxes of certain energy products, and amendments.
5	**Domestic compliance and enforcement:**	Fine and/or up to 2 years of imprisonment
6	**Description:**	Tax on energy products depending on their contribution to CO2 emissions based an average tax of DKK 90 per tonnes of CO2. The taxes are: Gas oil and diesel oil: DKK 0.252 per litre Fuel oil: DKK 0.298 per kilogramme Heating tar: DKK 0.261 per kilogramme Petroleum: DKK 0.252 per litre Coal, coke, furnace coke, coke gravel: DKK 225.7 per tonnes Crude coke: DKK 301.3 per tonnes Lignite briquettes and lignite: DKK 166.0 per tonnes Electricity: DKK 0.89 per kWh Auto gas (LPG): DKK 0.149 per kilogramme Other liquified gas: DKK 0.28 per kilogramme Gas (refinery gas): DKK 0.27 per kilogramme Natural gas and Town gas: DKK 0.205 per Nm3
7	**Objective:**	Reductions in energy use and related CO2 emissions. The tax rate is indexed with 1,8 pct. pr. year in the period 2008-2015.
8	**Greenhouse gas(es) affected:**	CO_2
9	**Type of measure:**	Fiscal (tax)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 March 1992
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Taxation
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-2,7 (-1,5 & -1,2) (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-2,7 (-1,5 & -1,2) (a)
23	**2015 or (2013-2017)/5:**	-3,7 = [-2,7 (-1,5 & -1,2) (a)] + [0,98 (b)]
24	**2020:**	-3,7 = [-2,7 (-1,5 & -1,2) (a)] + [0,98 (b)]
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	1100 (325+775) DKK per tonnes CO2-equivalent (a)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5, the Effort Analysis(1) and the estimates shown above
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	http://www.retsinfo.dk/index/SKA/AN000065.htm (1) http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) The effects and socio-economic costs related to tax raises since 1990 shown here are from the Effort Analysis where the estimate includes the total effect of tax raises since 1990 on all oil products. Reductions related to mineral oil tax on petrol and diesel have been estimated separately, but are now included in the estimate showing the total effect. (b) The effect of the indexation of energy taxes described in chapter 4.

TD-6	Green Owner Tax	
1	**Sector:**	Transport (Energy consumption)
2	**Name*:**	Green Owner Tax
3	**Origin:**	Related to Council Directive 80/1268/EC
4	**Legal basis:**	Act no. 217 of 12 March 2007 on taxes on passenger cars depending on fuel efficiency.
5	**Domestic compliance and enforcement:**	Fines
6	**Description:**	Car owners have to pay half-yearly taxes which are differentiated in accordance with the fuel efficiency of the cars, expressed in kilometers per litre.
7	**Objective:**	To strengthen the incentive to choose more fuel efficient /energy efficient cars in order to increase the contribution to achieve the environmental objectives concerning limitation and reduction of the environmental impacts from the transport sector's pollution.
8	**Greenhouse gas(es) affected:**	CO_2
9	**Type of measure:**	Fiscal (tax)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	2 June 1997
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 July 1997
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Taxation
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-0,2 (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-0,6 (a)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	-0,6 (a)
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	NMVOCs, NO_x, CO, sulphur, benzene, particles
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5, the Effort Analysis(1) and the estimates shown above
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	http://www.retsinfo.dk/index/SKA/AN003124.htm (1) http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) The effects and socio-economic costs related to tax raises since 1990 shown here are from the Effort Analysis where the estimate includes the total effect of tax raises since 1990 on all oil products. Reductions related to mineral oil tax on petrol and diesel have been estimated separately, but are now included in the estimate showing the total effect. (b) The effect of the indexation of energy taxes described in chapter 4.

TD-7	Registration Tax Act	
1	**Sector:**	Transport (Energy consumption)
2	**Name*:**	Registration Tax Act
3	**Origin:**	Related to Council Directive 80/1268/EC
4	**Legal basis:**	Act no. 631 of 25 June 2008 on registration tax on motor vehicles
5	**Domestic compliance and enforcement:**	Fine and/or up to 2 years of imprisonment
6	**Description:**	Motorcycles: 105% of DKK 8900-24900 and 180% of the rest. Other motorised vehicles: 105% of DKK 79000 and 180% of the rest. The tax is furthermore regulated by how far it can drive per litre diesel or gasoline: Private cars on diesel: For every kilometre less than 18 per litre diesel the tax will be increased by DKK 1000 - or reduced by DKK 4000 for every kilometre the car exceed the 18 km per litre. Private cars on gasoline: For every kilometres less than 16 per litre diesel the tax will be increased by DKK 1000 - or reduced by DKK 4000 for every kilometres the car exceed the 16 km per litre.
7	**Objective:**	Restructuring of existing legislation and reduction in consumption of polluting fuels by introducing incentives to buy more fuel efficient cars.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Fiscal (tax)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 January 2000
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Taxation
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-0,2 (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-0,6 (a)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	-0,775
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5, the Effort Analysis(1) and the estimates shown above
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	http://147.29.40.91/_SHOWF_B602867490/1606&A20020097729REGL&0004&000001 (1) http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) The effects and socio-economic costs related to tax raises since 1990 shown here are from the Effort Analysis where the estimate includes the total effect of tax raises since 1990 on all oil products. Reductions related to mineral oil tax on petrol and diesel have been estimated separately, but are now included in the estimate showing the total effect. (b) The effect of the indexation of energy taxes described in chapter 4.

EN-1	Energy development and demonstration	
1	**Sector:**	Energy sector
2	**Name*:**	Energy development and demonstration
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 555 of 6. June 2007on a Energy Technological Development and Demonstration Programme (EUDP)
5	**Domestic compliance and enforcement:**	
6	**Description:**	EUDP, under the responsability of the EUDP Secretariat c/o the Danish Energy Authority, support energy development and demonstration projects. Directly related research projects may also be supported as well as other activities such as public/private partnerships
7	**Objective:**	The main objective of the EUDP is to support the governments energy policy target, which is a cost effective, environmentally friendly and stable energy supply, and to support the competitiveness of Danish compagnies in the energy area. A further important goal is to strenghten and make use of Danish commercial potentials.
8	**Greenhouse gas(es) affected:**	CO_2
9	**Type of measure:**	Development and demonstration (and directly related research)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	November 2, 2006
12	**Date for adoption of legislation, if different:**	June 6, 2007
13	**Date of beginning:**	2008
14	**Date of end, if relevant:**	not relevant
15	**Allocated resources, if any:**	Financial support for energy research, development and demonstration projects can be obtained from different programmes with different sub-objectives (the budgets for 2009 are shown in the parentesis): - The EUDP (Energy Technological Development and Demonstration Programme (DKK 226 mill.), - The PSO-scheme on environmentally friendly electricity production technologies (DKK 130 mill.), - The PSO-scheme for efficient use of electricity (DKK 25 mill.) and - The Strategical Research Council's budget for energy and environment (170 mill.). (It may be added that Højteknologifonden (advanced technology fund) often allocates approx. 20-25% (or yearly 60-70 mill. DKK) of its funding to energy technology projects)
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	EUDP Secretariat c/o Danish Energy Agency
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	-6 mill. tonnes CO_2 annually 2005-7
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the estimate shown above
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No, implemented after 2001
41	**References and links for further information:**	http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_275/l_27520031025en00320046.pdf http://www.energistyrelsen.dk/sw11540.asp http://www.energistyrelsen.dk/sw13515.asp http://www.ens.dk/lovgivning
42	**Comments:**	

EN-2	Biomass Agreement (Agreement on the use of biomass in electricity production)	
1	**Sector:**	Energy sector
2	**Name*:**	Biomass Agreement (Agreement on the use of biomass in electricity production)
3	**Origin:**	National measure
4	**Legal basis:**	Biomass Agreement of 14 July 1993, amendment og follow-up reforms on 1 July 1997 and 22 March 2000. Electricity Supply Act
5	**Domestic compliance and enforcement:**	Precondition for permits. Fines.
6	**Description:**	In 1993 it was agreed to increase the use of biomass in the energy supply. The agreement has been adjusted several times. The target was to reach an amount of 1.4 mill. tonnes of biomass in energy supply by 2005. The incentive for producers of electricity is a garanteed minimum sales price for electricity at DKK 0.4 per kWh through a subsidy adjusted in accordance with the market price on electricity. In addition, certain plants for production of heat and power can obtain a subsidy of max. 100 DKK per tonnes of biomass combusted - but for no longer than 10 years.
7	**Objective:**	Increased use of biomass, R&D, demonstration, reduction of CO2
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (financial, subsidies)
10	**Status of implementation:**	Implemented, with the exception of one straw fired CHP plant
11	**Date for the political adoption:**	14 July 1993
12	**Date for adoption of legislation, if different:**	1 May 2001
13	**Date of beginning:**	1993
14	**Date of end, if relevant:**	10 years after production start at the latest
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	The electricity producers are Dong and Vattenfall. Originally, it was Elsam and E2
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes
41	**References and links for further information:**	http://www.energistyrelsen.dk/sw13380.asp http://www.energistyrelsen.dk/sw20499.asp http://www.ens.dk/lovgivning (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme /Frame.asp?http://www2.mst.dk/udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	

EN-3	Price supplement and subsidies for renewable energy production	
1	**Sector:**	Energy sector
2	**Name*:**	Price supplement and subsidies for renewable energy production
3	**Origin:**	National measure
4	**Legal basis:**	The political Agreement on Energy of 21 February 2008. The price supplement for production of environmentally friendly electricity is implemented via the Act on Renewable Energy from 18 December 2008
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Increasing the share of renewable energy of the total energy consumption. Reduction of the impact on the environment, including CO2 emissions. Support for technology development
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (financial, subsidies, price supplement)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	21 February 2008
12	**Date for adoption of legislation, if different:**	2008 December 18
13	**Date of beginning:**	21 February 2008
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	All renewable energy production plants receive subsidies. The allocation to the central power plants' biomass-based electricity production is increased from 0.10 to 0.15 DKK/kWh. The subsidy for new wind turbines is raised to 0.25 DKK/kWh for 22.000 peak load hours + 0.023 DKK/kWh in balancing costs + 0.004 DKK/kWh to a green fund. All new and existing bio gas plants is subject to a fixed electricity price of 0.745 DKK/kWh or a fixed-price premium of 0.405 of DKK/kWh when bio gas is used along with natural gas. To promote heat pumps for replacing individual oil burners, a pool of 30 million DKK over two years is given for information campaigns, labelling of efficient pumps, limited subsidy schemes, etc. Furthermore, 25 million DKK/kWh is given to small RE technologies (i.e. solar cells and wave power) for four years.
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Agency and entities responsible for energy production
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No, implemented after 2001
41	**References and links for further information:**	http://www.ens.dk/sw15282.asp
42	**Comments:**	

EN-4	Tenders for offshore wind turbines	
1	**Sector:**	Energy sector
2	**Name*:**	Tenders for offshore wind turbines
3	**Origin:**	National measure
4	**Legal basis:**	The Act on Electricity Supply
5	**Domestic compliance and enforcement:**	
6	**Description:**	In the agreements of 29 March 2004 it was agreed to establish 2 offshore wind turbine facilities, each wih a size of 200 MW. One of the facilities should be located at Horns Rev ("Horns Rev II") and the other at Rødsand ("Rødsand II"). Both should be build on the basis of tenders.
7	**Objective:**	Promote technology development and aiming for making electricity production with wind turbines competitive to conventionally produced electricity. Reduction of the electricity production's impact on the environment, including CO2 emissions.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Regulatory (administrative, tender), Economic (financial, tender)
10	**Status of implementation:**	In 2005, the winner of the tender on Horns Rev II has been found and production is expected to start in 2009. The deadline for the final bid on Rødsand II is 13 December 2005.
11	**Date for the political adoption:**	29 March 2004
12	**Date for adoption of legislation, if different:**	Additional legal steps, if necessary, will be take by the end of 2005 or in 2006.
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	The winners of the tenders will receive price supplement
18	**Implementering entity or entities:**	Danish Energy Authority
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No, implemented after 2001
41	**References and links for further information:**	http://www.energistyrelsen.dk/sw13778.asp http://www.energistyrelsen.dk/sw14306.asp http://www.ens.dk/lovgivning
42	**Comments:**	

EN-5	Scrapping scheme for old wind turbines	
1	**Sector:**	Energy sector
2	**Name*:**	Scrapping scheme for old wind turbines
3	**Origin:**	National measure
4	**Legal basis:**	Law of Renewable Energy.
5	**Domestic compliance and enforcement:**	Danish Energy Agency
6	**Description:**	The scrapping scheme will support taking down old and unfavourable placed wind turbines and will support expansion of wind power.
7	**Objective:**	Additional 350 MW installed kW before 2012. Promote technology development and aiming for making electricity production with wind turbines competitive to conventionally produced electricity. Reduction of the electricity production's impact on the environment, including CO2 emissions.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (financial, price supplement)
10	**Status of implementation:**	The legal basis has been implemented. The planning of where to relocate old and locate new wind turbines began in 2005. Act no. 505 adopted 17th of June 2008 changes the Electricity supply Act. But the law has not come into force yet.
11	**Date for the political adoption:**	21 February 2008
12	**Date for adoption of legislation, if different:**	18th of December 2008
13	**Date of beginning:**	21 February 2008
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	Turbines under the new scrapping scheme is given an extra fixed supplement of 0.08 DKK/kWh for the first 12,000 peak load hours
16	**For planned measures, planned date of start (& end?):**	Wind turbines to be scrappede under the former scheme shall be taken down in the period 15 December 2004 - 15 December 2009. The replacing wind turbines shall be connected to the grid in the period from 1 January 2005 to 31 December 2009.
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Agency
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No, implemented after 2001
41	**References and links for further information:**	http://www.energistyrelsen.dk/sw14138.asp http://www.energistyrelsen.dk/sw15568.asp http://www.ens.dk/lovgivning
42	**Comments:**	

EN-6	Energy development and demonstration	
1	**Sector:**	Energy sector
2	**Name*:**	Energy development and demonstration
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 555 of 6. June 2007on a Energy Technological Development and Demonstration Programme (EUDP)
5	**Domestic compliance and enforcement:**	
6	**Description:**	EUDP, under the responsability of the EUDP Secretariat c/o the Danish Energy Authority, support energy development and demonstration projects. Directly related research projects may also be supported as well as other activities such as public/private partnerships
7	**Objective:**	The main objective of the EUDP is to support the governments energy policy target, which is a cost effective, environmentally friendly and stable energy supply, and to support the competitiveness of Danish compagnies in the energy area. A further important goal is to strenghten and make use of Danish commercial potentials.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Development and demonstration (and directly related research)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	November 2, 2006
12	**Date for adoption of legislation, if different:**	June 6, 2007
13	**Date of beginning:**	2008
14	**Date of end, if relevant:**	not relevant
15	**Allocated resources, if any:**	Financial support for energy research, development and demonstration projects can be obtained from different programmes with different sub-objectives (the budgets for 2009 are shown in the parentesis): - The EUDP (Energy Technological Development and Demonstration Programme (DKK 226 mill.), - The PSO-scheme on environmentally friendly electricity production technologies (DKK 130 mill.), - The PSO-scheme for efficient use of electricity (DKK 25 mill.) and - The Strategical Research Council's budget for energy and environment (170 mill.). (It may be added that Højteknologifonden (advanced technology fund) often allocates approx. 20-25% (or yearly 60-70 mill. DKK) of its funding to energy technology projects)
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	EUDP Secretariat c/o Danish Energy Agency
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	No, not direct, but indirect through the support of the technology development assumed in the energy projections - on which the GHG emission projection is based
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No
41	**References and links for further information:**	http://www.energistyrelsen.dk/sw11580.asp http://www.energistyrelsen.dk/sw12337.asp http://www.ens.dk/lovgivning
42	**Comments:**	

EN-7	National CO2 allowance scheme for electricity producers	
1	**Sector:**	Energy sector, measures no longer in place or replaced
2	**Name*:**	National CO_2 allowance scheme for electricity producers
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 376 of 2 June 1999.
5	**Domestic compliance and enforcement:**	Extra tax (on emissions exceeding the allocated amount of allowances), fines
6	**Description:**	The national CO2 allowance scheme imposed CO2 emission ceilings on production of electricity, if CO2 emissions were above 100,000 tonnes of CO2. If the ceiling was exceeded the producer of electricity had to pay an extra tax. Allowances could be traded among producers of electricity under the scheme.
7	**Objective:**	CO_2-reduction, forerunner for the EU allowance regulation
8	**Greenhouse gas(es) affected:**	CO_2
9	**Type of measure:**	Economic (financial)
10	**Status of implementation:**	Implemented and in place in the period 2001-2004
11	**Date for the political adoption:**	3 March 1999
12	**Date for adoption of legislation, if different:**	2 June 1999
13	**Date of beginning:**	1 January 2001
14	**Date of end, if relevant:**	31. december 2004
15	**Allocated resources, if any:**	None
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State authorities (Danish Energy Authority), energy producers. EU CO2 allowance scheme also covers energy-intensive enterprises
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-3 mill. tonnes CO_2 in total in the period from 2000 to 2004
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	Not higher than the quota price
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the estimate shown above
37	**Explanation, if the measure is no longer in place:**	Replaced by the EU CO2 allowance scheme (EU ETS) from 1 January 2005
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes, for the first year of the projection (2004)
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No
41	**References and links for further information:**	http://www.energistyrelsen.dk/sw19297.asp http://www.energistyrelsen.dk/sw17278.asp http://www.ens.dk/lovgivning
42	**Comments:**	

EN-8a	Subsidy to electricity generation (Renewable Energy)	
1	**Sector:**	Energy sector, measures no longer in place or replaced
2	**Name*:**	Subsidy to electricity generation (Renewable Energy)
3	**Origin:**	National measure
4	**Legal basis:**	Act on subsidies for the production of electricity
5	**Domestic compliance and enforcement:**	Act of 7 October 1992 on exploitation of renewable energy sources
6	**Description:**	Subsidy for the production of electricity from renewable energy sources. In the beginning of the 1990s the subsidy amounted to DKK 0.27 per kWh produced. Electricity produced from renewable energy sources got an extra payment equal the costs saved. For wind turbines this was calculated as 85% of the sales price from decentralised CHP plants to the grid (excl. vat and taxes) based on a tariff in three segments.
7	**Objective:**	Reduce CO2 emissions, promote technology development and aiming for making electricity production with wind turbines competitive to conventionally produced electricity.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (financial, price supplement and settling prices)
10	**Status of implementation:**	No longer in place. With the reorganisation of 1 January 2005 it was replaced by price supplement for the production of environmentally friendly electricity.
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	For wind turbines 1 April 2001. For other renewable energy plants 1 January 2005
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Authority, Energy producers (administered the implementation).
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	Decrease in emissions of SO2 and NOx from power plants due to decrease in production of electricity
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	Replaced by price supplement for the production of environmentally friendly electricity
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Regarding the measures effect on the etablishment of renewable energy based heat and power capacity, the effect in the future is assumed to be the same as in 2003. Since energy statistics for 2003 are the basis for the projections, only effects deviating from the effect in 2003 have been included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	http://www.ens.dk/lovgivning http://www.ens.dk/sw11368.asp http://www.ens.dk/sw14294.asp http://www.ens.dk/graphics/Energiforsyning/Vedvarende_energi/Vind/Afregning/Forenklet_vindmolleafreg-u2.pdf (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) In the Effort Analysis the effect of subsidies for production of electricity from wind turbines is estimated together with the effect of subsidies for production of electricity from other renewable energy sources

EN-8b	Subsidies for electricity generation (wind turbines)	
1	**Sector:**	Energy sector, measures no longer in place or replaced
2	**Name*:**	Subsidies for electricity generation (wind turbines)
3	**Origin:**	National measure
4	**Legal basis:**	The agreement on an electricity reform, Act on electricity supply, Act on exploitation of renewable energy sources
5	**Domestic compliance and enforcement:**	
6	**Description:**	Electricity from wind turbines bought before the end of 1999 is guaranteed a price of DKK 0.43 per kWh in 10 years and a price supplement of DKK 0.17 per kWh for a full load hour production graduated after turbine size. After this period, electricity have to be sold on market terms with a price supplement up to DKK 0.10 per kWh until the age of the turbine is 20 years. The price supplement is adjusted in such a way, that the sum of market price and price supplement will not exceed DKK 0.36 per kWh. Rules on price supplements have been changed over time. The latest change took place with Act no. 495 of 9 June 2004.
7	**Objective:**	Reduce CO2 emissions, promote technology development and aiming for making electricity production with wind turbines competitive to conventionally produced electricity.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (price supplement and settling prices)
10	**Status of implementation:**	Implemented. With the reorganisation of 1 January 2005 it was replaced by price supplement for the production of environmentally friendly electricity.
11	**Date for the political adoption:**	The agreement on an electricity reform of 3 March 1999
12	**Date for adoption of legislation, if different:**	Several times. The latest change took place with Act no. 495 of 9 June 2004.
13	**Date of beginning:**	1 April 2001
14	**Date of end, if relevant:**	End of 2012
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Authority, Energy producers
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	Decrease in emissions of SO2 and NOx from power plants due to decrease in production of electricity
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	The effort on reduction of SO2 and NOx emissions from power plants
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	Replaced by price supplement for the production of environmentally friendly electricity
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Regarding the measures effect on the etablishment of renewable energy based heat and power capacity, the effect in the future is assumed to be the same as in 2003. Since energy statistics for 2003 are the basis for the projections, no separate extra effects from this meaures is included in the projections.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	http://www.ens.dk/lovgivning http://www.ens.dk/sw11368.asp http://www.ens.dk/sw14294.asp http://www.ens.dk/graphics/Energiforsyning/Vedvarende_energi/Vind/Afregning/Forenklet_vindmolleafreg-u2.pdf (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) In the Effort Analysis the effect of subsidies for production of electricity from wind turbines is estimated together with the effect of subsidies for production of electricity from other renewable energy sources

EN-9	Priority for electricity from CHP plants	
1	**Sector:**	Energy sector, measures no longer in place or replaced
2	**Name*:**	Priority for electricity from CHP plants
3	**Origin:**	National measure
4	**Legal basis:**	Agreement in 1990 between the government at that time (VKR) and the Socialdemocrates. The agreement was realised in a revision of the Act on heat supply. The subsidy was introduced as part of the CO2 tax package.
5	**Domestic compliance and enforcement:**	Memorandoms on terms
6	**Description:**	1. It was requried from the municipalities that they should see to that a shift from district heating (based om separated electricity and heat production) to decentralised combined heat and power based on natural gas. 2. In addition, from 1992 a subsidy for production of electricity in natural gas fired decentralised combined heat and power plants was given. The size of the subsidy has changed several times since then.
7	**Objective:**	Combined production of electricity and heat in order to the gain fuel savings in comparison with separate production.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	1. Regulatory (Requirement) 2. Economic (Subsidy)
10	**Status of implementation:**	No longer in place. Replaced by price supplement for the production of environmentally friendly electricity.
11	**Date for the political adoption:**	1. 1990 2. 1992
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State authorities, Municipalities and Energy producers
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1) Only investments in the period 1992-2002 are included.
32	**Side effects – on other GHGs or GHG emitting activities:**	The emission of methane is higher at combined heat and power production than at separate heat production.
33	**Side effects – on other air pollutants:**	Reduction of SO2- and NOx emissions.
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	Replaced by price supplement for the production of environmentally friendly electricity
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	http://www.ens.dk/lovgivning http://www.ens.dk/sw14254.asp (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	

EN-10	Requirement for offshore wind turbines	
1	**Sector:**	Energy sector, measures no longer in place or replaced
2	**Name*:**	Requirement for offshore wind turbines
3	**Origin:**	National measure
4	**Legal basis:**	Recommandations from "The action plan on offshore windturbines in Danish waters (1997)"
5	**Domestic compliance and enforcement:**	Requirement
6	**Description:**	Requirement to the power plants to build: 1. 200 MW wind power on land before 2000 (according to agreement between the Ministry for the Envionment and Energy and producers of electricity). 2. 750 MW offshore wind power in the period 2002-2008 (an element in the energi savings action plan Energy 21). However, this order was withdrawn in 2002. 3. In addition, a state financed subsidy of DKK 10 per kWh was given to the production of electricity from 1992 until mid 1999.
7	**Objective:**	Expansion of environmentally friendly technology in electricity production.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Regulatory (administrative), Economic (financial)
10	**Status of implementation:**	1. Implemented 2. Withdrawn and replaced by tenders 3. With the reorganisation of 1 January 2005 it was replaced by price supplement for the production of environmentally friendly electricity.
11	**Date for the political adoption:**	1996
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	Decrease in emissions of SO2 and NOx from power plants due to decrease in production of electricity. Therefore power plants can save some of the costs related to compliance with the SO2- og NOx quota regulation. With this, it is assumed that there are no extra environmental benefits from reduction of SO2- and NOx-emissions.
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	Replaced by offshore wind turbine tenders and price supplement for the production of environmentally friendly electricity.
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	http://www.energistyrelsen.dk/sw13787.asp http://www.energistyrelsen.dk/sw14312.asp http://www.ens.dk/lovgivning (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	

EN-11	Scrapping scheme for old, badly located wind turbines	
1	**Sector:**	Energy sector, measures no longer in place or replaced
2	**Name*:**	Scrapping scheme for old, badly located wind turbines
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 273 of 2 June 1999 and amendment by Act no. 1277 of 20 December 2000.
5	**Domestic compliance and enforcement:**	Fine and/or pay back of unwarranted subsidy
6	**Description:**	As an element in the electricity reform a replacement scheme was etablished. The scheme implied a scrapping certificate for scrapped wind turbines under 150 kW which entitled the owner(s) to a price supplement of DKK 0.17 per kWh in 12,000 full load hours in a new wind turbine. The scheme was in place until 1 January 2004.
7	**Objective:**	Scrapping of old, badly located wind turbines
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (financial, price supplement)
10	**Status of implementation:**	The scheme is no longer in place. From 2005, a new scrapping scheme has been established
11	**Date for the political adoption:**	The agreement on a electricity reform of 3 March 1999
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 April 2001
14	**Date of end, if relevant:**	End of 2003
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Authority
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	From 2005, a new scrapping scheme has been established
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	http://www.energistyrelsen.dk/sw14138.asp http://www.ens.dk/lovgivning
42	**Comments:**	

EN-12	Renewable energy island - Samsø	
1	**Sector:**	Energy sector, measures no longer in place or replaced
2	**Name*:**	Renewable energy island - Samsø
3	**Origin:**	National measure
4	**Legal basis:**	Not implemented by an Act
5	**Domestic compliance and enforcement:**	
6	**Description:**	The aim is to make the island of Samsø self-sufficient with local renwable energy sources within a period of 10 years.
7	**Objective:**	To demonstrate the practical, technological, institutional and financial possibilities in switching a local community over to 100% renewable energy supply and create a global show-window for Danish Renewable Energy Technology.
8	**Greenhouse gas(es) affected:**	CO_2
9	**Type of measure:**	Economic(financial), Research and Other(demonstration)
10	**Status of implementation:**	The switching over process is ongoing – now primarily with focus on possible changes in the Transport sector. As show-room and a role model community, the concept continues.
11	**Date for the political adoption:**	The initiative was included in ENERGY21 - the Action plan on Energy from 1996.
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1997
14	**Date of end, if relevant:**	2007
15	**Allocated resources, if any:**	The project has been supported by the state within exising budgets on subsidies for development projects and plants based on renewable energy. The investment subsidy has been approx. DKK 20 mill. in total.
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	Further earmaked funds are not planned.
18	**Implementering entity or entities:**	The project has been rooted locally.
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	
37	**Explanation, if the measure is no longer in place:**	Finished as state initiative. Continued locally.
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	No
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	www.veo.dk
42	**Comments:**	

EN-13	Construction subsidy for renewable energy	
1	**Sector:**	Energy sector, measures no longer in place or replaced
2	**Name*:**	Construction subsidy for renewable energy
3	**Origin:**	National measure
4	**Legal basis:**	The Development Programme for Renwable Energy (UVE)
5	**Domestic compliance and enforcement:**	Fine and/or pay back of unwarranted subsidy
6	**Description:**	Arrangements according to which subsidies were given to system approved boilers based on solar heat, heating pumps, biogas and biomass and for test facilities, information activities and test and demonstration projects.
7	**Objective:**	Incentive to use renewable energy.
8	**Greenhouse gas(es) affected:**	CO_2
9	**Type of measure:**	Economic (financial, subsidy)
10	**Status of implementation:**	Development and Demonstration projects under UVE as well as the special programmes on hydrogen, solar energy, geothermi and wave energy - except in a few cases - have ended in 2004.
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	Beginning of 1970s
14	**Date of end, if relevant:**	End of 2001
15	**Allocated resources, if any:**	DKK 450 mill. in the period 1991-2001.
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1) Only subsidies for solar heating, biomass fired plants and heating pumps have been included in the Effort Analysis. See Danish Energy Authority (2004)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	The subsidies are no longer in place
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	No
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes
41	**References and links for further information:**	http://www.ens.dk/sw16321.asp http://www.ens.dk/lovgivning (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	

EN-14	Subsidy for investment in energy savings by industry	
1	**Sector:**	Energy sector, Business sector, measures no longer in place or replaced
2	**Name*:**	Subsidy for investment in energy savings by industry
3	**Origin:**	National measure
4	**Legal basis:**	Lov nr. 2 af 3. januar 1992 Lov nr. 284 af 27. april 1994 Lov nr. 406 af 14. juni 1995
5	**Domestic compliance and enforcement:**	Fine and/or pay back of unwarranted subsidy
6	**Description:**	Subsidy for investments in energy efficient technology, establishment of CHP in industry, projects with development, test or demonstration objectives, advisory and information activities etc. The subsidy typically amounted to 20-40% of the total budget. This arrangement was linked to so-called Agreement Scheme.
7	**Objective:**	Energy Savings
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (subsidies)
10	**Status of implementation:**	No longer in place
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1993
14	**Date of end, if relevant:**	2001
15	**Allocated resources, if any:**	DKK 1.8 bn.
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Authority
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	SO2 og NOx
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes. To the extent that the effect deviates from the effect in 2003 - the latest year with energy statistics on which the energy projection is based - it is included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes
41	**References and links for further information:**	http://www.ens.dk/sw11574.asp http://www.ens.dk/lovgivning http://www.ens.dk/sw12329.asp http://www.ens.dk/sw17747.asp (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	

EN-15	Subsidy for conversion of old housing to CHP	
1	**Sector:**	Energy sector, Domestic sector, measures no longer in place or replaced
2	**Name*:**	Subsidy for conversion of old housing to CHP
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 5 of 3 January 1992 on state subsidy for conversion of old housing to CHP.
5	**Domestic compliance and enforcement:**	Fine and/or pay back of unwarranted subsidy
6	**Description:**	Subsidy for connection to district heating for old housing (build before 1950) without central heating, but with heating based on paraffin, town gas, bottled gas, electric heating or wood etc. A precondition was that housing was situated in an area with CHP district heating supply.
7	**Objective:**	To reduce CO2 emissions
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (financial, subsidy)
10	**Status of implementation:**	Implemented, but no longer in place
11	**Date for the political adoption:**	3 January 1992
12	**Date for adoption of legislation, if different:**	Latest statutory order: No. 534 of 8 July 1998
13	**Date of beginning:**	1 January 1993
14	**Date of end, if relevant:**	31 December 2001
15	**Allocated resources, if any:**	In the period 1993-2003: DKK 1,080 mill. (Budget was: DKK 1,500 mill.)
16	**For planned measures, planned date of start (& end?):**	1 January 1993
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Authority and Municipality Boards
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	It is estimated that the effect in the future will be the same as in 2003. Since 2003 is the latest year of energy statistics on which the projection of energy consumption is based, no additional effects have been included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes
41	**References and links for further information:**	http://www.ens.dk/lovgivning (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	

EN-16	Subsidy to promote connection to coal CHP	
1	**Sector:**	Energy sector, Domestic sector, measures no longer in place or replaced
2	**Name*:**	Subsidy to promote connection to coal CHP
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 420 of 1 June 1994 on state subsidy to promote connection to coal CHP.
5	**Domestic compliance and enforcement:**	Fine and/or pay back of unwarranted subsidy
6	**Description:**	Subsidy as an incentive to house owners with oil burners or electric heating to shift to district heating.
7	**Objective:**	Targetted compensation for the increase in coal tax in 1993.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (subsidy).
10	**Status of implementation:**	No longer in place
11	**Date for the political adoption:**	1 June 1994
12	**Date for adoption of legislation, if different:**	1 June 1994
13	**Date of beginning:**	1994
14	**Date of end, if relevant:**	2003
15	**Allocated resources, if any:**	At the adoption of the Act the budget for this subsidy was DKK 240 mill., but since then the budget has been reduced gradually. Until 2003 the total payment of this subsidy amounted to DKK 160 mill.
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Authority
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	It is estimated that the effect in the future will be the same as in 2003. Since 2003 is the latest year of energy statistics on which the projection of energy consumption is based, no additional effects have been included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes
41	**References and links for further information:**	http://www.ens.dk/lovgivning (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	

EN-17	State subsidy for energy savings measures in housing for pensioners	
1	**Sector:**	Energy sector, Domestic sector, measures no longer in place or replaced
2	**Name*:**	State subsidy for energy savings measures in housing for pensioners
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 1050 of 23 December 1992
5	**Domestic compliance and enforcement:**	Fine and/or pay back of unwarranted subsidy
6	**Description:**	Subsidy for energy savings measures in housing for pensioners receiving grants for heating costs.
7	**Objective:**	Permanent energy savings, increase employment, improve the pensioners comfort and reduce the need for heating cost grants.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (financial, subsidy)
10	**Status of implementation:**	No longer in place
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	23 December 1992
13	**Date of beginning:**	1 April 1993
14	**Date of end, if relevant:**	31 December 2003
15	**Allocated resources, if any:**	DKK 0.5 bn. In the period 1993-2004
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Authority and Municipality Boards
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	It is estimated that the effect in the future will be the same as in 2003. Since 2003 is the latest year of energy statistics on which the projection of energy consumption is based, no additional effects have been included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No
41	**References and links for further information:**	
42	**Comments:**	http://www.ens.dk/lovgivning

TR-1	Information campaign on fuel consumption of new cars	
1	**Sector:**	Transport
2	**Name*:**	Information campaign on fuel consumption of new cars
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Improve the efficiency of energy consumption, CO2-reduction
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Information
10	**Status of implementation:**	Implemented (the actual campaign lasted for 2 years)
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Denmark`s Road Safety and Transport Agency
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-0,2 (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-0,6 (a)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5, the Effort Analysis(1) and the estimates shown above
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	(1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) The effects related to improvement of energy efficiency of cars, both on individual cars and in total, and shown here are from the Effort Analysis where the estimate includes the total effect of EU measures (voluntary agreements with the automobile industry) and national measures (the green owner tax, information campaigns, energy labelling etc.)

TR-2	Energy-correct driving technique	
1	**Sector:**	Transport
2	**Name*:**	Energy-correct driving technique
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Improve the efficiency of energy consumption, CO2-reduction
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Information
10	**Status of implementation:**	Is included in the drivers education
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Justice
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-0,2 (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-0,6 (a)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5, the Effort Analysis(1) and the estimates shown above
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	(1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) The effects related to improvement of energy efficiency of cars, both on individual cars and in total, and shown here are from the Effort Analysis where the estimate includes the total effect of EU measures (voluntary agreements with the automobile industry) and national measures (the green owner tax, information campaigns, energy labelling etc.)

TR-3	Initiative on enforcing speed limits	
1	**Sector:**	Transport
2	**Name*:**	Initiative on enforcing speed limits
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Improve the efficiency of energy consumption, CO2-reduction
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Information, economic
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Justice
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

TR-4	Establishment of intermodal installations	
1	**Sector:**	Transport
2	**Name*:**	Establishment of intermodal installations
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Improve transport efficiency, CO2-reduction
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (financial)
10	**Status of implementation:**	Ongoing implementation
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Transport and Energy, counties, municipalities, HUR, DSB
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

TR-5	Promotion of environmentally friendly goods transport	
1	**Sector:**	Transport
2	**Name*:**	Promotion of environmentally friendly goods transport
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Improve transport efficiency, CO2-reduction
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (financial) and information
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Environmental Protection Agency, Haulage contractors
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

TR-6	Reduced travel times for public transport	
1	**Sector:**	Transport
2	**Name*:**	Reduced travel times for public transport
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Improve transport efficiency, CO2-reduction
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Regulatory (Administrative)
10	**Status of implementation:**	Ongoing implementation
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Transport and Energy, Counties and Danish State Railways (DSB)
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

TR-7	Spatial planning	
1	**Sector:**	Transport
2	**Name*:**	Spatial planning
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Reduce the need for transport, CO2-reduction
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Regulatory (Administrative)
10	**Status of implementation:**	Ongoing implementation
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Counties, municipalities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

BU-1	Agreements on energy efficiency with business	
1	**Sector:**	Business (energy consumption)
2	**Name*:**	Agreements on energy efficiency with business
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 1107 of 29 December 1999 Statutory Order no. 846 of 17 November 1997
5	**Domestic compliance and enforcement:**	Cancellation of the agreement and the CO2 tax discount. Fines in the case of incorrect or detained information.
6	**Description:**	In connection with the implementation of the CO2 tax also a subsidy for CO2 tax descount for energy intensive industries was introduced. However, a condition for getting the CO2 tax discount is an agreement on improvements in energy efficiency.
7	**Objective:**	Energy efficiency at energy-intensive enterprises and to reduce the effect of the CO2 tax on energy intensive industries' competitiveness.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Voluntary agreements, economic (financial)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1993
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	Subsidies (CO2 tax discount) approx. DKK 120 mill. annually (in 2007)
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Agency
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes. To the extent that the effect deviates from the effect in 2003 - the latest year with energy statistics on which the energy projection is based - it is included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	https://www.www.retsinformation.dk/Forms/R0710.aspx?id=86089 and (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme /Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(EN-18)

BU-2	Savings activities by elec. grid, gas, oil and district heating companies (consump. of final energy excl. Transp.)	
1	**Sector:**	Energy, Business
2	**Name*:**	Savings activities by elec. grid, gas, oil and district heating companies (consump. of final energy excl. Transp.)
3	**Origin:**	National measure
4	**Legal basis:**	Electricity grid companies: The Electricity Supply Act District heating companies: The Heating Supply Act Gas distribution companies: The Natural Gas Supply Act voluntary agreement for the oil supply companies.Act no. 520 of June 7th 2006 Changing in the above acts etc.Energy Saving Order no.1105 November 9th 2006.Agreement of August 22nd 2006, Agreement with the utility companies for electricity, gas and oil.
5	**Domestic compliance and enforcement:**	Fines in the case of failures in fulfillment of the energy suppy companies' obligations
6	**Description:**	The energy companies carry out campaigns and energy saving activities aimed at energy consumers. And the energy companies are obliged to realise savings in final consumption. In there efforts there are no geographical or sector limitations.the target for the savings is 2.95 PJ/year. The effort is financed by
7	**Objective:**	Energy savings, reduced energy costs
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Information (advice, education, campaigns), Regulation (administrative)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	2005 (in its present form)
12	**Date for adoption of legislation, if different:**	2006
13	**Date of beginning:**	2006 in its present form (the electricity companies have worked with energy savings since 1992-93)
14	**Date of end, if relevant:**	2013
15	**Allocated resources, if any:**	The energy companies' effort amount to approx. DKK 300 mill. annually
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Agency
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	The CO2 shadow price of the electricity companies' information effort amount to approx. DKK 140 per tonnes of CO2
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Effect is included in the energysaving projections which is included in the GHG projection, no additional effects have been included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	http://www.ens.dk/lovgivning http://www.ens.dk/sw13887.asp
42	**Comments:**	(EN-19)

BU-3	Tax on HFCs, PFCs and SF6	
1	**Sector:**	Business (the industrial gases)
2	**Name*:**	Tax on HFCs, PFCs and SF6
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 208 of 22 March 2001 on tax on ozone depleting substances and greenhouse gases. Latest amendment is in Act no. 127 of 27 February 2004.
5	**Domestic compliance and enforcement:**	Fines. The Ministry of taxation and its institutions is responsible for the enforcement of domestic compliance.
6	**Description:**	Tax on HFC, SF6 og PFC. The tax is differentiated in accordance with the global warming potential of the substance with DKK 0.1 per kilogramme of CO2 equivalents as the general principle and with DKK 400 per kilogramme of CO2 equivalents as a general upper limit.
7	**Objective:**	Reduction of HFCs, PFCs and SF6 emissions
8	**Greenhouse gas(es) affected:**	HFCs, PFCs and SF6
9	**Type of measure:**	Fiscal (tax)
10	**Status of implementation:**	Implementedt
11	**Date for the political adoption:**	15 December 2000
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 March 2001
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of taxation
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-0.05 mill. tonnes CO2-eq. (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-0,4 mill. tonnes CO2-eq. (a)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	In average DKK 200 per tonnes of CO2-eq. (a)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	Reduce consumption and emissions of HFCs, PFCs and SF6 - e.g. by providing incentives to focus on leakages of these substances from major plants or uses. See also Chapter 5, the effort analysis(1) and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	(1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) Reductions and costs have been estimated as the total effect of taxes on and regulation of HFC's, PFCs and SF6.

BU-4	Regulation of use of HFCs, PFCs and SF6 (phasing out most of the uses)	
1	**Sector:**	Business (the industrial gases)
2	**Name*:**	Regulation of use of HFCs, PFCs and SF6 (phasing out most of the uses)
3	**Origin:**	National measure
4	**Legal basis:**	Statutory order no. 552 of 2 July 2002 on regulation of certain industrial greenhouse gases.
5	**Domestic compliance and enforcement:**	Fines and/or up to 2 years of imprisonment.
6	**Description:**	Import, sale and use of the substances or new products containing the substances is forbidden from 1 January 2006 with some exceptions.
7	**Objective:**	Reduction of HFCs, PFCs and SF6 emissions
8	**Greenhouse gas(es) affected:**	HFCs, PFCs and SF6
9	**Type of measure:**	Regulation (administrative, ban)
10	**Status of implementation:**	Implemented (full effect from 1 January 2006)
11	**Date for the political adoption:**	2 July 2002
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	In general 1 January 2006, but for some uses before
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Environmental Protection Agency
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-0.05 mill. tonnes CO2-eq. (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-0,4 mill. tonnes CO2-eq. (a)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	In average DKK 200 per tonnes of CO2-eq. (a)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	Reduce consumption and emissions of HFCs, PFCs and SF6 - e.g. by making it necessary for users to focus on leakages of these substances from major plants or uses. See also Chapter 5, the effort analysis(1) and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	(1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(a) Reductions and costs have been estimated as the total effect of taxes on and regulation of HFC's, PFCs and SF6.

BU-5	The enterprise scheme on HFCs	
1	**Sector:**	Business (the industrial gases)
2	**Name*:**	The enterprise scheme on HFCs
3	**Origin:**	National measure
4	**Legal basis:**	Acts on the Central Government Budget 2005-2007
5	**Domestic compliance and enforcement:**	
6	**Description:**	A general enterprise scheme will be administeret by the Danish Environmental Protection Agency. The total budget for the period 2004-2007 is DKK 144 mill. where the budget for 2005 amount to DKK 26.3 mill. The general objective of the enterprise scheme is to promote better conditions for environmental improvements in enterprises. In the general enterprise scheme is included a budget share of DKK 12 mill. 2005-2007 for projects with the development of alternatives to HFCs in the refrigerating business and the establishment of a knowledge center for HFC-free cooling as the objectives.
7	**Objective:**	Reduction of HFCs use and emissions in the cooling business
8	**Greenhouse gas(es) affected:**	HFCs
9	**Type of measure:**	Economic (subsidy)
10	**Status of implementation:**	No longer in place
11	**Date for the political adoption:**	January 2005
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	2005
14	**Date of end, if relevant:**	2007
15	**Allocated resources, if any:**	DKK 12 mill. 2005-2007
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Environmental Protection Agency
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	Acted as support for the Statutory order on phase out (see BU-4)
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	Acted as support for the Statutory order on phase out (see BU-4)
37	**Explanation, if the measure is no longer in place:**	The phase out of HFCs (see BU-4) has taken place, and the support scheme 2005-2007 is no longer relevant.
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	http://www.mst.dk/Erhverv/Tilskudsordninger+på+erhvervsområdet/Virksomhedsordning/Indkaldelse_af_ansoegninger_til_Virksomhedsordningen_Kemikalier.htm
42	**Comments:**	

BU-6	Circular on energy-efficiency in state institutions	
1	**Sector:**	Energy, public service
2	**Name*:**	Circular on energy-efficiency in state institutions
3	**Origin:**	National measure
4	**Legal basis:**	Circular no. 27 of 19 April 2005
5	**Domestic compliance and enforcement:**	This is based on the general principle of self-governance in state institutions. According to this each ministry and its minister is responsible for being in compliance with the circular.
6	**Description:**	The circular require state institutions to: Focus on energy efficiency in their behaviour Buy energy efficient products Oprerate state buildings in an energy efficient manner Report on, and make public, figures on consumption of energy and water and energy labelling of buildings
7	**Objective:**	To limit central authorities' consumption of energy and water through promotion of energy efficient purchase and energy efficient behaviour in state institutions and to operate and maintain buildings owned or rented by the state in an energy efficient manner.
8	**Greenhouse gas(es) affected:**	CO_2
9	**Type of measure:**	Regulation (administrative)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	19 April 2005
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	27 April 2005
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	The Danish Energy Agency is responsible for the circular. The individual ministries and state institutions are responsible for the implementation of the circular.
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	It is estimated that the effect in the future will be the same as in 2003. Since 2003 is the latest year of energy statistics on which the projection of energy consumption is based, no additional effects have been included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	http://www.ens.dk/lovgivning http://www.ens.dk/sw11614.asp http://www.ens.dk/sw23194.asp
42	**Comments:**	(EN-20)

BU-7	Electricity Saving Trust – campaigns to promote electricity efficient appliances (promotes markeds and behavioral changes)	
1	**Sector:**	Energi, offentlig service
2	**Name*:**	Electricity Saving Trust – campaigns to promote electricity efficient appliances (promotes markeds and behavioral changes)
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 1209 of 27 December 1996 Act no. 819 of 3 November 1997
5	**Domestic compliance and enforcement:**	Subsidies, information and voluntary agreements
6	**Description:**	The task of the Electricity Saving Trust includes th promotion of efficient electric appliances etc. and electric heating conversion in households and the public sector. The Trust are making use of measures such as national campaigns, efforts to influence the market, voluntary agreements and efforts to raise awareness on the consumption. The budget is approx. DKK 90-100 mill. annually.
7	**Objective:**	Electricity savings, technology development and market promotion of energy efficient products and appliances.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Information (campaigns), agreements, economic (subsidies)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	1996
12	**Date for adoption of legislation, if different:**	1 December 1996
13	**Date of beginning:**	1997
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	DKK approx. 90-100 mill. annually. The Trust is financed by households and public institutions via a special energy saving contribution on the electricity bill.
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	DKK approx. 90-100 mill. annually.
18	**Implementering entity or entities:**	The Minister for Climate and Energy / The Danish Energy Authority
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	In the period 2007-2010 the annual electricity savings is expected to reach an average of approx. 150 GWh
21	**2005:**	In the period 1997-2007 the annual electricity savings is expected to reach an average of approx. 100 GWh.
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	According to the Trust, the cost of the effort in the period 2007-2010 is expected to reach an average of approx. DKK 110 per tonnes of CO2.
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Effect is included in the energysaving projections which is included in the GHG projection, no additional effects have been included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	http://www.ens.dk/lovgivning http://www.ens.dk/sw13892.asp http://www.ens.dk/sw20018.asp
42	**Comments:**	(EN-21)

AF-1	Action Plan for the Aquatic Environment I+II and Action Plan for Sustainable Agriculture	
1	**Sector:**	Agriculture (/Land-use)
2	**Name*:**	Action Plan for the Aquatic Environment I+II and Action Plan for Sustainable Agriculture
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	
6	**Description:**	The action plans contain several measures e.g. with the objective to increase the area with winter green fields and better utilisation of manure.
7	**Objective:**	Reduction of nitrate pollution to the aquatic environment, i.e. reduction of N run-off from agriculture by 100,000 tonnes N per year.
8	**Greenhouse gas(es) affected:**	N2O
9	**Type of measure:**	Regulation (order)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	1991 og 1998
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State and county authorities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-1.6 mill. tonnes CO2-eq. (a)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-1.9 mill. tonnes CO2-eq. (a) in (1), however this could be too low according to new estimates: -2,2 mio.t.CO2ækv.(2)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	The action plans have especially reduced emissions of N2O, but it is likely that they have also reduced emissions of methane from storages of manure and emissions of CO2 through an increased storage of carbon in agricutural soils.
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5, the effort analysis(1) and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes (a)
41	**References and links for further information:**	Olesen et al. (2004) (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/ (2) Gyldenkærne et al. (2005) - in preparetion
42	**Comments:**	(a) The total effect of the Action Plan for the Aquatic Environment I+II and Action Plan for Sustainable Agriculture and the NPO Action Plan

AF-2	Action Plan for the Aquatic Environment III	
1	**Sector:**	Agriculture
2	**Name*:**	Action Plan for the Aquatic Environment III
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	

6	**Description:**	The plan contain several measures, where the most import in relation to greenhouse gas emissions are:
		  Establishment of 4000 ha wetlands in 2004 and 2005.
		  Making the rules on catch crops more rigorous.
		  Making the rules on exploitation of N in animal manure more rigorous.
		  Additional environmentally friendly measures in crop farming.

7	**Objective:**	Protection of the aquatic environment from nitrate and phosphorus pollution.
8	**Greenhouse gas(es) affected:**	N2O
9	**Type of measure:**	Regulation (order), economic
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	2004
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State and county authorities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-0,15 without taking into account the effects of catch crops / with: -0,20
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No, implemented after 2001
41	**References and links for further information:**	Olesen (2004)
42	**Comments:**	

AF-3	Ban on burning straw on fields	
1	**Sector:**	Agriculture
2	**Name*:**	Ban on burning straw on fields
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 68 of 24 January 1989 on environment protection as amended in Act. No. 753 of 25 August 2001
5	**Domestic compliance and enforcement:**	
6	**Description:**	Ban on burning straw on fields
7	**Objective:**	Less air pollution
8	**Greenhouse gas(es) affected:**	CO2, CH4, N2O
9	**Type of measure:**	Regulation (order)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1989
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State and county authorities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	CO2 emissions will be reduced both from increased return of straw in order to increase stored soil carbon and from incresed use of straw as substitute for fossil fuel in energy supply. Emissions of methane and nitrous oxide from burning of straw will be reduced. However, increased decomposition of straw residues will increase emissions of nitrous oxide to some extent.
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No
41	**References and links for further information:**	
42	**Comments:**	

AF-4a	Ammonia action plan and the new statutory order on manure: Optimisation of manure handling during housing.	
1	**Sector:**	Agriculture (/Land-use)
2	**Name*:**	Ammonia action plan and the new statutory order on manure: Optimisation of manure handling during housing.
3	**Origin:**	National measure
4	**Legal basis:**	Statutory order no. 753 of 25 August 2001 on fur animal farms Statutory order no. 814 of 13 July 2006 on professional animal farming, manure and slurry etc.
5	**Domestic compliance and enforcement:**	Fines and/or up to 2 years of imprisonment
6	**Description:**	Ammonia action plan and the new statutory order on manure: Optimisation of manure handling during housing for cattle, pigs, poultry and fur animals e.g. cleaning in fur animal houses at least once a week and a maximum time of 6 hours from field application of manure to incorporation and cover requirements etc..
7	**Objective:**	Protection of the aquatic environment from nitrate pollution.
8	**Greenhouse gas(es) affected:**	N2O
9	**Type of measure:**	Regulation (order)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	Cleaning: 1 August 2002 - 1 August 2007 Storage: See the data sheet on AF-4b Spreading: See the data sheet on AF-4c.
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State and county authorities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-0,03 (a)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	An element in the Ammonia Action Plan.
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No, implemented after 2001
41	**References and links for further information:**	
42	**Comments:**	(a) The total effect of the Ammonia Action Plan (Ban on spreading, cover on manure, reduced storage time, ban on ammonia treatment of straw)

AF-4b	Ammonia action plan and the new statutory order on manure: Rules on covering storage facilities.	
1	**Sector:**	Agriculture (/Land-use)
2	**Name*:**	Ammonia action plan and the new statutory order on manure: Rules on covering storage facilities.
3	**Origin:**	National measure and in part EU legislation
4	**Legal basis:**	Statutory order no. 814 of 13 July 2006 on professional animal farming, manure and slurry etc., (Ammonia action plan, Council directive no. 91/767/EC of 12 December 1991 on the protection of waters against nitrate pollution from agriculture)
5	**Domestic compliance and enforcement:**	Fines and/or up to 2 years of imprisonment
6	**Description:**	Order with rules on covering storage facilities for solid manure (compost layer or another air tight material) and slurry tanks (floating layer, tent or similar).
7	**Objective:**	Protection of the aquatic environment from nitrate pollution.
8	**Greenhouse gas(es) affected:**	N2O
9	**Type of measure:**	Regulation (order)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	Spring 2001
12	**Date for adoption of legislation, if different:**	15 July 2002
13	**Date of beginning:**	Solid manure: 1 August 2004 Slurry: 1 March 2003
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State and county authorities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-0,03 (a)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	An element in the Ammonia Action Plan.
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No, implementet after 2001
41	**References and links for further information:**	Olesen et al. (2004): "Forberedelse af Vandmiljøplan III" (Preparations for the Action Plan on the Aquatic Environment III)
42	**Comments:**	(a) The total effect of the Ammonia Action Plan (Ban on spreading, cover on manure, reduced storage time, ban on ammonia treatment of straw)

AF-4c	Ammonia action plan and the new statutory order on manure: Ban on surface spreading of manure	
1	**Sector:**	Agriculture
2	**Name*:**	Ammonia action plan and the new statutory order on manure: Ban on surface spreading of manure
3	**Origin:**	National measure and in part EU legislation
4	**Legal basis:**	Statutory order no. 814 of 13 July 2006 on professional animal farming, manure and slurry etc., (Ammonia action plan, Council directive no. 91/767/EC of 12 December 1991 on the protection of waters against nitrate pollution from agriculture)
5	**Domestic compliance and enforcement:**	Fines and/or up to 2 years of imprisonment
6	**Description:**	With spreading of manure with towing tubes instead of ordinary broad surface spreading the evaporation of ammonia will be reduced. Also emissions of nitrous oxide will be reduced.
7	**Objective:**	Protection of the aquatic environment from nitrate pollution.
8	**Greenhouse gas(es) affected:**	N_2O
9	**Type of measure:**	Regulation (order)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	Spring 2001
12	**Date for adoption of legislation, if different:**	15 July 2002
13	**Date of beginning:**	1 August 2003
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State and county authorities
19	**Estimated effect (mill. tonnes CO_2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	0
23	**2015 or (2013-2017)/5:**	0
24	**2020:**	0
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	There will be a risk of N_2O formation due to anaerobic conditions. Spreading of manure with towing tubes will increase energy consumption and therefore also CO_2 emissions. It is estimated that the measure - in total - has no effect on greenhouse gas emissions.
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	N content in manure applied will increase due to reduced evaporation, and the need for commercial fertiliser will decrease.
35	**Interaction with other policies and measures:**	An element in the Ammonia Action Plan.
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No, implemented after 2001
41	**References and links for further information:**	Olesen et al. (2001), Olesen et al. (2004)
42	**Comments:**	

AF-4d	Ammonia action plan and the new statutory order on manure: Reduction of the time on field surfaces.	
1	**Sector:**	Agriculture (/Land-use)
2	**Name*:**	Ammonia action plan and the new statutory order on manure: Reduction of the time on field surfaces.
3	**Origin:**	National measure and in part EU legislation
4	**Legal basis:**	Statutory order no. 814 of 13 July 2006 on professional animal farming, manure and slurry etc., (Ammonia action plan, Council directive no. 91/767/EC of 12 December 1991 on the protection of waters against nitrate pollution from agriculture)
5	**Domestic compliance and enforcement:**	Fines and/or up to 2 years of imprisonment
6	**Description:**	Manure applied to areas without crops shall be ploughed in within 6 hours.
7	**Objective:**	Protection of the aquatic environment from nitrate pollution.
8	**Greenhouse gas(es) affected:**	N2O
9	**Type of measure:**	Regulation (order)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	Spring 2001
12	**Date for adoption of legislation, if different:**	15 July 2002
13	**Date of beginning:**	1 August 2002
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State and county authorities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	-0,03 (a)
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	N content in manure applied will increase due to reduced evaporation, and the need for commercial fertiliser will decrease.
35	**Interaction with other policies and measures:**	An element in the Ammonia Action Plan.
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No, implemented after 2001
41	**References and links for further information:**	Olesen et al. (2004): Forberedelse af Vandmiljøplan III (Preparations for the Action Plan on the Aquatic Environment III)
42	**Comments:**	(a) The total effect of the Ammonia Action Plan (Ban on spreading, cover on manure, reduced storage time, ban on ammonia treatment of straw)

AF-4e	Ammonia action plan and the new statutory order on manure: Ban on ammonia treatment of straw.	
1	**Sector:**	Agriculture (/Land-use)
2	**Name*:**	Ammonia action plan and the new statutory order on manure: Ban on ammonia treatment of straw.
3	**Origin:**	National measure and in part EU legislation
4	**Legal basis:**	Statutory order no. 814 of 13 July 2006 on professional animal farming, manure and slurry etc., (Ammonia action plan, Council directive no. 91/767/EC of 12 December 1991 on the protection of waters against nitrate pollution from agriculture)
5	**Domestic compliance and enforcement:**	Fines and/or up to 2 years of imprisonment
6	**Description:**	Ban on ammonia treatment of straw.
7	**Objective:**	Protection of the aquatic environment from nitrate pollution.
8	**Greenhouse gas(es) affected:**	N2O
9	**Type of measure:**	Regulation (order)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	Spring 2001
12	**Date for adoption of legislation, if different:**	15 July 2002
13	**Date of beginning:**	1 August 2002
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State and county authorities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	-0,03 (a)
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	An element in the Ammonia Action Plan.
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No, implemented after 2001
41	**References and links for further information:**	Olesen et al. (2004): Forberedelse af Vandmiljøplan III (Preparations for the Action Plan on the Aquatic Environment III)
42	**Comments:**	(a) The total effect of the Ammonia Action Plan (Ban on spreading, cover on manure, reduced storage time, ban on ammonia treatment of straw)

AF-4f	Environmental Approval Act for Livestock Holdings	
1	**Sector:**	Agriculture
2	**Name*:**	Environmental Approval Act for Livestock Holdings
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 1572 of 20 December 2006 on Environmental Approval Act for Livestock Holdings
5	**Domestic compliance and enforcement:**	Fines and/or up to 2 years of imprisonment
6	**Description:**	The measures covered by the Environmental Approval Act for Livestock Holdings are: • 300 m buffer zones around ammonia sensistive areas where no extension of livestock farms can take place if such an extension would lead to increased ammonia deposition in natural areas vulnerable to ammonia. • Demand for reduction of ammonia emissions relative to production facility with lowest ammonia emission norm: 2007: 15%, 2008: 20%, 2009: 25% • Demands for injection of animal slurry on black soil and grass within buffer zones (1 km from vulnerable natural areas). • Demand for fixed cover on most new containers for solid manure and slurry tanks (depending on distance to neighbours and vulnerable natural areas). • Reduced number of LU/ha when in Nitrate vulnerable areas with low denitrification capacity • Regulation of phosphorous surplus on manure spreading areas
7	**Objective:**	National minimum requirements for environmental protection (odour, ammonia, nitrate, phosphorous, landscape, etc.) when livestock holdings above 75 Livestock Units (LU) are established, expanded or changed. The purpose of the act is to ensure the use of best available techniques (BAT).
8	**Greenhouse gas(es) affected:**	N2O
9	**Type of measure:**	Regulation (order)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	15 December 2006
12	**Date for adoption of legislation, if different:**	20 December 2006
13	**Date of beginning:**	1 January 2007
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State and county authorities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	The effect of these measures on green house gas emissions has not yet been quantified.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	https://www.retsinformation.dk/Forms/R0710.aspx?id=13068
42	**Comments:**	

AF-5	Planting of windbreaks	
1	**Sector:**	Agriculture
2	**Name*:**	Planting of windbreaks
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Binding of CO2
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (subsidies)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1960s
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	0,14
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

AF-6	Biogas plants	
1	**Sector:**	Agriculture and Energy
2	**Name*:**	Biogas plants
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Reduced CO2 and methane emissions and better exploitation of manure
8	**Greenhouse gas(es) affected:**	CO2, N2O og CH4
9	**Type of measure:**	Economic (subsidies)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1987
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	State
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	-0,2
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-0,5
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	No
41	**References and links for further information:**	
42	**Comments:**	

AF-7	Subsidies scheme for private afforestation on agricultural land (increase the forest area in Denmark)	
1	**Sector:**	Forstry / Land-use
2	**Name*:**	Subsidies scheme for private afforestation on agricultural land (increase the forest area in Denmark)
3	**Origin:**	National measure and in part EU legislation
4	**Legal basis:**	Act no. 1044 of 20 October 2008 Statutory Order no. 453 of 9 June 2004 on subsidies for private afforestation Council regulation no. 1698/2005, Articel 43.
5	**Domestic compliance and enforcement:**	Approved subsidies may be canceled in part or totally. Pay back of subsidies already payed can be required with interests. Fines is also possible in servere cases.
6	**Description:**	Private owners of agricultural land can get grants for establishment of broadleaves or conifer forests, nursing of these in the first 3 years, establishment of fences, mapping and or accounting of the area - if the forest will be established in an area planned for afforestation.
7	**Objective:**	Promote private afforestation in achieving the target of an increse in forest area by 450,000-500,000 ha in 100 years.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Economic (subsidies)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	30 January 1997
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	8 February 1997
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Forest and Nature Agency
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	-0,001
20	**2001:**	-0.021
21	**2005:**	-0,056
22	**2010 or (2008-2012)/5:**	-0,116 (-0,120 in "2010")
23	**2015 or (2013-2017)/5:**	-0,193
24	**2020:**	-0,28
25	**2025:**	-0,319
26	**2030:**	-0,387
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

AF-8	Public afforestation (state, counties and municipalities)	
1	**Sector:**	Forstry / Land-use
2	**Name*:**	Public afforestation (state, counties and municipalities)
3	**Origin:**	National measure
4	**Legal basis:**	
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Public afforestation in achieving the target of an increase in forest area by 450,000-500,000 ha in 100 years for purposes such as outdoor recreation, groundwater protection and CO2 sequestration.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	State: Regulation (adopted target, with financial support through the annual state budget) / Counties and Municipalities: Voluntary agreements
10	**Status of implementation:**	Ongoring implementation through annual budgets
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Forest and Nature Agency, counties and municipalities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	-0,006
20	**2001:**	-0,027
21	**2005:**	-0,044
22	**2010 or (2008-2012)/5:**	-0,069 (-0,068 in "2010")
23	**2015 or (2013-2017)/5:**	-0,102
24	**2020:**	-0,123
25	**2025:**	-0,16
26	**2030:**	-0,172
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the effects shown above.
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

DO-1	Energy labelling of small and large buildings (incl. public sector and business)	
1	**Sector:**	Energy, Domestic sector
2	**Name*:**	Energy labelling of small and large buildings (incl. public sector and business)
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 585 of 24 June 2005 on promotion of energy in buildings
5	**Domestic compliance and enforcement:**	Fines in the cases of: 1) landlords failing to ensure that a tenant is provided with the energy labelling for a tenancy before a rental agreement 2) owners who do not comply with the requirement that buildings with a total floor area of 1000 m2 or more have be regularly certified; 3) registered energy consultants who do not have a required public liability insurance 4) registered companies employing energy consultants, which let energy consultants whose registrations have been withdrawn, carry out energy performance certification; 5) omitting or submitting incorrect information concerning circumstances relating to the regulation, which they are legally obliged to report to the authorities. Companies etc. (legal persons) may be punished with a fine according to provisions of the Criminal Code.
6	**Description:**	1. Energy labelling of buildings when built, sold or rented: Must be implemented after finishing the construction of a building and on the sale or rental of the building - primarily heating consumption. This applies in principle for all buildings indifferent of size, apart from production fascilities, factories etc. 2. Regular Energy labelling of large buildings and public buildings Energy labels and an energy plan must be prepared regularly every five years for all large buildings over 1,500 m2 (1000 m2 at July 2009) and for all public buildings over 60 m2 - primarily heating consumption and air conditioning systems
7	**Objective:**	Promotion of energy savings.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Information, Regulation (administrative, order)
10	**Status of implementation:**	Implemented. The act is under revision in order to implement the EU building directive.
11	**Date for the political adoption:**	24 June 2005
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 January 1997
14	**Date of end, if relevant:**	1 January 2006
15	**Allocated resources, if any:**	Financed by the users
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Authority
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	It is estimated that the effect in the future will be the same as in 2003. Since 2003 is the latest year of energy statistics on which the projection of energy consumption is based, no additional effects have been included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes
41	**References and links for further information:**	http://www.ens.dk/sw28015.asp (legislation) (1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	(EN-22)

DO-2	Energy labelling of electric appliances	
1	**Sector:**	Energy, Domestic sector
2	**Name*:**	Energy labelling of electric appliances
3	**Origin:**	EU legislation (Common and Co-ordinated Policies and Measures - CCPM)
4	**Legal basis:**	- Act no. 450 of 31 May 2000 on promotion of energy savings and statutory orders cf. comments - Council directive 92/75/EC of 22 September 1992 - the framework directive on energy labelling and the Commissions directives cf. comments
5	**Domestic compliance and enforcement:**	Fines in the case of missing or inadequate labelling
6	**Description:**	The EU energy labelling directives on household appliances within the scope of the framework directive are mandatory and all products under these directives must be labelled. The energy consumption of the appliances have to be shown in a scale from A to G, where A represent the lowest energy consumption.
7	**Objective:**	To promote development and use of energy efficient appliances with the purpose of reducing energy consumption and CO2 emissions.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Information
10	**Status of implementation:**	Implemented. In the EU work on a recast of the framework directive is on-going, aiming for the inclusion of other types of appliances under the labelling scheme.
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1992
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Agency
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	Information not available
20	**2001:**	Information not available
21	**2005:**	Information not available
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	It is estimated that the effect in the future will be the same as in 2003. Since 2003 is the latest year of energy statistics on which the projection of energy consumption is based, no additional effects have been included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	http://www.ens.dk/lovgivning http://www.ens.dk/sw11747.asp http://www.ens.dk/sw12327.asp
42	**Comments:** Council directives: 2003/66/EC of 3 July 2003 (refrigerators – freezers) 2002/40/EC of 8 May 2002 (electric ovens) 2002/31/EC of 22 March 2002 (air-conditioners) 99/9/EC of 26 February 1999 amending 97/17/EC (dishwashers) 98/11/EC of 27 January 1998 (lamps) 96/89/EC of 17 December 1996 amending 95/12/EC (washing machines) 96/60/EC of 16 September 1996 (washer-driers) 95/13 EC of 23 May 1995 (tumble driers) 92/75/EC of 22 September 1992	(EN-23) Statutory orders: 2003/66: Administrative order no. 693 of 17 June 2004 on energy labelling and required information concerning household electric refrigerators, freezers and their combinations. 2002/40: Administrative order no. 1096 of 9 December 2002 on energy labelling and required information concerning household electric ovens. 2002/31: Administrative order no. 1097 of 9 December 2002 on energy labelling and required information concerning household electric air conditioners. 99/9 & 97/17: Administrative order no. 59 of 29 January 1999 on energy labelling and required information concerning household electric dishwashers. 98/11: Administrative order no. 572 of 2 July 1999 on energy labelling and required information concerning household electric lamps. 96/89 & 95/12: Administrative order no. 318 of 7 May 2002 on energy labelling and required information concerning household electric washing machines. 96/60: Administrative order no. 320 of 20 May 2002 on energy labelling and required information concerning household electric washer-driers. 95/13: Administrative order no. 319 of 7 May 2002 on energy labelling and required information concerning household electric tumble driers. 92/75: Act no. 450 of 31 May 2000 on the promotion of savings in energy consumption

WA-1	Obligation to send combustible waste to incineration (in practice a ban on landfilling).	
1	**Sector:**	Waste
2	**Name*:**	Obligation to send combustible waste to incineration (in practice a ban on landfilling).
3	**Origin:**	National measure
4	**Legal basis:**	Statutory order no. 581 of 24 june 1996 om waste as amended in statutory order no. 1634 of 13 December 2006 on waste.
5	**Domestic compliance and enforcement:**	Fines and/or up to 2 years of imprisonment.
6	**Description:**	
7	**Objective:**	Reduce landfilling, energy production, greater recycling, CH4 reduction
8	**Greenhouse gas(es) affected:**	CH4 (methane)
9	**Type of measure:**	Regulation (administative)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	1994
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 January 1997
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Municipalities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	0,021
21	**2005:**	
22	**2010 or (2008-2012)/5:**	0,333
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	Reductions of CO2 emission in energy supply when biomass in waste for incineration substitutes fossil fuel combustion. All incineration plants in Denmark are connected to district heating grids. However, this effect has not been quantified separately.
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5, the Effort Analysis(1) and the effects shown above
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	Yes
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes
41	**References and links for further information:**	(1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	

WA-2	The waste tax	
1	**Sector:**	Waste
2	**Name*:**	The waste tax
3	**Origin:**	National measure
4	**Legal basis:**	Act no. 570 of 3 August 1998 on waste tax and tax on raw materials as amended by act no. 1165 of 27 November 2006 (originally introduced in 1986)
5	**Domestic compliance and enforcement:**	
6	**Description:**	A tax is imposed on waste for incineration or landfilling. The taxes are DKK 375 per tonne for landfilling and DKK 330 per tonne for incineration.
7	**Objective:**	Greater recycling and least possible landfilling.
8	**Greenhouse gas(es) affected:**	CH4 (methane)
9	**Type of measure:**	Fiscal (tax)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1 January 1987
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry of Taxation
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	Danish Environmental Protection Agency (1997), Waste Center Denmark (www.mst.dk/udgiv/publikationer/2003/87-7972-958-4/html/)
42	**Comments:**	

WA-3	Weight-and-volume-based packaging taxes	
1	**Sector:**	Waste
2	**Name*:**	Weight-and-volume-based packaging taxes
3	**Origin:**	National measure
4	**Legal basis:**	Act no 101 of 13 Frebuary 2001 on tax on packings, bags, service and PVC folios Statutory order no. 111 of 5 February 2000 on tires Statutory order no. 599 of 11 June 2007 on CFCs Statutory order no. 1638 of 13 December 2006 on lead accumulators
5	**Domestic compliance and enforcement:**	
6	**Description:**	Taxes or compensations on several products. E.g. taxes on packings, tires, lead accumulators, CFCs and bags.
7	**Objective:**	The objectives of both weight and volume -based packaging taxes are to reduce the amount of packaging waste and its impacts on the environment. The taxes provide for economic incentives to behave in accordance with these objectives.
8	**Greenhouse gas(es) affected:**	CH_4 (methane) and CO_2
9	**Type of measure:**	Fiscal (tax)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	
19	**Estimated effect (mill. tonnes CO_2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	Waste Centre Denmark (www.affaldsinfo.dk/vidensbank) have an electronic industrial waste bank that collates and systematizes knowledge about industrial waste in 20 sectors.
42	**Comments:**	

WA-4	Subsidy programme – Enterprise Scheme (special scheme for businesses)	
1	**Sector:**	Waste
2	**Name*:**	Subsidy programme – Enterprise Scheme (special scheme for businesses)
3	**Origin:**	National measure
4	**Legal basis:**	Textual note no. 106 to paragraph 23 in the Act on the state budget for 2010. Statutory order no. 1040 of 20 October 2009.
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	Reduce environmental impacts from waste
8	**Greenhouse gas(es) affected:**	CH_4 (methane)
9	**Type of measure:**	Economic (subsidies)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	December 2003
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	2004
14	**Date of end, if relevant:**	2012
15	**Allocated resources, if any:**	Approx. DKK 33 mill. over 4 years (2004-2007) and 38.8 mill. over 3 years (2010-12)
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry for the Environment
19	**Estimated effect (mill. tonnes CO_2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

WA-5	Increased recycling of waste plastic packaging	
1	**Sector:**	Waste
2	**Name*:**	Increased recycling of waste plastic packaging
3	**Origin:**	The EU packaging directive.
4	**Legal basis:**	Statutory order no. 1634 of 13 December 2006 on waste.
5	**Domestic compliance and enforcement:**	
6	**Description:**	The collection of plastic packaging waste for recycling is increased
7	**Objective:**	Increase the recycling of plastic packaging waste to a level of 22.5% i 2008.
8	**Greenhouse gas(es) affected:**	CO2
9	**Type of measure:**	Regulation (administrative)
10	**Status of implementation:**	Implemented
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Environmental Protection Agency
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	-0,005
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

WA-6	Implementation of the EU landfill directive	
1	**Sector:**	Waste
2	**Name*:**	Implementation of the EU landfill directive
3	**Origin:**	The EU landfill directive
4	**Legal basis:**	Statutory order no. 252 of 31 March 2009 on landfills
5	**Domestic compliance and enforcement:**	
6	**Description:**	
7	**Objective:**	To introduce more rigorous demands for landfilling of waste and to lower the amount of waste going to landfills.
8	**Greenhouse gas(es) affected:**	CH4 (methane)
9	**Type of measure:**	Regulation (administrative)
10	**Status of implementation:**	The statutory order on landfills is implemented.
11	**Date for the political adoption:**	31 March 2009
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	
14	**Date of end, if relevant:**	
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Environmental Protection Agency, counties and municipalities
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

WA-7	Support for (construction of facilities for) gas recovery at landfill sites	
1	**Sector:**	Waste, measures no longer in place, but replaced with the general price supplement (See data sheet EN-3)
2	**Name*:**	Support for (construction of facilities for) gas recovery at landfill sites
3	**Origin:**	National measure
4	**Legal basis:**	The development programme for renewable energy (UVE), The Plant Fond etc.
5	**Domestic compliance and enforcement:**	
6	**Description:**	Methane is recovered at landfills. The methane collected acts as fuel in CHP production.
7	**Objective:**	Energy supply and reduction of methane emissions.
8	**Greenhouse gas(es) affected:**	CH4 (methane) and CO2 from fossil fuel based energy supply
9	**Type of measure:**	Economic (subsidies)
10	**Status of implementation:**	Until 1 January 2002 subsidies could be given to the establishment of plants for recovery and use of gas from landfills. Today, support for use of methane from landfills is supported via the general support for using biogas, i.e. tax exception for heat production and price supplement in the case of electricity production. See data sheet EN-3.
11	**Date for the political adoption:**	
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	Mid 1980s
14	**Date of end, if relevant:**	31 December 2001
15	**Allocated resources, if any:**	
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Danish Energy Authority
19	**Estimated effect (mill. tonnes CO2-eq.) in - 1995:**	
20	**2001:**	See the Effort Analysis(1)
21	**2005:**	
22	**2010 or (2008-2012)/5:**	See the Effort Analysis(1)
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	See the Effort Analysis(1)
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5 and the Effort Analysis(1)
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	Combustion of biogas from landfills will emit e.g. NOx.
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5 and the Effort Analysis(1)
37	**Explanation, if the measure is no longer in place:**	See under Implementation above
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	It is estimated that the effect in the future will be the same as in 2003. Since 2003 is the latest year of energy statistics on which the projection of energy consumption is based, no additional effects have been included in the projection.
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	Yes
41	**References and links for further information:**	(1) See Annex B2 and http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk /udgiv/publikationer/2005/87-7614-587-5/html/
42	**Comments:**	

WA-8	Subsidy programme for cleaner products	
1	**Sector:**	Waste, measures no longer in place
2	**Name*:**	Subsidy programme for cleaner products
3	**Origin:**	National measure
4	**Legal basis:**	Statutory order no. 731 and 732 of 9 October 1998 on subsidy programme for cleaner products and on The Environment Council on Cleaner Products as amended in Statutory order no. 784 of 4 September 2003.
5	**Domestic compliance and enforcement:**	
6	**Description:**	Under the subsidy programme for cleaner products it was possible to get grants for projects targetted at reducing the environmental impact from management of waste generated throughout the life cycle of products as well as for projects with the objective to limit environmental problems in connection with waste management.
7	**Objective:**	Reduce the impact of waste on the environmental.
8	**Greenhouse gas(es) affected:**	CH_4 (methane)
9	**Type of measure:**	Economic (subsidies)
10	**Status of implementation:**	Implemented, but no longer in place.
11	**Date for the political adoption:**	9 October 1998
12	**Date for adoption of legislation, if different:**	
13	**Date of beginning:**	1999
14	**Date of end, if relevant:**	2003
15	**Allocated resources, if any:**	Approx. DKK 100 mill. in total the period 1999-2003
16	**For planned measures, planned date of start (& end?):**	
17	**For planned measures, planned allocation of resources:**	
18	**Implementering entity or entities:**	Ministry for the Environment
19	**Estimated effect (mill. tonnes CO_2-eq.) in - 1995:**	
20	**2001:**	
21	**2005:**	
22	**2010 or (2008-2012)/5:**	
23	**2015 or (2013-2017)/5:**	
24	**2020:**	
25	**2025:**	
26	**2030:**	
27	**Reduction cost, short term - with side effects:**	
28	**Reduction cost, short term - without side effects:**	
29	**Reduction cost, long term - with side effects:**	
30	**Reduction cost, long term - without side effects:**	
31	**Methods and assumptions used for the estimation of reduction effects and socio-economic costs:**	See Chapter 5
32	**Side effects – on other GHGs or GHG emitting activities:**	
33	**Side effects – on other air pollutants:**	
34	**Side effects – other:**	
35	**Interaction with other policies and measures:**	
36	**How will the policy or measure modify longer-term trends in anthropogenic GHG emissions and removals:**	See Chapter 5
37	**Explanation, if the measure is no longer in place:**	
38	***Is the effect of the measure included in the "with measures" GHG projection) ?:**	
39	***Is the effect of the measure included in the "with additional measures" GHG projection) ?:**	N.a.
40	***Is effect estimated and subtracted in the "without measures (since 1990)" - projection ?:**	
41	**References and links for further information:**	
42	**Comments:**	

Annex C Description of selected JI and CDM projects

This Annex includes examples of JI and CDM projects in the form of a brief description of the following three projects:

1) Biomass energy from sawdust in Rumania
2) Zafarana 8 – Wind Power Plant Project, Arab Republic of Egypt
3) Brite Tech CDM composting project

Programme or project title: Biomass energy from sawdust in Romania			
Objective: Replace fossil fuels with biomass in energy supply in 5 cities in Romania			
Recipient country	**Sector**	**Expected CO_2 reduction purchased by DK**	**Expected to be in operation by**
Romania	Energy supply (district heating)	721,108 tonnes CO_2 equivalents	April 2004
Description: The project concerns utilising sawdust from forestry in Romanian energy supply in 5 cities instead of oil and natural gas. The project was launched in spring 2004 and has subsequently ensured reductions in greenhouse gas emissions. The project contributes to reducing pollution caused by wood waste that traditionally was dumped in nature, and furthermore it secures a stabile district heating supply for citizens in the five cities.			
Technology transferred: Biomass-based district heating			

Programme or project title: Zafarana 8 – Wind Power Plant Project, Arab Republic of Egypt			
Objective: To install a 120 MW wind power plant that generate electricity thereby replacing electricity otherwise being generated from conventional power plants using fossil fuels			
Recipient country	**Sector**	**Expected CO_2 reduction purchased by DK**	**Expected to be in operation by**
Egypt	Industry	1,150,000 tonnes CO_2 equivalents	October 2005
Description: Zafarana 8 is part of a greater wind power development by New and Renewable Energy Authority (NREA) in the Zafarana region. Until now a total capacity of 305 MW is installed. The installation has been done in phases. The project is located approx. 200 km south east of Cairo at the coast of the Red Sea in an area with favourable wind conditions. The project consists of 142 turbines (850 kW) and has an expected capacity factor of 38%, resulting in an expected net production of 399,456 MWh of electricity annually. The plant operation life is estimated to be 21 years. The electricity generated by the project will replace grid electricity and thereby when fully implemented contribute to annual carbon emission reductions of about 228,089 tCO_2e per year for the duration of the project activity.			
Technology transferred: The project will consist of 142 wind turbines with a size of 850 kW. The wind turbine used in the project is a three-bladed turbine.			

Programme or project title: Brite Tech CDM composting project			
Objective: Use wastewater from Palmoil mills to produce high quality compost			
Recipient country	**Sector**	**Expected CO_2 reduction purchased by DK**	**Expected to be in operation by**
Malaysia	Waste handling and disposal	240,000 tonnes CO_2 equivalents	2009
Description: Palm oil mills are producing a lot of wastewater with a high contrition content which normally is treated anaerobic in deep foul smelling lagoons next to the mill. Apart from the foul smell and being breathing ground for mosquito's these pools also emit large amounts of methane – a GHG with a green house gas potential 21 times CO2. To get rid of the lagoons and the methane emissions Simon Moes from Denmark have developed a method to dewater the sludge using low tech "containers", The dewatered sludge is then composted and used as a high quality fertilizer in the oil palm plantations. In other words the project is reducing the GHG emissions, getting rid of the foulsmelling lagoons and making the oil palm plantations more sustainable.			
Technology transferred: AVC technology provided by Simon Moes			

Annex D Information on Denmark's Efforts published in 2009 on the COP 15 host web-site

This Annex include examples of the information on Denmark's climate efforts published in 2009 on the COP 15 host web-site:

1) WHY WE SHOULD HAVE A CLIMATE CHANGE AGREEMENT
2) THE DANISH GOVERNMENT'S GOALS FOR COP15
3) TAKE PART IN THE DEBATE
4) CLIMATE DIPLOMACY
5) THE DANISH EXAMPLE
6) TRADE AND CLIMATE
7) THE BUSINESS PANEL ON CLIMATE CHANGE
8) CLIMATE AT DANISH METEOROLOGICAL INSTITUTE
9) DANISH CLEANTECH SOLUTIONS - DRIVING EXPORT AND ATTRACTING FOREIGN INVESTMENTS
10) GREEN IT
11) CIVIL SOCIETY ORGANIZATIONS
12) CLIMATE EDUCATION IN 2009
13) SUSTAINABLE TRANSPORT - BETTER INFRASTRUCTURE
14) PROFILE SHEETS
15) GREENLAND DIALOGUE PROVIDES POLITICAL GUIDANCE TO CLIMATE NEGOTIATIONS
16) COP15 CLIMATE CONFERENCE: DENMARK SKIPS THE GIFTS AND EDUCATES YOUTH INSTEAD

1) WHY WE SHOULD HAVE A CLIMATE CHANGE AGREEMENT

A global climate change agreement is necessary so we can limit the negative man-made effects on the climate system for future generations.

Ministry of Foreign Affairs of Denmark

Today, the Kyoto Protocol regulates the greenhouse gas emissions up to 2012.

If the world's nations are to decide upon a new agreement to enter into force before the first commitment period of the Kyoto Protocol expires, 2009 is the final opportunity to do so.

A global climate change agreement is necessary so that we can limit the negative man-made effects on the climate system for future generations.

Global climate changes have always taken place. There have been ice ages and warm periods. Ice core drilling has shown how temperatures and emissions of greenhouse gases have fluctuated over the last 650,000 years. Greenhouse gases in the atmosphere have not been the decisive factor for the temperature swings, but they have contributed to intensifying them.

Climate changes in themselves are nothing new. What is new is that man-made emissions have led to the volume of greenhouse gases in the atmosphere being increased massively, and for that reason global warming is happening significantly faster than previously.

2) THE DANISH GOVERNMENT'S GOALS FOR COP15

The Danish Government's goal is to enter into a binding global climate agreement at the United Nations Conference in Copenhagen. The agreement will apply to the period after 2012.

Ministry of Foreign Affairs of Denmark

The government's ambition is for the agreement to include as many countries as possible, and that the agreement must contribute to a reduction in man-made greenhouse gases which have a negative effect on our climate system.

The government will therefore put all its efforts into obtaining an agreement that combines respect for the environment, living standards and long-term security of energy supply in the best way possible.

3) TAKE PART IN THE DEBATE

Through the COP15 website, the Danish government invites the world to participate in the global debate leading up to the UN Climate Change Conference 2009 (COP15), which will take place in Copenhagen in December 2009.

Ministry of Foreign Affairs of Denmark

On the website, you can participate by commenting on news articles and blog posts. Visitors to the site can also participate through the following initiatives:

The Climate Quiz allows visitors to cop15.dk to test their climate knowledge. Visitors can also compare climate knowledge with friends. The quiz can be accessed at www.quiz.cop15.dk
Climate Thoughts is a unique visual representation of climate opinions from visitors to cop15.dk as well as well-known climate thinkers. Climate Thoughts can be accessed at www.thoughts.cop15.dk
The Climate Game allows visitors to cop15.dk to experiment with CO_2 reductions in an entertaining environment. The Climate Game can be accessed at www.game.cop15.dk
On Facebook, it is possible to show support of the UN Climate Change Conference 2009. The COP15 page on Facebook can be accessed through www.facebook.cop15.dk
On Twitter, the Danish government posts regular news updates on climate change. The COP15 Twitter account can be reached through www.twitter.cop15.dk

4) Climate diplomacy

The Danish government has taken a range of initiatives to increase the focus on the necessity of an international agreement on a reduction in greenhouse gas emissions.

Ministry of Climate and Energy of Denmark

By hosting the UN climate conference COP15 in 2009, the current Danish government has brought energy into focus again as a decisive political area. Furthermore, the Danish government has taken a range of initiatives to increase the focus on the necessity of an international agreement on a reduction in greenhouse gas emissions. Among these initiatives are:

The Greenland dialogue. This came about as an initiative of the Danish Minister for Climate and Energy, Connie Hedegaard. The plan was to create a forum where the often stiff and protracted discussions under the auspices of the UN could be softened up. The idea was simple. Ministers from more than 20 countries gathered in the summer of 2005 in Greenland in order to see with their own eyes some of the consequences of climate change. At the same time the meeting was supposed to provide a haven for the politicians to talk to one another without restrictions. Accordingly a code of conduct was put forward: there were to be no consultation documents, no press, only one official per minister, no conclusions were to be made on anything, and subsequently nothing of what the participants had said was to be reported.

This haven for dialogue was a success, and therefore it has been followed by similar dialogue meetings in South Africa in 2006, in Sweden in 2007 and in Argentina in 2008.

Climate attachés. In order to keep updated on climate-related discussions in other parts of the world, the Danish government has sent five climate attachés to New Delhi, Moscow, Washington, Brasilia and Pretoria. The attachés are to report home on climate-related developments in the region they are covering.

5) THE DANISH EXAMPLE

Experience from Denmark shows that it is possible to maintain high economic growth while at the same time reducing the dependency on fossil fuels.

Ministry of Climate and Energy of Denmark

The Danish Example:

"The Danish example" – the way to an energy efficient and energy friendly economy

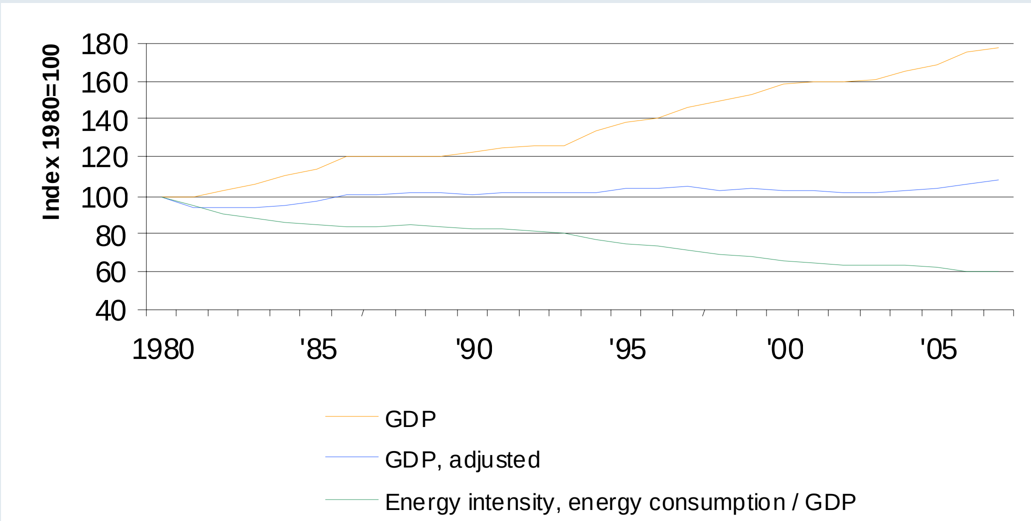
February 2009

Danish experience shows that through persistent and active energy policy focus on enhanced energy efficiency, it is possible to sustain high economic growth and at the same time reduce fossil fuel dependency and protect the environment.

In terms of production, Denmark is one of the most efficient users of energy compared with the other EU Member States and OECD countries. This also applies to CO_2 emissions in relation to production. Despite relatively low energy consumption, Denmark is among the best in the EU and the OECD at continuously reducing its energy dependency and CO_2 emissions. In an international perspective, Denmark therefore belongs to a group of countries that have relatively low energy and CO_2 intensities, while over the past more than 25 years, being able to achieve above-average reductions in energy and CO_2 intensity.

Since 1980, the Danish economy has grown by 78%, while energy consumption has remained more or less constant, and CO_2 emissions have been reduced. This development reflects an increase in energy and CO_2 efficiency. A majority of countries have seen underlying increases in their energy and CO_2 efficiencies, but the Danish increase is among the greatest in the OECD area.

Energy consumption, GDP and energy intensity



Furthermore, the composition of energy consumption in Denmark has changed significantly as a consequence of energy policy measures to promote the use of renewable energy. Renewable energy today makes up more than 19% of final energy consumption[1].

This has increased the security of energy supply and has contributed considerably to fulfilling Denmark's climate goals. From 1990 to 2007, economic activity in Denmark increased by more than 45%, while CO_2 emissions (adjusted for fluctuations in the weather and in cross-border exchange in electricity) were reduced by more than 13%.

This paper describes how Denmark has been able to sustain economic growth while energy consumption has remained almost unchanged and CO_2 emissions have dropped.

Energy consumption and the development in energy and CO_2 intensity in an international perspective

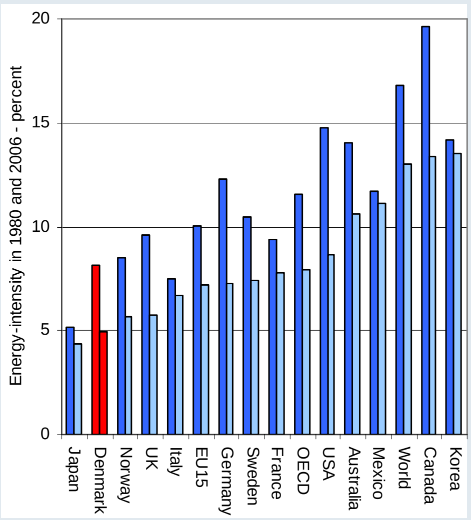
Today, Denmark's energy efficiency is one of the best in the EU and continues to improve year by year. Danish energy intensity is thus the lowest in the EU. Energy intensity is measured as the ratio of energy production[2] to real GDP.

Since 1980, Denmark has reduced its energy intensity by more than the OECD average, and by noticeably more than for the world as a whole. At the same time, Denmark has one of the lowest energy intensities. However, several countries have seen a development in energy intensity similar to Denmark's, as can be seen in the figure on the next page to the right.

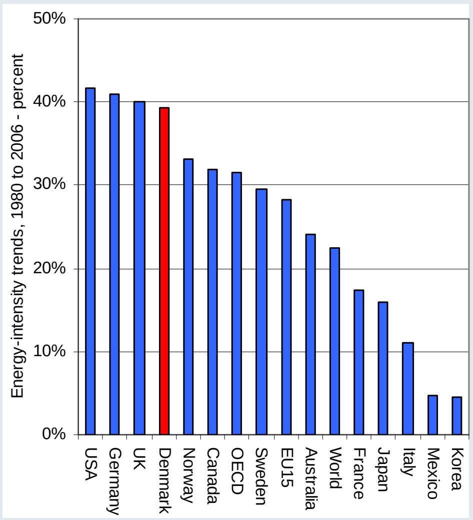
[1] When the share of renewable energy is calculated on the basis of final energy consumption rather than on the basis of gross energy consumption, the basis for calculating is energy consumption by end users, exclusive of cross-border trade and consumption for non-energy purposes. Distribution loss and own consumption from electricity and district heating production are included in final energy consumption.

[2] IEA data are used which does not include adjustments for cross-border electricity exchanges.

Energy intensity in selected OECD countries, 1980 and 2006



Reduction in energy intensity in selected OECD countries in the period 1980-2006

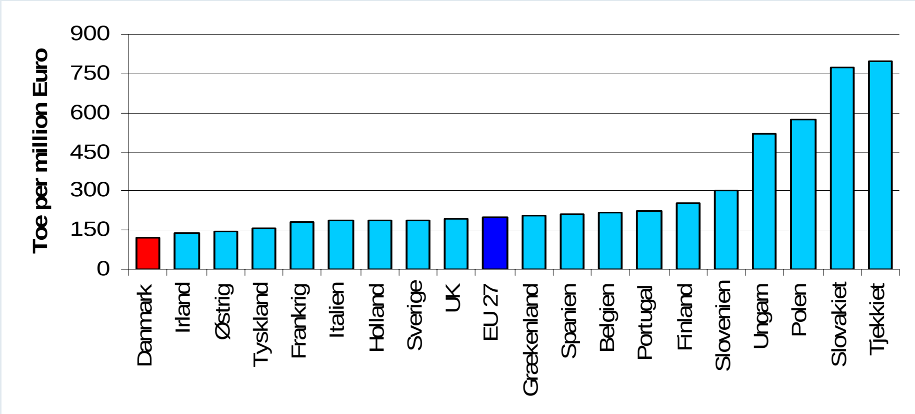


Note: In the figure to the left, the dark blue column (left column) indicates the energy intensity for the individual country in 1980, while the light blue column (right column) indicates the energy intensity for the individual country in 2006.

Note: Energy consumption for foreign shipping (foreign bunkering), according to international energy statistics standards, is not included in the energy consumption of the individual country, but is stated separately. This consumption therefore does not appear from the figure. The added value in Danish foreign shipping trade is included in GDP.

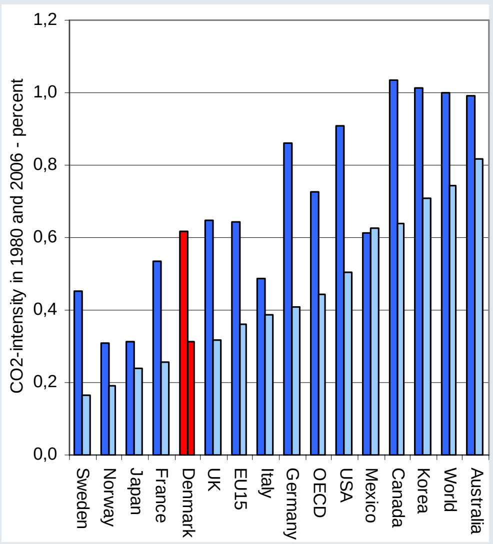
Note: These intensity figures are based on GDP at market prices. Please note that relatively high indirect taxes in Denmark, all things being equal, increase the nominally calculated GDP at market prices and thus reduce the calculated energy intensity. For the Eastern European countries in particular, a relatively lower price level will tend towards a lower calculated GDP at market prices and thus a higher calculated energy intensity for these countries. Source: IEA, 2008

Energy intensity in EU Member States, 2006

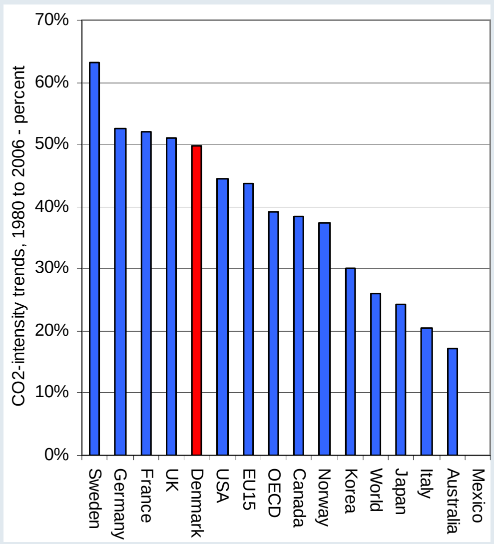


In addition to energy intensity, Denmark has also reduced its CO_2 intensity by more than the OECD average, and by noticeably more than for the world as a whole, just as Denmark has one of the OECD's lowest CO_2 intensities (CO_2 intensity is measured as the ratio of CO_2 emissions to real GDP). Several other countries, however, have also seen a development in energy intensity in line with Denmark's. It is important to note that, amongst other things, differences in the structure of industry influence both energy intensity and CO_2 intensity across countries.

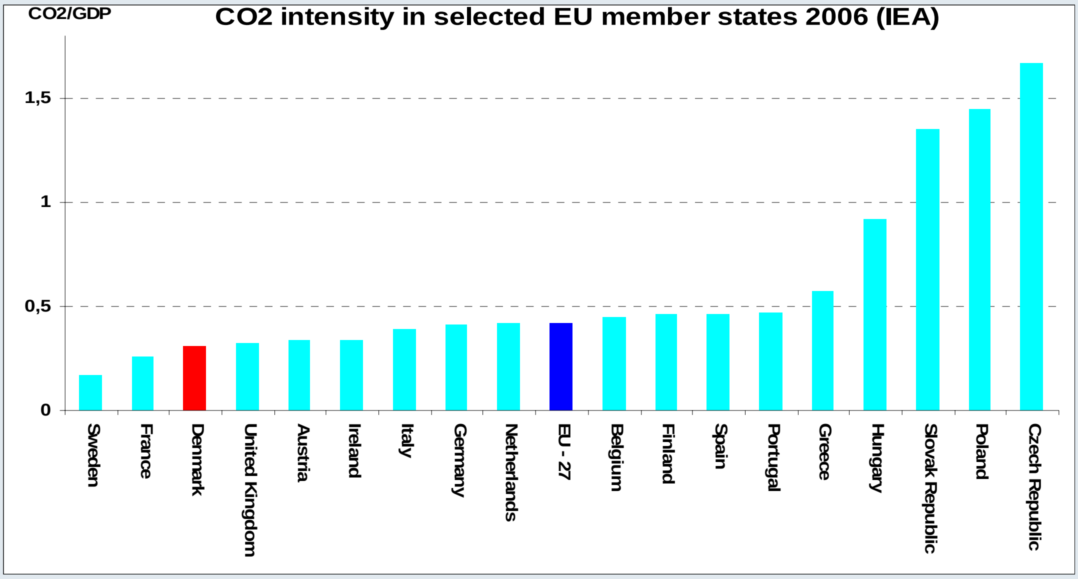
CO_2 intensity in selected OECD countries, 1980 and 2006



Reduction in CO_2 intensity in selected OECD countries in the period 1980-2006

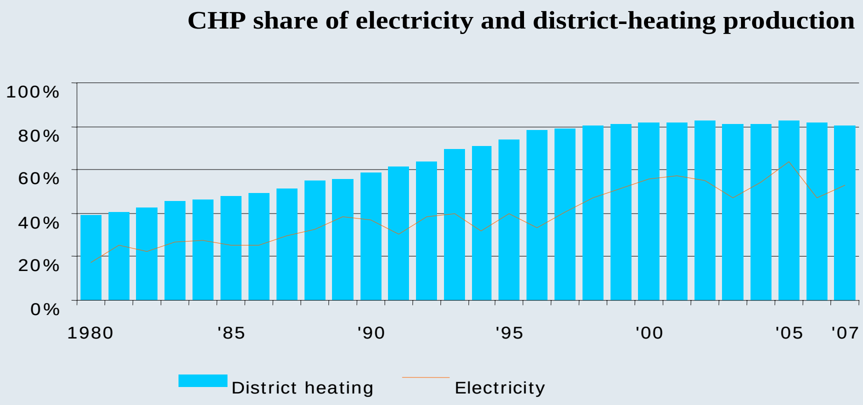


Note: In the left figure, the dark blue column (left column) indicates the CO2 intensity for the individual country in 1980, while the light blue column (right column) indicates the CO2 intensity for the individual country in 2006.
Note: See notes to figure above.
Source: IEA, 2008



The promotion of cogenerated electricity and heat, one of a long series of measures to improve energy efficiency, has been extremely important for Denmark's good results. Cogeneration of electricity and heat ensures far more efficient use of the fuels that are used in production. The most efficient CHP plants have an energy efficiency rate of more than 90%. As can be seen from the figure below, the share of district heating produced at CHP plants has more than doubled, from 39% to 80%, since 1980. Similarly, the share of electricity cogenerated with heat has gone up from just under 18% to almost 53%.

CHP share of electricity and district-heating production



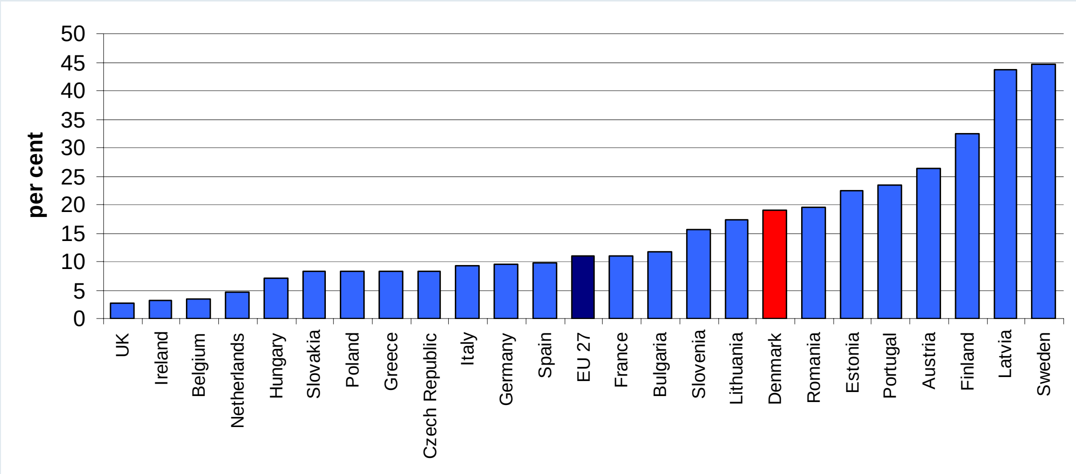
In addition to more energy efficient energy production, a number of initiatives have been carried out to increase the efficiency of end-user consumption, that is, consumption by consumers and enterprises. Initiatives include the establishment of high energy standards for buildings and energy labelling schemes for electrical appliances, public campaigns to promote energy savings in households, energy saving agreements with industry, and, not least, the implementation of taxes on energy consumption. Environmental and energy taxes in Denmark are therefore contributing factors in making the price of consuming energy better reflect the environmental costs of production, use and disposal.

Over the past five years there has been a slight increase in energy consumption in Denmark. This increase is expected to slow down, particularly due to the intense energy saving effort adopted in 2005 and followed up by the Energy Agreement of 21 February 2008 at an even greater level of ambition, both of which were adopted by a broad political majority. In the new policy agreement, the targets for the energy saving efforts are a reduction by 4% by 2020 and by 2% by 2011 of gross energy consumption compared to 2006.

Renewable energy

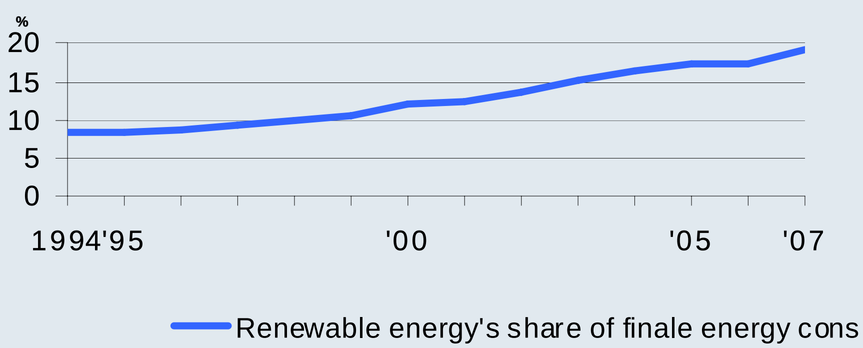
Despite almost no hydropower resources and the lack of a long tradition of utilising biomass, Denmark has managed to become among the leading countries in renewable energy.

Renewable energy[3] - share of final energy consumption, 2006

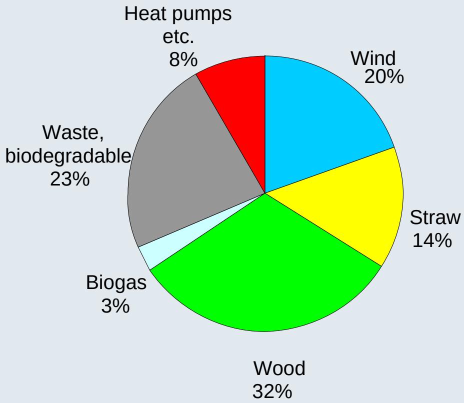


Renewable energy's share of final energy consumption in Denmark has been steadily increasing since 1980. Today, more than 19% of Denmark's final energy consumption is covered by renewable energy.

Renewable energy in Denmark



Renewable energy's contribution to final energy consumption is composed of several different forms of renewable energy. As can be seen from the figure on the right, various forms of biomass together contribute the largest share. Of this share, wood accounts for the largest share, followed by biodegradable waste and straw.



Looking at electricity supply alone, renewable energy today accounts for 28%, which is chiefly due to the incorporation of wind energy in electricity production. Denmark today has 3,150 MW of installed wind energy capacity, of which 420 MW are offshore wind turbines (July 2008).

The Energy Agreement of 21 February 2008 sets out a number of initiatives to ensure that renewable energy constitutes at least 20% of gross energy consumption in 2011 (corresponding to at least 22% of the final energy consumption). The Government's goal is furthermore that renewable energy constitutes at least 30% of gross energy consumption in 2025 (corresponding to at least 33% of the final energy consumption).

Renewable energy contributes to enhancing the security of energy supply and is an important element in meeting the Government's long-range vision to make Denmark entirely independent of fossil fuels. Furthermore, renewable energy sources are generally CO_2 neutral and therefore contribute to reducing the emission of greenhouse gases.

Analyses show that the costs of introducing renewable energy in Denmark have been relatively high, however falling costs over time and increasing prices of fossil fuels have gradually made renewable energy sources more competitive against traditional energy sources.

Research and development

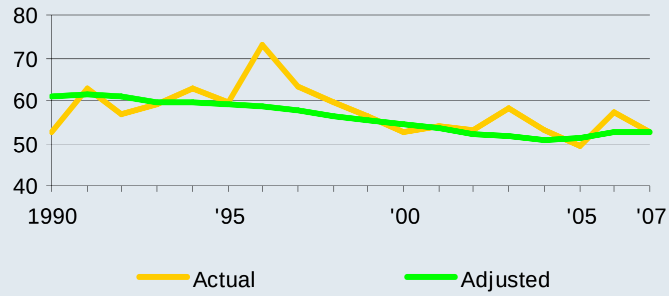
Research, development and demonstration of new technologies and systems have been decisive for the Danish stronghold in the energy area. Likewise, Denmark has a well-developed tradition of broad cooperation on research and development in the energy area, including good experience and fine examples of effective cooperation projects and networking between enterprises and research and knowledge institutions. Research has received state support through a number of research and innovation programmes and through basic research at the research institutions.

In recent years, the energy area has been allocated extra public funding, and the government's objective is to double public efforts up to 2010. Most recently, the Energy Technology Development and Demonstration Programme (EUDP) was established to help new energy technologies and solutions in the final steps towards market introduction.

Greenhouse gas emissions reduction

As a consequence of the more or less stable trend in energy consumption and the increasing share of renewable energy, CO_2 emissions in Denmark (adjusted for fluctuations in the weather and in cross-border exchange in electricity) have been reduced by more than 13% since 1990. As can be seen from the figure below, there was a slight increase in adjusted CO_2 emissions from 2005 to 2007. This slight increase, however, does not influence the general trend which is that CO_2 emissions have been reduced since 1990.

Trends in CO_2 emissions

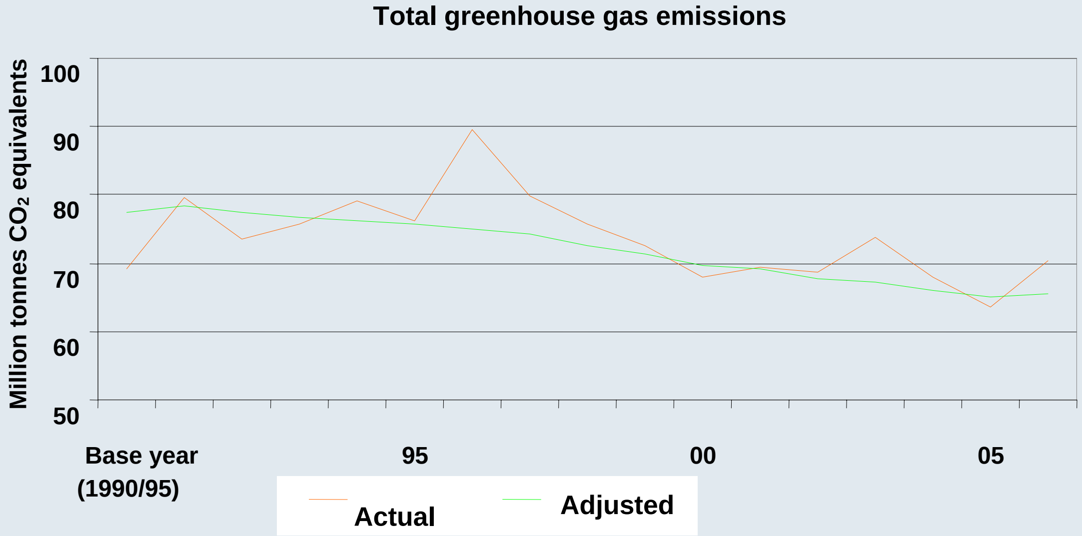


Note: The figure shows that actual CO_2 emissions fluctuate markedly from year to year because Denmark exports electricity in some years and imports in others. In the adjusted graph, imports and exports of electricity have been eliminated from the figures for CO_2 emissions.

The CO_2 emissions stated above concern only emissions of CO_2 from energy use, however these account for about 75% of Denmark's overall greenhouse gas emissions.

When calculating the total greenhouse gas emissions, the other greenhouse gas emissions must also be included. The total greenhouse gas emissions are decisive in relation to Denmark's ambitious Kyoto target, which is to reduce emissions of greenhouse gases by 21% in the period 2008-2012 relative to 1990. Total greenhouse gas emissions also include CO_2 from other, non-energy related activities, nitrous oxide coming primarily from agriculture, methane coming primarily from agriculture and landfills, and the so-called industrial greenhouse gases, which stem primarily from refrigerants and from protective gas in larger electrical installations.

The most recent historical statement of Denmark's total greenhouse gas emissions is from 2006 and, without adjustments, shows that emissions in this year were 1.8% above the base year 1990/95. With adjustments for fluctuations in the weather and cross border electricity exchange there was actually a 15% drop in emissions since the base year 1990/95.



Note: Denmark's base year under the Kyoto Protocol comprises emissions of CO_2, methane and nitrous oxide in 1990 and emissions of the industrial greenhouse gases in 1995.

Due to the ambitious targets of a reduction in energy consumption up to 2020 and an increasing share of renewable energy, Danish CO_2 emissions will also follow a falling trend in the future.

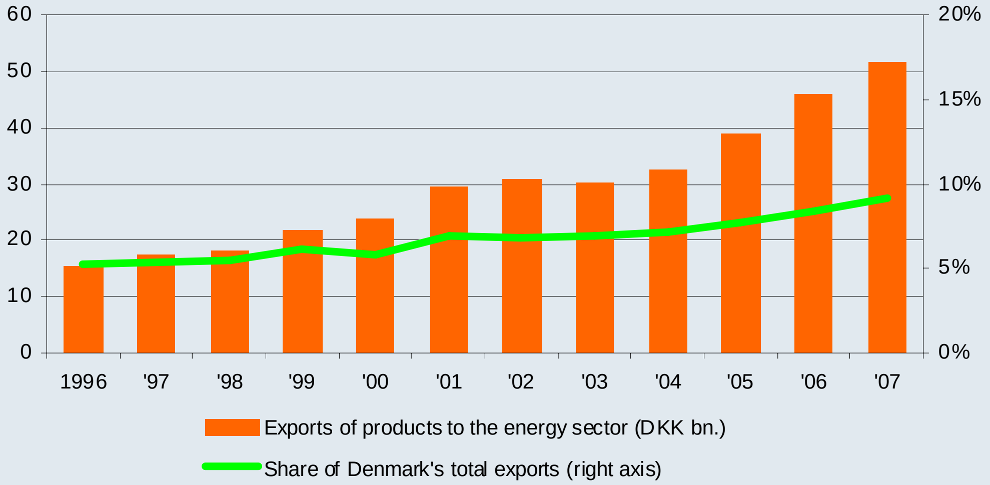
Denmark - a competitive country

All in all, it must be concluded that since 1980 Denmark has been able to maintain its status as a wealthy country with sound economic growth, while energy consumption has remained more or less constant and greenhouse gas emissions have been reduced.

The persistent political and commercial focus on energy efficiency, along with the introduction of new technologies, have meant that Danish enterprises throughout several years have developed and gained valuable experience from new energy technology solutions. And these solutions have been converted into increased exports. For example, Denmark today is a leading player in wind turbine production, and covers about one-third of the global wind turbine market.

In total, Danish exports of energy technology increased to about DKK 52 billion in 2007. From 1996 to 2007 this figure more than trebled, and exports of energy technology now account for more than 9% of total exports.

Exports of products to the energy sector



Not only in the energy area does Denmark excel as a competitive country. Danish enterprises are exploiting the opportunities offered by globalisation, and today Denmark is among the top ten most prosperous countries in the world. Denmark has a GDP per capita that is higher than the EU15 average and Danish unemployment is lower than the EU15 average.

Sources:
"Energy Statistics 2007", the Danish Energy Agency, September 2008
"CO_2 from Fossil Fuel Combustion", IEA 2008.

6) TRADE AND CLIMATE

The climate changes are considered one of the world's greatest challenges. There is a need for everyone to limit the emission of CO_2.

Ministry of Foreign Affairs of Denmark

With this overall goal and motivated by the hosting of COP15, the Ministry of Foreign Affairs has started to look closer at the relationship between trade and climate. The question is if and how trade policy instruments can contribute to the fight against climate change. This initiative was launched at the informal meeting between the ministers of trade, which took place in the margin of COP13 on Bali, December 2007.

<u>The Informal Meeting of Ministers of Trade at Bali, December 8th and 9th 2007</u>

During the climate conference COP13 on Bali, Indonesia, the Indonesian government took the initiative to hold an informal meeting between the ministers of trade. The purpose of the meeting was to start an informal dialogue about the possibilities of trade policy to contribute to the fight against climate change. The talks dealt, among other things, with the joint proposition of the EU and the United States from December 3rd 2007. The proposal concerned a reduction in the tariffs on environment friendly goods and services and on transfer of technology to the developing countries. One of the conclusions from the trade ministers' meeting was that there was a need for further studies of the connections between trade and climate. The hosts of COP14 and COP15, respectively Poland and Denmark, were encouraged by the Indonesian government to continue the dialogue between the ministers of trade. As a result of the conclusions from the meeting in Indonesia, the Ministry of Foreign Affairs has started a process aiming at furthering the knowledge on the relations between trade and climate.

The Process towards COP15

Taking its starting point in the conclusions from the informal meeting of minsters of trade in December 2007, the Ministry of Foreign Affairs has focused on the relations between trade and climate, and has therefore arranged two larger events in the spring of 2008.

At the annual trade politicy conference on the 9th of May 2008 at the University of Copenhagen the focus was “WTO – trade and climate”. On the basis of presentations from minister of foreign affairs, Per Stig Møller, minister for trade and development from the UK, Gareth Thomas, and vice-secretary for WTO, H.V. Singh there were discussions on the latest developments in the Doha negotiations and on the question of how the international trade system could contribute to the fight against climate change. The conference was well attended with a wide variety of guests consisting of academics, politicians, business people and NGOs.

In order to continue the process, the Ministry of Foreign Affairs decided to gather 50 experts and provide them with the opportunity to discuss the relations between trade and climate at the seminar “Trade and Climate Change”. The seminar took place on the 18-20th of June in Eigveds Pakhus in Copenhagen and was arranged in cooperation with the German Marshall Fund of the United States (GMF). The International Institute for Sustainable Development (IISD) was responsible for the background papers ahead of the seminar, while the International Centre for Trade and Sustainable Development (ICTSD) contributed with expert knowledge and input. The seminar was made possible through significant economic support from the William and Flora Hewlett Foundation.

At the seminar the participants were split into six working groups and over a 2-day period discussed how and in what way trade politicy instruments could contribute to the fight against climate change. Due to the difference in the participants' background and points of reference, the discussions in the working groups were versatile and contained several perspectives on the various challenges.

The (preliminary) results of the seminar are expected to be followed up in a trans-ministerial taskforce chaired by the Ministry of Foreign Affairs. The taskforce will attempt to specify the Danish position on how trade politicy instruments can contribute to the fight against climate change.

The aim is to improve the foundation of Denmark’s active participation in the international discussions leading up to and during COP15 in Copenhagen in December 2009.

7) THE BUSINESS PANEL ON CLIMATE CHANGE

In September 2007, the Danish Government established a Business Panel on Climate Change to meet the interests of the business community.

Ministry of Economic and Business Affairs

Background

The business community and its organizations' interest in having their points of view considered and their interests represented prior to the conference was channelled through the government's establishment of a Business Panel on Climate Change. Using analyses, presentations and recommendations, the panel provided advises to the government nationally and internationally about the activities and issues surrounding environmental technology and the climate change conference.

The Minister of Economic and Business Affairs chaired the panel. The Environment Minister, the Foreign Minister, the Science Minister and the Climate and Energy Minister also took part. In addition, a series of organizations, companies and scientific institutions, all of which have a significant objective interest in the area, participated.

The panel was supported by a secretariat in the Economic and Business Affairs Ministry.

Members of the Business Panel on Climate Change

Ministers

Economic and Business Affairs Minister
Foreign Minister
Science Minister
Climate and Energy Minister
Environment Minister

Organizations

Danish Construction Association
Danish Energy Association
Danish Chamber of Commerce
The Confederation of Danish Industries (DI)
Danish Metalworkers' Union
The Danish Federation of Small and Medium-Sized Enterprises
Local Government Denmark (LGDK)
Danish Agriculture Council
Danish Confederation of Trade Unions (LO)
Danish Shipowners' Association
Danish Wind Industry Association

Personal appointees

Anders Eldrup, CEO DONG Energy
Birgitte K. Ahring, CEO Biogasol
Torkil Bentzen, Chairman of Programme for Energy Technology Development and Demonstration
Ditlev Engel, Group CEO, Vestas
Erik Rasmussen, CEO Mandag Morgen
Haldor Topsøe, Chairman of Haldor Topsøe
Johan Prior Knock, CEO Rockwool
John Nordbo, Head of Climate Team WWF World Wide Fund for Nature
Jørgen Lundsgaard, Director IRD Fuel Cell Technology

Jørgen Mads Clausen, Chairman of the Board of Danfoss
Jørgen Tang Jensen, CEO Velux
Lise Kingo, Group Director Novo Nordisk
Niels Due Jensen, Chairman of the Danish Council for Sustainable Business Development Chairman of the Board of Grundfos
Ole Brinch-Nielsen, CEO Shell Denmark
Steen Risgaard, CEO Novozymes
Stine Bosse, Group CEO TrygVesta
Susanne Larsen
Thomas Thune Andersen, CEO Maersk Oil
Tom Knutzen, CEO Danisco

Universities and Research
Technical University of Denmark
DHI
University of Copenhagen
Danish Technological Institute
University of Aarhus

8) CLIMATE AT DANISH METEOROLOGICAL INSTITUTE

It's important to include knowledge on future climate change in long term planning in many sectors.

Danish Meteorological Institute

Climate change is evident from observations of air and ocean temperatures, widespread melting of snow and ice and global sea level change, and climate change will continue. It is, therefore, important to include knowledge on future climate change in long term planning in many sectors.

Research in and observations of the climate is shared by several departments at The Danish Meteorological Institute (DMI). Central areas are maintained by Danish Climate Center, department of Data and Climate and Centre for Ocean and ice.

The Danish Climate Centre (DKC) provides in-depth information and advice on climate and climate change and collaborates in research projects, both in Denmark and internationally.

The main objectives of the DKC are to develop climate projections into the 21st century. The tasks include development of methods for seasonal forecasting, development of state-of-the art global and regional climate models and studies of climate processes. The tasks also include the use of climate models to simulate global and regional climate variability and change in the past and to predict future changes.

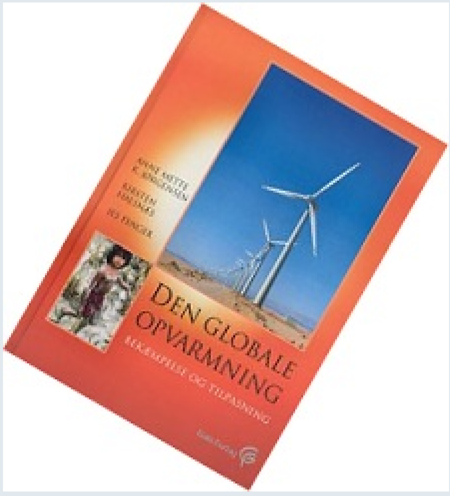


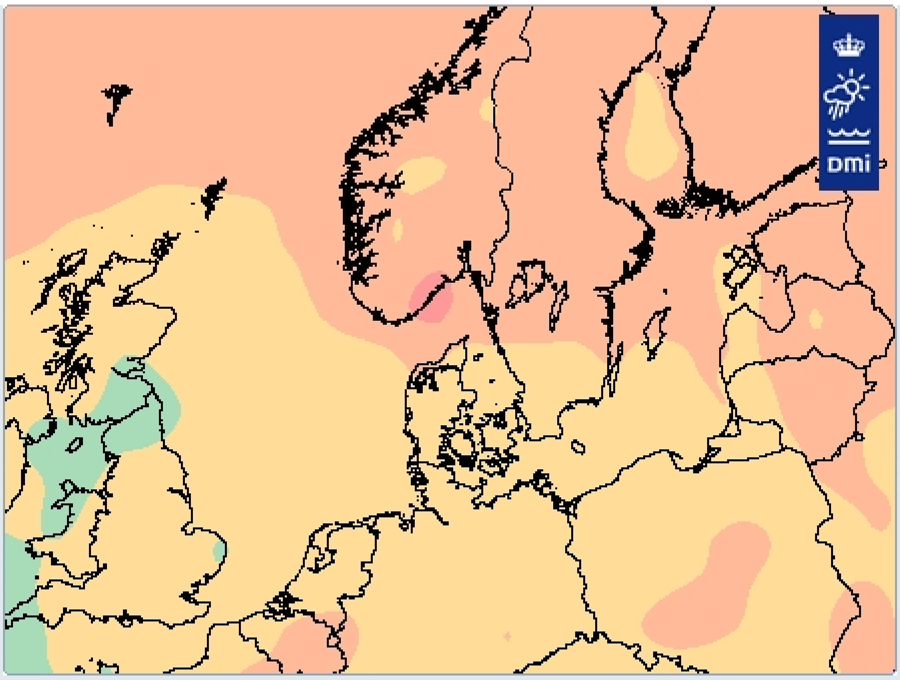
Figure 4: *Book cover…*

The Centre is very active in outreach activities. It publishes books, papers, news and articles in different media including the internet, and gives presentations on many occasions.

The DKC currently has a staff at around 30 uses the Cray XT5 supercomputer at DMI. Its funding comes from the Danish Government and from research councils and programmes, mainly the European Framework Programmes for Science and Technology.

One of the international projects in which DKC participates, is the ENSEMBLES project. ENSEMBLES is an integrated project supported by the EU 6th Framework Programme, and it includes both global and regional modelling. The DKC hosts the ENSEMBLES data server.

An important focus area for DKC is seasonal prediction. Some climate variations depend on sea surface temperatures and snow and ice cover, and such variations are partly predictable on timescales of weeks to months. The DMI bases its seasonal forecasts on the ensemble forecast product from the European Centre for Medium-Range Weather Forecasting.



***Figur 1**: Map, showing seasonal prediction…*

The map shows an example of a seasonal temperature forecast for Denmark. Such forecasts are made available to the public on www.dmi.dk. The DKC also produces statistical forecasts for Denmark and Greenland.

Developing countries are especially vulnerable to climate change. For example, changes in precipitation may have an impact on both water resources and agricultural production. Seasonal climate prediction has improved considerably over the past decade and may be used in agricultural production planning. The DKC carried out a study in Ghana in collaboration with the national meteorological service and local institutes.

Greenland is another focus area for DKC. Research includes the mass balance of Greenland Ice Cap – how does it affect climate and what are the impacts of climate change on the Ice Cap? Another research area is the impact of climate change on permafrost and sea ice conditions.

In a new project the carbon cycle in tundra and taiga is studied experimentally in Northern Russia and modelled. Climate change, including changes in permafrost, may lead to emissions of greenhouse gases from the ground, and this will be a positive feedback to further enhance climate change.

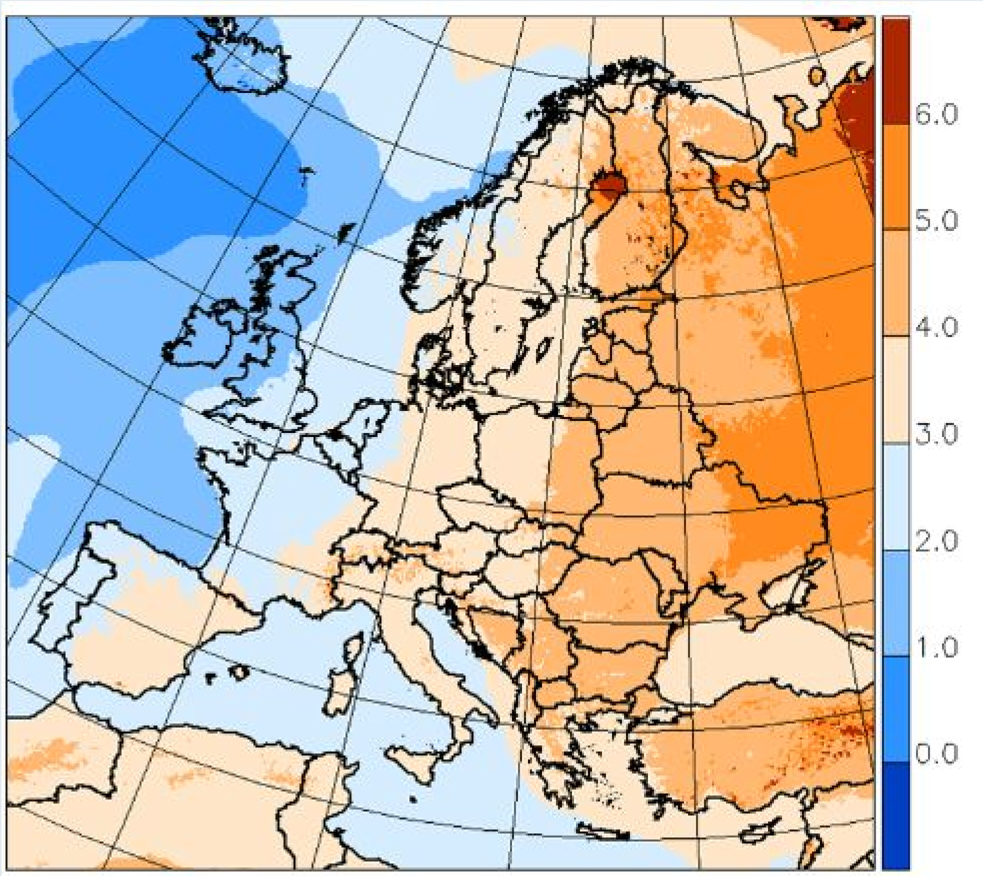


Figure 5: *Chart from HIRHAM.*

The HIRHAM regional climate model at DMI is used for simulating regional climate changes. The map shows temperature change 2071-2100 as compared to 1961-90 for one emissions scenario. Detailed climate scenarios are important for studies of impacts of climate change, vulnerability and adaptation.

The Danish Climate Centre participates in the EC Earth initiative on global Earth System Modelling. A coupled global atmosphere-ocean model is implemented at the DMI Cray XT5 supercomputer and is used for high resolution projections under the CMIP5 protocol. The projections will be a Danish contribution to the IPCC AR5.

The DKC is heavily engaged in international collaboration. The Centre is actively participating in the work of the Intergovernmental Panel on Climate Change (IPCC), both delivering data and reviewing reports from the IPCC. In addition, staff members have contributed to IPCC reports, one as coordinating lead author.

Department of Data and Climate holds the DMI historical Climate database, which contains 150 years of data for Denmark, The Faroe Islands and Greenland. The past climate is reported continuously as publications, statements and information on dmi.dk to all parts of the society. Additionally a climate grid as interpolated values in 1x1 km resolution for more specific planning and calculation purposes are available.

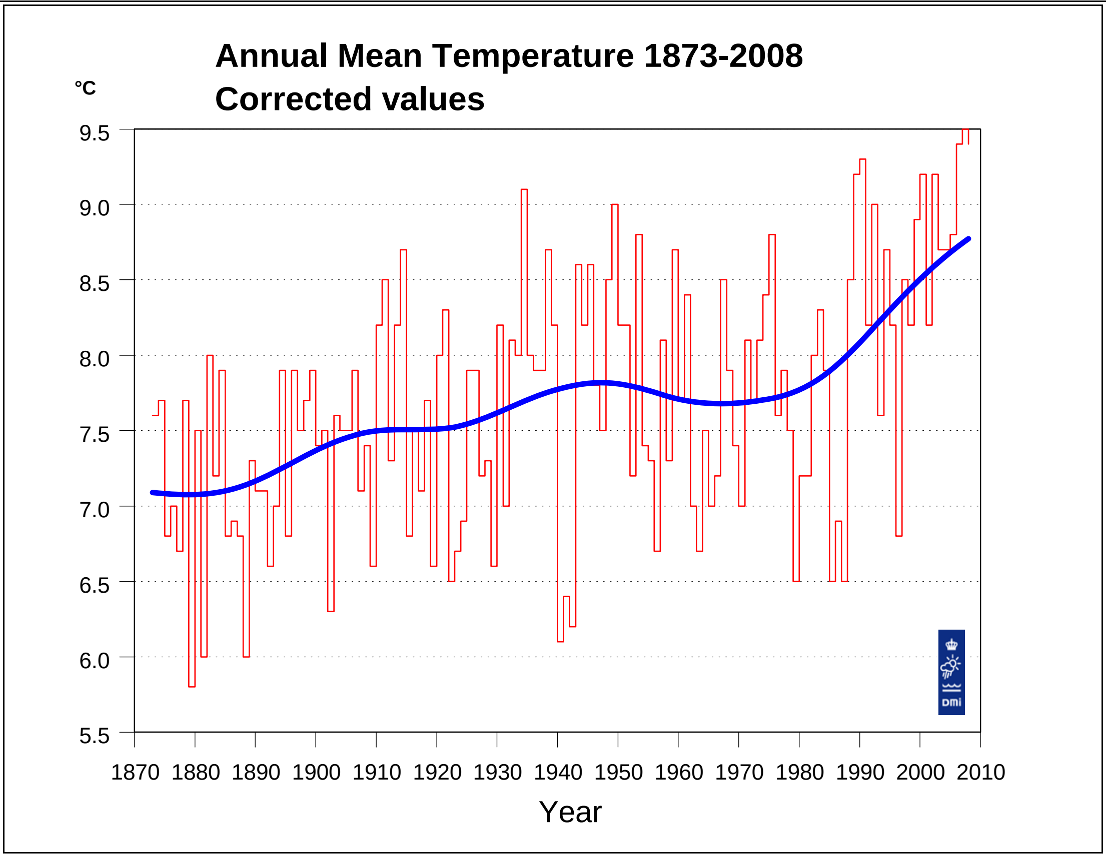


Figure 6: *Temperature in DK 1973-2008*

Source: Cappelen 2009a

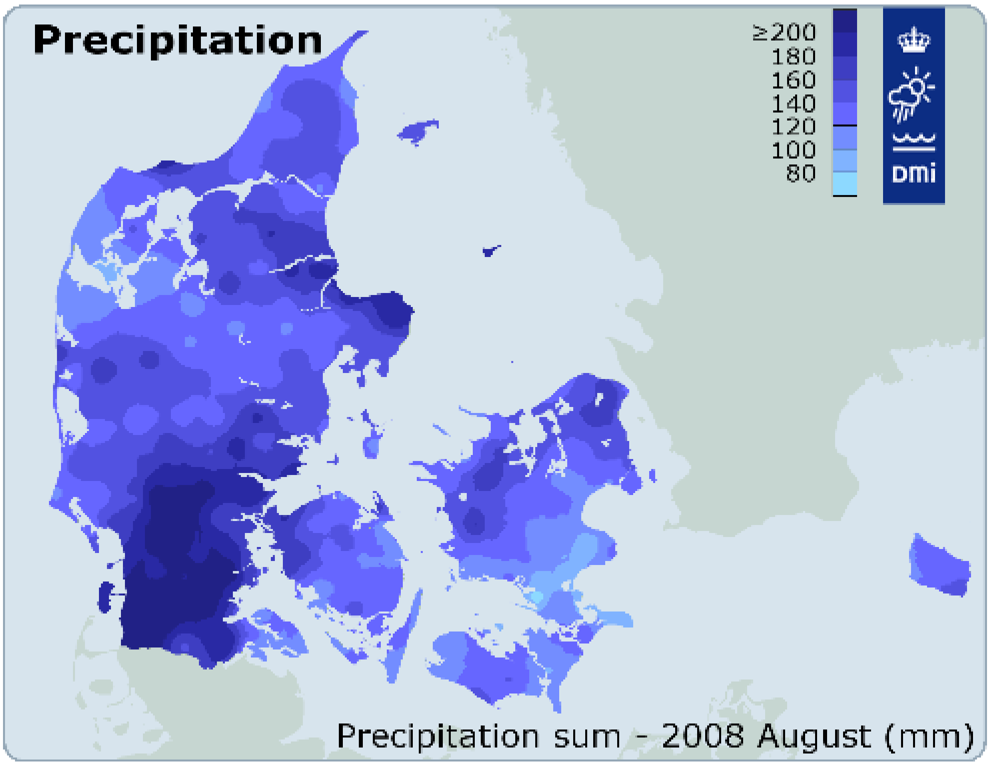


Figure 7: *Precipitation in DK in august 2008*

Data and Climate also operates DMI Customer Service, which helps the public and authorities in questions regarding recent weather and climate.
Core areas for **Centre for Ocean and Ice** (COI) are storm surge warning, ice charting, waves, sea currents, satellite surveillance, sea climate and marine data.
Geographically COI covers The North Sea, The Baltic Seas and the waters around Greenland and the Faroe Islands and the North Atlantic.
Read more about DMI at dmi.dk
Danish Meteorological Institute
Lyngbyvej 100
DK-2100 Copenhagen
Denmark
T +45 39 15 75 00

9) Danish Cleantech Solutions - driving export and attracting foreign investments

Denmark is in a unique position to help the world mitigate and adapt to climate change as well as to handle other environmental challenges.

Ministry of Foreign Affairs of Denmark

Hosting the COP15 Denmark not only brings ambitions and political will to the global scene, but also solid proof that caring for the environment and the climate does not contradict aspirations for growth and welfare. And Denmark is capable of providing a wide range of solutions and technologies that the world needs in order to address climate change.
Following the oil crisis in 1973, Denmark has converted production processes and facilities from solely fossil fuel based to more diverse sources of energy. Simultaneously, energy efficiency measures have been developed in order to cut down energy consumption and CO_2 emissions. Add to this combined heat and power plants, district heating, waste and waste water management. This and the fact that Danish environmental policy is integrated into all major policy sector objectives put Denmark among the world leaders in developing and commercializing cleantech technologies. Read more about " The Danish Example "
Denmark is in a unique position to help the world mitigate and adapt to climate change as well as to handle other environmental challenges. Danish companies and organizations provide energy and cleantech products, technologies as well as knowledge and consultancy. Together, they are capable of providing world class end-to-end solutions based on quality and efficiency.

Danish Energy and Cleantech Solutions

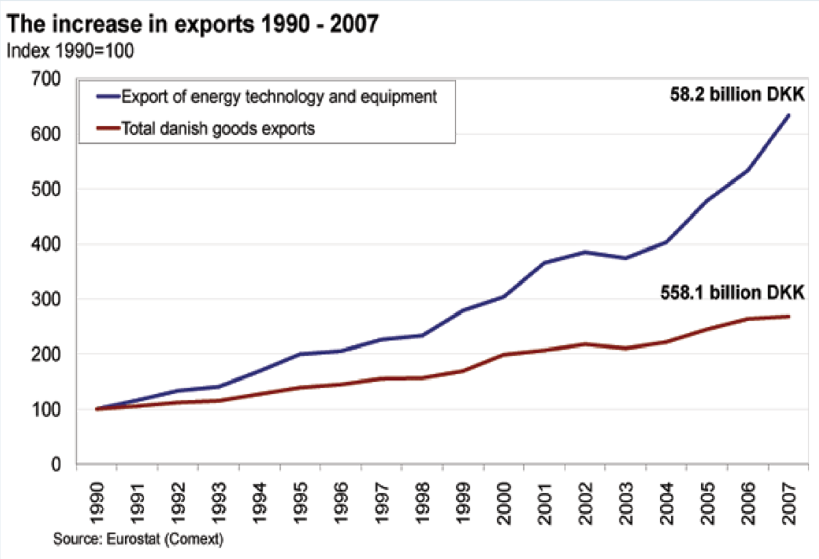
Renewable Energy	Energy Effiiciency	Eco-efficient Solutions	
• Wind Energy	• Building Solutions and Components	• Ventilation	• Solid/Industrial/Household Waste Management • Waste to Energy
• Biomass/Biogas	• Efficient Electric Motors	• Renewable Energy Storage	• Water Supply • Water Sanitation • Water Ressource Management
• Bioethanol–2.generation	• Pumps	• Metering	• Vehicle to Grid
• Solar Energy	• Energy-efficient Power Plant	• District Heating and Cooling	• Eco-friendly Agriculture
• Fuel Cells	• Combined Heat and Power	• RE System Integration in the power sector	• Sustainable Urban Planning and Architecture
• Hydro and Wave Power	• Micro Combined Heat and Power	• Efficient boilers	
• Geothermal Energy			

Danish Energy and Cleantech Competencies include renewable energy solutions, energy efficiency, waste and waste water management, and international cutting-edge expertise in wind energy.

An elaboration of Danish climate solutions is found in the co-operated publications between the Scandinavian think tank Monday Morning and, the official Danish investment promotion agency, Invest in Denmark, part of the Danish Ministry of Foreign Affairs. The publications aim to portray the wide range of opportunities and world-class competencies within the field of renewable energy and climate solutions that Denmark offers. Furthermore, the publications illustrate the Danish way to become one of the world leaders in the market of Cleantech

Solutions.

Danish Cleantech Solutions has become a key export commodity for Denmark. Not least energy equipment has become an important driver behind Danish export growth in recent years.



Danish exports of energy technology and equipment shows a remarkable increase in 1990 - 2007.
(Source:"The Danish Energy Industry Federation & the Danish Energy Authority.)

Danish exports of energy technology and equipment has more than tripled in the last decade, outperforming most other Danish export items. Danish expertise in wind energy is second to none and Danish companies are still market leaders when it comes to wind power technology. In 2007, the wind power sector alone contributed 6.5 % of total Danish exports and the share is still growing.
Trade Council of Denmark and Danish diplomatic missions abroad are supporting export and other globalization efforts made by Danish companies. In 2008 and 2009, the Trade Council of Denmark is dedicated to a special and focused promotion of Danish cleantech solutions. 17 markets have been singled out for targeted efforts: Brazil, Canada, China, France, Germany, India, Italy, Japan, Mexico, Poland, Russia, Spain, South Africa, South Korea, UK, Ukraine, and the US.
In general, Danish diplomatic missions stand ready to assist foreign companies interested in Danish solutions. For contact information in your country, please link to "Danish Missions Abroad".

Danish Cleantech Solutions is not only interesting as an export commodity. The Danish Cleantech Clusters offers a unique co-existence of manufacturers, sub suppliers, research and educational institutions, consultants, and power companies using state of the art cleantech solutions. This makes Denmark a very interesting target for foreign investors interested in Cleantech. For more information on Danish Cleantech Clusters and investment in Danish technologies please link to Invest in Denmark . Invest in Denmark stands ready to assist foreign investors.
For foreign companies looking for investment opportunities or interested in learning more on Danish cleantech solutions, 2009 offers a special opportunity: it is possible to order a tailor made tour to energy installations, companies, national and local authorities. The Danish Climate Consortium has the overall responsibility for the Energy Tours. Find more information at http://www.energytours.dk . For details on Danish climate and energy

solutions, installations, projects, cases, events and statistics, please refer to http://www.energymap.dk .

Read more about Danish Cleantech Solutions	Danish organizations
• Focus Denmark "Energy the Danish Way" • Profile sheets "Denmark's approach to energy reduction and climate change" • Bright Green – Danish solutions for sustainable growth • Climate Solutions Denmark – handbook from the conference Nordic Climate Solutions 2008 • Danish Exporters – general information on Danish products and suppliers • • Monday Morning and Invest in Denmark publications	• Trade Council of Denmark • Invest in Denmark • Danish Energy Agency • Danish Environmental Protection Agency • The Climate Consortium • Renewable Energy Network • Danish Energy Industries Federation • The Danish Agricultural Council • Danish Association of Consulting Engineers • Danish Association of Architectural Firms • Danish Construction Association • Danish Energy Association

10) Green IT

In April 2008, The Ministry of Science, Technology and Innovation of Denmark published an Action Plan for Green IT. IT is responsible for more than two percent of the world's total emission of CO_2.

Ministry of Science, Technology and Innovation of Denmark

Denmark has repeatedly been chosen as the world's leading IT nation, and the Danish IT infrastructure is world class. Therefore, Denmark is well suited to take the lead in the battle against climate change – also in the field of IT. The Action Plan from the Ministry of Science, Technology and Innovation aimed to make it easier for citizens, businesses and public authorities to choose energy-efficient IT solutions. At the same time, the Action Plan set out to promote the development of IT-based solutions that could help to reduce overall energy consumption.

The Action Plan for Green IT from the Ministry of Science, Technology and Innovation pursued two main objectives:

1. Citizens, businesses and public authorities' use of IT should be greener.
The public must grow better at using IT in an environmentally friendly way, and it should be made easier for the public to choose energy-efficient IT products. Corporate IT use must become greener and Green IT must be incorporated into corporate social responsibility, along with other environmental issues. Finally, the public authorities need to grow better at saving power and choosing energy-efficient IT solutions.

2. IT should help bring about a reduction in overall energy consumption.
Smart IT solutions can, in many instances, help to reduce energy consumption and thus CO_2 emissions. For example, intelligent management of electrical devices in businesses and in private homes can ensure that energy consuming equipment is not switched on when not in use. Furthermore, the use of electronic mail and eGovernment by public authorities can save both paper and transportation.

Therefore, new research must be initiated to refine existing IT-based solutions and to develop completely new IT-based solutions for a sustainable future.

The Action Plan contained eight individual initiatives, all of which have now been carried out.

Action Plan for Green IT in Denmark: http://www.itst.dk/filer/Publications/Action_plan_for_Green_IT_in_Denmark/index.htm

11) CIVIL SOCIETY ORGANIZATIONS

The Danish government is supporting a targeted program to improve the possibilities for civil society in developing countries to take action.

Ministry of Foreign Affairs of Denmark

To improve the possibilities for civil society in developing countries to improve capacity and create awareness on climate change in their own country, and to participate in the UN climate negotiations, the Government supports a targeted program, implemented by Danish NGOs and their international partners.

The Government holds regular meetings with civil society.

There is an ongoing dialogue with international NGOs during UNFCCC meetings, where key issues in the COP15 process are discussed. This gives an opportunity for the international NGOs to present their positions and to exchange information on activities planned up to and during COP15. The dialogue between the international NGOs and the Danish Government will intensify during 2009.

Several times a year, the Government calls a broad range of Danish civil society organizations for a meeting to inform about the latest developments in the COP15 preparations, and to provide the opportunity to ask questions. These meetings ensure a general exchange of information between the civil society and the government, as well as among the civil society organizations.

Prior to the UN climate change meetings, the government meets the Danish NGOs that follows the UNFCCC-negotiations. The meetings provide the NGOs with an update on the latest developments, as well as an opportunity to comment and present their own initiatives and strategies.

The Danish civil society organizations prepare a wide range of activities, before and during COP15. The Government supports different actions to facilitate coordination, synergies and cooperation between civil society initiatives. The Government supports information activities by civil society organizations and media, aiming to improve the knowledge and awareness in the Danish public on the impacts of climate change on the social and economic development of poorer developing countries.

12) Climate Education in 2009

The Ministry of Education is taking a series of initiatives for primary and lower secondary education, youth education programmes and tertiary education in order to put climate on the agenda.

The Danish Ministry of Education

The Danish Ministry of Education is making a special effort to encourage pupils/students, teachers and schools to put the climate on the agenda in the year 2008/09. It happens through a series of initiatives for primary and lower secondary education, youth education programmes and relevant tertiary education.

The initiatives are based on five key perspectives which will be dealt with differently depending on educational programmes, the proficiency of students and teaching context:

- Knowledge perspective - what do we know about Earth's climate and factors that affect it?
- Action and behavioural perspective - what can be done to limit global warming?
- Technology and community perspective - which technologies / production forms in existence could help limit the greenhouse effect? What are the socio-economic conditions for the spread of these technologies / production forms?
- Future Perspective – future sustainable technologies, practices and dissemination
- Socio-economic perspective - issues connected to climate change, including
  a) how will climate change and efforts to improve the climate influence economic growth?
  b) security aspects of climate and energy policy.

The project includes:

1. A national dissemination and networking project, which can be found at www.klimaundervisning.dk and which includes a learning tool database, a diary, network of climate teachers, network of climate facilitators (institutions offering advanced level programmes, museums, informal learning environments, enterprises etc.), conferences, teaching staff meetings etc.

2. A special climate topic on the EMU - Denmark's educational website portal – aiming at primary and secondary school, vocational training and education and the general upper secondary programmes, see http://www.emu.dk/tema/klima/.

3. Cooperation between the projects "Climate Education" and "Education for Sustainable Development" see for example www.ubuportalen.dk

4. Support for a number of educational projects, which will be published on www.klimaundervisning.dk, as they become ready for dissemination.

Klimaundervisning.dk

Klimaundervisning.dk (teaching climate) is a project managed by Danish Science Communication for the Danish Ministry of Education.

The purpose of the project is to strengthen the interest in teaching climate. The project targets teachers in primary and lower secondary schools, and in upper secondary schools.

This website offers a unique opportunity to get an overview of the vast number of tools and classroom activities that exist in the area of climate. It offers descriptions of and links to all essential teaching tools regarding climate from a wide range of suppliers such as publishers, museums, science centers, enterprises, organizations etc. The website also includes a calendar which mentions relevant activities and course offerings.

As part of the project, two networks have been established. There is one network targeting climate teachers who have an interest in teaching climate. The other network targets climate communicators who supply the tools or courses to be used by the teachers. Both networks receive newsletters and benefit from each other's existence. Among other things, a series of events for climate teachers is being organized and hosted by members of the climate communicators' network.

Relevant funds on climate teaching are available in the Ministry of Education.

Danish Minister of Education Bertel Haarder launched the project in the early months of 2008 at a kick-off conference. Five regional meetings followed this conference.

For more information on the project, contact project manager at Danish Science Communication, Karen Vesterager, kv@formidling.dk.

Climate change in the classroom

EMU is the common portal for the educational world in Denmark. On the EMU website you will find a subject about climate change. The climate subject is targeted against pupils and students in the primary schools and upper secondary schools.
The subject links to relevant websites about climate change on EMU as well as to other Danish and international internet resources that can be utilized when teaching climate change.
You will find the website on EMU (in Danish): http://www.emu.dk/tema/klima/

www.ubuportalen.dk

www.ubuportalen.dk is published by the Danish National Commission for UNESCO in cooperation with and financed by the Ministry of Education.
www.ubuportalen.dk was established in 2005 in connection with the UN Decade of Education for Sustainable Development 2005-2014. On this homepage you will find source references, links, articles, suggestions for further reading, examples of teaching, and of practical applications on how to work with sustainable development in the formal as well as in the non-formal education system.
In the various themes of the homepage a broad approach to the concept of sustainable development has been applied. It is e.g. the duty of the education sector to ensure that children and young people achieve sufficient knowledge and skills within natural and social science subjects, as well as cultural subjects in order for them to be able to participate in democratic debates about the distribution of the resources of the world.
The themes on the www.ubuportalen.dk also deal with problems in relation to climate changes. Here you will - among other things - find links to educational games and other teaching materials which provide ideas for discussions about each individual citizen's possibility of having an influence on development in relation to the climatic changes we are facing.
The www.ubuportalen shows the interaction between environmental, economic, social and cultural aspects.

13) Sustainable transport - better infrastructure

The Danish Government intends to work towards a better connected Denmark in terms of both its traffic and the environment. Traffic in Denmark has increased by more than 50% in the last 20 years and is expected to continue to increase at the same rate in the foreseeable future.

Ministry of Transport

This is a necessary and positive development: high levels of mobility are an integral freedom, dynamic impetus and economic growth.

But the strategy we adopt for developing the traffic of the future depends on which type of society we want.

The Government wants a society in which we combine economic growth and high mobility with a better environment, higher priority for and better preservation of nature, reduced traffic noise and measures to combat climate change.

It is an ambitious target, and the transport policy is crucial to its success.

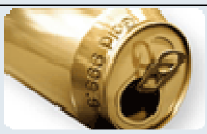
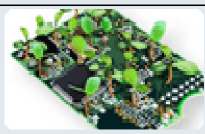
The Danish Infrastructure Commission has pointed out that the country faces significant transport-related challenges for which longterm planning is essential.

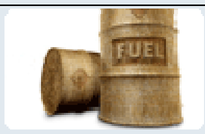
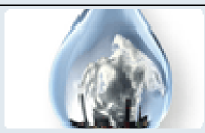
The transport sector currently accounts for approx. 25% of Denmark's CO_2 emissions, and this figure is expected to rise in the years to come; and although in recent years there has been reduction in toxic emissions from traffic, the problems with noise and pollution remain.

This is a trend which the Government intends to reverse.

14) Profile sheets

Ministry of Foreign Affairs of Denmark

	What's waste worth to you?
	What makes technology eco-efficient?
	Will Copenhagen still be wonderful in 2015?
	Where does your energy come from?

	What's waste worth to you?
	How stable is your energy supply?
	How can we fight global warming locally?
	How do we fuel sustainable growth?
	Is clear water an issue?
	Energy efficiency - do you realize the potential?
	A major opportunity to take action on climate change

	What's waste worth to you?
	Denmarks Energy Policy 2008-2011

15) Greenland Dialogue provides political guidance to climate negotiations

Ministers and Heads of Delegation from 29 countries gathered this week for intense climate talks in Ilulissat, Greenland.

Ministry of Climate and Energy of Denmark

The dialogue meeting was convened by Denmark in preparation for the UN Climate Conference in Copenhagen in December 2009. Launched by Denmark in August 2005, in Ilulissat, the Greenland Dialogue came full circle when it returned to Greenland this week.

The Dialogue provides an informal setting for Ministers to debate openly the most pressing issues in the negotiations in the run up to COP15 in Copenhagen. Dialogue sessions are conducted under Chatham House Rules. A set of Chairs Conclusions sums up discussions.

After the Dialogue, Denmark’s Climate and Energy Minister and incoming President of the COP15, Connie Hedegaard, said:

“The Dialogue meeting was held in an unusually open atmosphere where even the most controversial issues were discussed in a constructive manner”.

“For the first time, we sense consensus among participating countries that global temperatures do not increase by more than 2 degrees Celsius over pre-industrial levels.”

“Participants seem to agree that finance for adaptation and mitigation should be treated separately and that a mix of different sources is needed”.

“There is also general agreement that adaptation has been neglected for too long and that adaptation must be the true second leg of a Copenhagen agreement”.

“On emission reductions, participants agreed that developed countries should explore how they can strengthen the ambition of their contributions and that developing countries’ actions must be strengthened – all in order to meet the demands of science”.

“Ministers feel that our frank discussions provide useful guidance for the formal climate negotiations up to Copenhagen. They urge that we continue the dialogue. Consequently, we have agreed to continue the consultations in this group in the second half of September in New York.”

“But before we meet in this forum again, it is important that Heads of State and Government provide clear guidance. The first opportunity to do so is next week, when leaders meet at the Major Economies Forum in L’Aquila, Italy. The next opportunity will be on 22 September at the UN Secretary General’s High Level Event on Climate Change in New York”.

“The world will be watching: Strong leaders’ guidance to the negotiations is urgently needed. Leaders bear an immense responsibility to provide this guidance now”.

”This Dialogue meeting clearly increased mutual trust among parties. That may well be the most important outcome”.

16) COP15 Climate Conference: Denmark skips the gifts and educates youth instead

11 young people from all over the world have now started their climate studies at different master courses at Danish universities.

Ministry of Foreign Affairs of Denmark

Travel and living expenses plus tuition will be paid by the Danish Government through the COP15 Climate Scholarships. The money for the Scholarships comes from the savings pursuant to the Danish Government’s decision not to give gifts or hand out conference kits to the COP15 conference participants.

According to the tradition from earlier climate conferences and other similar international conferences, the conference participants – an estimated 12-15.000 at COP15 – would receive gifts and so-called conference-kits (goody bags with different representative items from the host nation).

However, that is not going to be the case in Copenhagen. Experience shows that these gifts often end up in garbage bins at conferences venues and hotels. Obviously, not all conference participants are in need of the items in the conference-kits, or they do not have space in their luggage for them when they return home. Basically, the Danish Government’s decision not to hand out gifts or conference kits is part of its efforts to reduce the environmental and climate impact of the conference.

The launch of the COP15 Climate Scholarship in the beginning of February 2009 clearly stirred interest among young people abroad to pursue their studies in Denmark. This could be seen from the increase in hits on www.studyindenmark.dk, where the scholarships were announced, and also in the number of foreign student applications at Danish universities. Following the launch of the scholarships, a focused mainly web-based campaign was carried out, including press releases, web-marketing, paid commercials, and other kinds of information activities. The aim was to have a sufficient number of well qualified applicants for the climate grants before the universities' dead-line in March. And indeed applications came in.

The news about spending money from the gifts for scholarships sparked many positive reactions, including from those national delegations who now will not receive any gifts at COP15. Concretely, the increase in interest also manifested itself in a doubling of the number of unique hits on www.studyindenmark.dk.

By the universities' deadline in March 2009 a total of 843 applications had been submitted.

University	Applications
University of Southern Denmark (SDU)	170
Aalborg University (AAU)	170
Roskilde University (RUC)	27
Copenhagen University (KU)	33
Aarhus University (1) (AU)	171
Aarhus University (2) (AU)	29
Technical University of Denmark (DTU)	243
Total	**843**

As a positive side-effect the climate scholarships have increased the number of applications at Danish Universities from students from abroad.

All the climate scholars have been nominated by the respective universities based on their academic achievements. It is beyond any doubt, that the recipients from 11 different nations are highly qualified. They now pursue studies at the following eight courses:

Rafael Tabase (M)	Ghana	AU	Biosysten engineering
Most Sarmin (K)	Bangladesh	AU	Agro-environmental management
Renate Sales (K)	Brasilien	DTU	Wind energy
Juan Murcia (M)	Columbia	DTU	Wind energy
Denisa Cupi (K)	Albanien/USA	KU	Environmental chemistry and health
Maija Bertule (K)	Letland	RUC	Technological and socio-econ.planning
Ankit Joshi	Indien	RUC	Technological and socio-econ. planning
Ndifor Bache (M)	Cameroun	SDU	Environmental and ress. management
Hong Ren (K)	Kina	AAU	Environmental management
Koman Habib (K)	Parkistan	AAU	Environmental management
Jospeh Adine (M)	Nigeria	AAU	Wind power systems

In her welcoming speech to the Climate Scholars on September 1, 2009, the Danish Minister for Development Cooperation among other things said, “that with all its well known negative effects, such as the melting away of glaciers, the rise of sea-levels, drought, desertification etc., global warming also carries with it one potential opportunity: As a global and pressing challenge it forces us to work together, strengthen international co-operation, and to make the best use of all resources available – be it material, human or other resources“.

For more information on the COP15 Climate Scholarship: www.studyindenmark.dk/climate)

Annex E Results and supplementary information concerning greenhouse gas projections

This Annex consists of the following 2 sub-annexes:

Annex E1: The results of Denmark's February 2009 'with measures' projection of greenhouse gas emissions 2007-2025, cf. *Nielsen O.-K. et al.,* (NERI, February 2009).

Note to Tables E1-1 to E1-8:

The tables show the historical and projected greenhouse gas emissions in ´000 tonnes CO_2 equivalents for CO_2, methane (CH_4), nitrous oxide (N_2O) and the F-gases (HFCs, PFCs and SF_6) respectively. Calculation of the emissions for the various IPCC categories are described in chapters 2-11 in Projection of greenhouse gas emissions 2004 to 2030, NERI Technical Report No. 703, 2009Projections for the use of lubricants are not yet included, because emissions from this source have not been implemented in the historical inventories until April 2009.. An inclusion of emissions from the use of lubricants in the projections would increase total greenhouse gas emissions with about 0.037 million tonnes CO_2 equivalents.

Notes to Table E1-8:

* Include process emissions – that is corresponding to the IPCC category Industry – in that industry's energy consumption is included under Energy as well as emissions from the use of organic solvents.

** Only includes methane and nitrous oxide from agriculture – that is corresponding to the IPCC category Agriculture – in that agriculture's energy consumption is included under Energy.

*** Projections of emissions and removals in the land-use, land-use change and forestry (LULUCF) sector are not included in the February 2009 projection from NERI. When new inventories for the LULUCF sector and the activities under Articles 3.3 and 3.4 of the Kyoto Protocol will be available for the April 2010 reporting under the UNFCCC and the KyotoProtocol (NIR2010), new projections for this sector and these activities will be elaborated. A separate update of the foresty projections carried out in the August 2009 is described in section 5.1.6.

**** Also includes emissions from wastewater treatment, cf. the IPCC guidelines.

Annex E2: A brief description of the work involved in preparing the energy projections.

Table E1-1: The result of Denmark's 'with measures' greenhouse gas projection 2008-2025 as regards CO_2

Source: *Nielsen O.-K. et al., (*NERI, February 2009).

CO_2 emissions (KP Base Year - 2007) and projections (2008-2025) (Gg)	KP Base Year (1990/95 in 2006)	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2008-12	2015	2020	2025
Total (excluding LULUCF)	52712	52793	60574	52918	50229	58069	53228	57316	53410	51963	52640	49671	53000	47822	43213	42704
1. Total Energy	51474	51462	58938	51091	48525	56327	51494	55509	51617	50173	50850	47889	51207	46039	41437	40927
A Fuel Combustion Activities (Sectoral Approach)	51211	51198	58576	50498	48085	55903	51127	55089	51172	49730	50411	47450	50770	45600	41014	40629
1 Energy Industries	26173	26173	31934	24958	22140	29869	25132	28775	24785	24107	24948	22131	24949	20790	16885	16095
a Public Electricity and Heat Production	24736	24736	29828	22521	19610	27271	22545	26031	21997	21218	21947	19023	22043	17496	13243	12630
b Petroleum Refining	897	897	1371	988	927	966	970	938	938	938	938	938	938	938	938	938
c Manufacture of Solid Fuels and Other Energy Industries	540	540	735	1449	1602	1631	1617	1807	1851	1951	2063	2170	1968	2356	2704	2528
2 Manufacturing Industries and Construction	5423	5424	5891	6005	5576	5756	5686	5691	5693	5688	5655	5629	5671	5421	5191	5174
3 Transport	10336	10528	11852	12061	13050	13418	13986	13676	13914	13362	13445	13529	13585	13752	13895	14700
a Civil Aviation	243	243	199	154	133	141	107	160	161	161	161	162	161	169	181	192
b Road Transportation	9241	9275	10585	11202	12214	12589	13198	12837	13074	12521	12604	12686	12745	12899	13017	13794
c Railways	297	297	303	228	232	227	228	226	227	228	229	229	228	234	247	265
d Navigation	555	713	765	476	471	461	454	453	452	452	451	450	452	449	449	449
4 Other Sectors	9159	8954	8646	7364	7048	6734	6148	6794	6626	6421	6209	6009	6412	5485	4889	4507
a Commercial/Institutional	1403	1403	1116	891	932	947	790	940	933	901	840	799	883	677	654	651
b Residential	5084	5059	5106	4132	3933	3695	3368	3585	3414	3237	3076	2902	3243	2494	1901	1492
c Agriculture/Forestry/Fisheries	2673	2493	2424	2341	2183	2091	1990	2269	2279	2282	2293	2309	2286	2315	2334	2365
5 Other	119	119	252	111	271	126	175	153	153	153	153	153	153	153	153	153
B Fugitive Emissions from Fuels	263	263	363	593	440	425	367	421	445	443	439	438	437	438	424	298
2 Oil and Natural Gas	263	263	363	593	440	425	367	421	445	443	439	438	437	438	424	298
a Oil																
b Natural Gas																
c Venting and Flaring	263	263	363	593	440	425	367	421	445	443	439	438	437	438	424	298
Flaring	263	263	363	593	440	425	367	421	445	443	439	438	437	438	424	298
2. Total Industrial Processes	1101	1152	1495	1701	1604	1649	1647	1720	1710	1710	1711	1703	1711	1704	1696	1698
A Mineral Products	1072	1073	1407	1620	1548	1610	1607	1673	1663	1663	1664	1656	1664	1657	1649	1650
B Chemical Industry	1	1	1	1	3	2	2	2	2	2	2	2	2	2	2	2
C Metal Production	28	28	39	41	16	0	0	45	45	45	45	45	45	45	45	45
F Consumption of Halocarbons and SF6																
G Other		50	49	40	38	37	38									
3. Total Solvent and Other Product Use	137	179	141	127	99	92	87	86	83	79	79	79	82	79	79	79
4. Total Agriculture																
A Enteric Fermentation																
B Manure Management																
D Agricultural Soils																
6. Total Waste	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A Solid Waste Disposal on Land																
1 Managed Waste Disposal on Land																
B Waste Water Handling																
2 Domestic and Commercial Waste Water																
Memo Items (not included above):																
International Bunkers	4823	4823	6928	6629	5211	6016	6260	6055	6058	6046	6027	6054	6048	6184	6426	6626
Aviation	1736	1736	1867	2350	2575	2583	2701	2612	2615	2603	2584	2611	2605	2741	2983	3183
Marine	3087	3087	5061	4279	2636	3433	3559	3443	3443	3443	3443	3443	3443	3443	3443	3443

Table E1-2: The result of Denmark's 'with measures' greenhouse gas projection 2008-2025 as regards methane (CH_4)

Source: *Nielsen O.-K. et al., (*NERI, February 2009).

CH_4 emissions (KP Base Year - 2007) and projections (2008 - 2025) (Gg CO_2 equivalents)	KP Base Year (1990/95 in 2006)	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2008-12	2015	2020	2025
Total (excluding LULUCF)	5692	5695	5989	5890	5678	5625	5748	5633	5713	5734	5723	5706	5702	5660	5610	5578
1. Total Energy	222	224	510	639	640	632	595	585	624	604	601	593	601	568	551	532
A Fuel Combustion Activities (Sectoral Approach)	182	185	448	559	539	503	466	514	557	570	564	554	552	526	508	492
1 Energy Industries	23	23	249	321	277	240	193	229	271	282	277	267	265	243	228	208
a Public Electricity and Heat Production	22	22	247	320	275	238	191	228	270	280	275	265	263	241	226	206
b Petroleum Refining	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1
c Manufacture of Solid Fuels and Other Energy Industries	0	0	1	1	2	2	2	1	1	1	1	1	1	2	2	2
2 Manufacturing Industries and Construction	15	15	18	33	27	24	20	32	32	32	32	32	32	30	29	28
3 Transport	53	56	51	40	30	28	26	24	23	21	19	18	21	14	11	9
a Civil Aviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b Road Transportation	52	55	50	39	29	27	25	23	22	20	18	17	20	14	10	8
c Railways	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
d Navigation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4 Other Sectors	91	90	130	165	205	211	227	228	231	235	237	237	234	238	241	247
a Commercial/Institutional	4	4	13	20	17	18	17	22	21	21	21	20	21	20	19	19
b Residential	68	67	89	98	148	160	185	164	167	171	173	173	170	175	179	184
c Agriculture/Forestry/Fisheries	20	20	28	48	40	32	25	42	43	43	43	44	43	43	43	43
5 Other	0,104	0,109	0,370	0,119	0,276	0,126	0,159	0,136	0,126	0,117	0,110	0,103	0,118	0,088	0,074	0,068
B Fugitive Emissions from Fuels	40	40	62	80	101	129	128	71	67	34	37	38	50	42	42	40
2 Oil and Natural Gas	40	40	62	80	101	129	128	71	67	34	37	38	50	42	42	40
a Oil	32	32	48	73	93	121	123	66	62	29	32	33	45	36	38	36
b Natural Gas	6	6	12	5	5	7	3	5	5	5	5	5	5	5	4	3
c Venting and Flaring	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0
Flaring	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0
2. Total Industrial Processes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A Mineral Products																
B Chemical Industry																
C Metal Production																
F Consumption of Halocarbons and SF6																
G Other																
3. Total Solvent and Other Product Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4. Total Agriculture	4011	4010	4001	3818	3700	3663	3835	3704	3748	3793	3787	3782	3763	3764	3735	3726
A Enteric Fermentation	3259	3259	3133	2864	2675	2621	2787	2667	2702	2738	2710	2683	2700	2600	2462	2498
B Manure Management	752	751	867	954	1025	1042	1048	1037	1046	1055	1077	1099	1063	1164	1273	1227
D Agricultural Soils																
6. Total Waste	1460	1461	1478	1433	1338	1330	1319	1344	1340	1337	1335	1332	1338	1328	1324	1321
A Solid Waste Disposal on Land	1334	1335	1301	1215	1077	1081	1063	1090	1089	1088	1088	1088	1089	1091	1099	1108
1 Managed Waste Disposal on Land	1334	1335	1301	1215	1077	1081	1063	1090	1089	1088	1088	1088	1089	1091	1099	1108
B Waste Water Handling	126	126	177	217	262	248	256	254	251	249	247	244	249	237	225	213
2 Domestic and Commercial Waste Water	126	126	177	217	262	248	256	254	251	249	247	244	249	237	225	213
Memo Items (not included above):																
International Bunkers	3	2	3	3	2	3	3	3	3	3	3	3	3	3	3	3
Aviation	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Marine	1	1	2	2	1	2	2	2	2	2	2	2	2	2	2	2

Table E1-3: The result of Denmark's 'with measures' greenhouse gas projection 2008-2025 as regards nitrous oxide (N_2O)

Source: *Nielsen O.-K. et al., (*NERI, February 2009).

N_2O emissions (KP Base Year - 2007) and projections (2008 - 2025) (Gg CO_2 equivalents)	KP Base Year (1990/95 in 2006)	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2008-12	2015	2020	2025
Total (excluding LULUCF)	10593	10527	9358	8288	6739	6482	6780	6731	6711	6698	6646	6585	6674	6417	6149	6160
1. Total Energy	425	397	463	456	445	472	458	480	472	470	469	459	470	445	434	436
A Fuel Combustion Activities (Sectoral Approach)	424	395	461	452	443	469	457	478	469	468	467	457	468	443	431	435
1 Energy Industries	119	119	154	150	142	168	150	164	156	155	157	150	157	146	141	140
a Public Electricity and Heat Production	103	103	131	122	113	138	120	132	123	121	122	114	122	107	98	98
b Petroleum Refining	9	9	15	11	10	11	11	11	11	11	11	11	11	11	11	11
c Manufacture of Solid Fuels and Other Energy Industries	6	6	9	17	19	19	19	22	22	23	25	26	23	28	32	30
2 Manufacturing Industries and Construction	54	54	56	59	57	58	59	59	59	59	59	58	59	56	54	54
3 Transport	141	116	148	150	138	137	139	146	146	146	144	142	145	136	134	140
a Civil Aviation	3	3	3	2	2	3	2	3	3	3	3	3	3	3	3	4
b Road Transportation	125	97	128	137	126	125	127	133	133	133	131	129	132	123	121	126
c Railways	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2
d Navigation	10	13	14	8	8	8	8	8	8	8	8	8	8	8	8	8
4 Other Sectors	109	105	101	92	103	105	107	107	107	107	106	105	106	102	100	99
a Commercial/Institutional	12	12	10	8	8	9	7	10	10	10	10	9	10	9	8	8
b Residential	57	57	58	52	64	66	72	64	64	63	63	62	63	60	57	56
c Agriculture/Forestry/Fisheries	40	36	34	33	31	30	29	33	33	33	33	33	33	34	34	35
5 Other	1	1	2	1	3	1	2	2	2	2	2	2	2	2	2	2
B Fugitive Emissions from Fuels	1	1	2	3	2	2	1	2	2	2	2	2	2	2	2	2
2 Oil and Natural Gas	1	1	2	3	2	2	1	2	2	2	2	2	2	2	2	2
a Oil																
b Natural Gas																
c Venting and Flaring	1	1	2	3	2	2	1	2	2	2	2	2	2	2	2	2
Flaring	1	1	2	3	2	2	1	2	2	2	2	2	2	2	2	2
2. Total Industrial Processes	1043	1043	904	1004	0	0	0	0	0	0	0	0	0	0	0	0
A Mineral Products																
B Chemical Industry	1043	1043	904	1004	0	0	0	0	0	0	0	0	0	0	0	0
C Metal Production																
F Consumption of Halocarbons and SF6																
G Other																
3. Total Solvent and Other Product Use	0	0	0	0	14	38	37	37	37	37	37	37	37	37	37	37
4. Total Agriculture	9037	8999	7906	6764	6229	5923	6238	6162	6151	6139	6088	6037	6115	5883	5627	5635
A Enteric Fermentation														0		
B Manure Management	685	685	642	602	572	537	586	575	580	584	577	570	577	548	512	513
D Agricultural Soils	8352	8314	7264	6162	5657	5385	5652	5587	5571	5555	5511	5467	5538	5335	5115	5122
6. Total Waste	88	88	85	65	51	50	47	51	51	51	51	51	51	51	52	52
A Solid Waste Disposal on Land														0		
1 Managed Waste Disposal on Land																
B Waste Water Handling	88	88	85	65	51	50	47	51	51	51	51	51	51	51	52	52
2 Domestic and Commercial Waste Water	88	88	85	65	51	50	47	51	51	51	51	51	51	51	52	52
														0		
Memo Items (not included above):														0		
International Bunkers	78	78	119	109	79	94	98	95	95	95	95	95	95	96	99	101
Aviation	18	18	20	25	28	28	29	28	28	28	28	28	28	29	32	34
Marine	60	60	99	83	51	67	69	67	67	67	67	67	67	67	67	67

Table E1-4: The result of Denmark's 'with measures' greenhouse gas projection 2008-2025 as regards HFCs

Source: *Nielsen O.-K. et al., (*NERI, February 2009).

HFC emissions (KP Base Year - 2007) and projections (2008 - 2025) (Gg CO_2 equivalents)	KP Base Year (1990/95 in 2006)	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2008-12	2015	2020	2025
Total (excluding LULUCF)	218	0	218	605	795	815	840	847	830	804	756	692	786	488	152	152
1. Total Energy																
A Fuel Combustion Activities (Sectoral Approach)																
1 Energy Industries																
a Public Electricity and Heat Production																
b Petroleum Refining																
c Manufacture of Solid Fuels and Other Energy Industries																
2 Manufacturing Industries and Construction																
3 Transport																
a Civil Aviation																
b Road Transportation																
c Railways																
d Navigation																
4 Other Sectors																
a Commercial/Institutional																
b Residential																
c Agriculture/Forestry/Fisheries																
5 Other																
B Fugitive Emissions from Fuels																
2 Oil and Natural Gas																
a Oil																
b Natural Gas																
c Venting and Flaring																
Flaring																
2. Total Industrial Processes	218	0	218	605	795	815	840	847	830	804	756	692	786	488	152	152
A Mineral Products																
B Chemical Industry																
C Metal Production																
F Consumption of Halocarbons and SF6	218	0	218	605	795	815	840	847	830	804	756	692	786	488	152	152
G Other																
3. Total Solvent and Other Product Use																
4. Total Agriculture																
A Enteric Fermentation																
B Manure Management																
D Agricultural Soils																
6. Total Waste																
A Solid Waste Disposal on Land																
1 Managed Waste Disposal on Land																
B Waste Water Handling																
2 Domestic and Commercial Waste Water																
Memo Items (not included above):																
International Bunkers																
Aviation																
Marine																

Table E1-5: The result of Denmark's 'with measures' greenhouse gas projection 2008-2025 as regards PFCs

Source: *Nielsen O.-K. et al., (*NERI, February 2009).

PFC emissions (KP Base Year - 2007) and projections (2008 - 2025) (Gg CO_2 equivalents)	KP Base Year (1990/95 in 2006)	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2008-12	2015	2020	2025
Total (excluding LULUCF)	1	0	1	18	14	16	15	12	11	10	10	9	10	7	6	6
1. Total Energy																
A Fuel Combustion Activities (Sectoral Approach)																
1 Energy Industries																
a Public Electricity and Heat Production																
b Petroleum Refining																
c Manufacture of Solid Fuels and Other Energy Industries																
2 Manufacturing Industries and Construction																
3 Transport																
a Civil Aviation																
b Road Transportation																
c Railways																
d Navigation																
4 Other Sectors																
a Commercial/Institutional																
b Residential																
c Agriculture/Forestry/Fisheries																
5 Other																
B Fugitive Emissions from Fuels																
2 Oil and Natural Gas																
a Oil																
b Natural Gas																
c Venting and Flaring																
Flaring																
2. Total Industrial Processes	1	0	1	18	14	16	15	12	11	10	10	9	10	7	6	6
A Mineral Products																
B Chemical Industry																
C Metal Production																
F Consumption of Halocarbons and SF6	1	0	1	18	14	16	15	12	11	10	10	9	10	7	6	6
G Other																
3. Total Solvent and Other Product Use																
4. Total Agriculture																
A Enteric Fermentation																
B Manure Management																
D Agricultural Soils																
6. Total Waste																
A Solid Waste Disposal on Land																
1 Managed Waste Disposal on Land																
B Waste Water Handling																
2 Domestic and Commercial Waste Water																
Memo Items (not included above):																
International Bunkers																
Aviation																
Marine																

Table E1-6: The result of Denmark's 'with measures' greenhouse gas projection 2008-2025 as regards SF_6

Source: *Nielsen O.-K. et al., (*NERI, February 2009).

SF_6 emissions (KP Base Year - 2007) and projections (2008 - 2025) (Gg CO_2 equivalents)	KP Base Year (1990/95 in 2006)	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2008-12	2015	2020	2025
Total (excluding LULUCF)	107	44	107	59	22	36	30	36	36	36	69	115	58	123	59	59
1. Total Energy																
A Fuel Combustion Activities (Sectoral Approach)																
1 Energy Industries																
a Public Electricity and Heat Production																
b Petroleum Refining																
c Manufacture of Solid Fuels and Other Energy Industries																
2 Manufacturing Industries and Construction																
3 Transport																
a Civil Aviation																
b Road Transportation																
c Railways																
d Navigation																
4 Other Sectors																
a Commercial/Institutional																
b Residential																
c Agriculture/Forestry/Fisheries																
5 Other																
B Fugitive Emissions from Fuels																
2 Oil and Natural Gas																
a Oil																
b Natural Gas																
c Venting and Flaring																
Flaring																
2. Total Industrial Processes	107	44	107	59	22	36	30	36	36	36	69	115	58	123	59	59
A Mineral Products																
B Chemical Industry																
C Metal Production	36	31	36	21	0	0	0	0	0	0	0	0	0	0	0	0
F Consumption of Halocarbons and SF6	71	13	71	38	22	36	30	36	36	36	69	115	58	123	59	59
G Other																
3. Total Solvent and Other Product Use																
4. Total Agriculture																
A Enteric Fermentation																
B Manure Management																
D Agricultural Soils																
6. Total Waste																
A Solid Waste Disposal on Land																
1 Managed Waste Disposal on Land																
B Waste Water Handling																
2 Domestic and Commercial Waste Water																
Memo Items (not included above):																
International Bunkers																
Aviation																
Marine																

Table E1-7: The result of Denmark's 'with measures' greenhouse gas projection 2008-2025 as regards the total inventories (GHG)
Source: *Nielsen O.-K. et al.*, (NERI, February 2009).

GHG emissions (KP Base Year - 2007) and projections (2008 - 2025) (Gg CO_2 equivalents)	KP Base Year (1990/95 in 2006)	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2008-12	2015	2020	2025
Total (excluding LULUCF)	69323	69060	76246	67778	63477	71043	66641	70574	66711	65246	65844	62779	66231	59961	55188	54660
1. Total Energy	52121	52083	59912	52186	49611	57431	52546	56574	52713	51248	51920	48941	52279	47051	42421	41895
A Fuel Combustion Activities (Sectoral Approach)	51817	51779	59485	51510	49067	56875	52050	56080	52198	50768	51442	48462	51790	46569	41953	41556
1 Energy Industries	26315	26315	32337	25429	22559	30277	25475	29169	25212	24543	25382	22549	25371	21179	17254	16443
a Public Electricity and Heat Production	24861	24861	30206	22963	19999	27648	22856	26390	22389	21619	22343	19402	22429	17844	13567	12934
b Petroleum Refining	908	908	1387	999	937	977	981	949	949	949	949	949	949	949	949	949
c Manufacture of Solid Fuels and Other Energy Industries	546	546	744	1467	1623	1653	1638	1829	1874	1975	2089	2198	1993	2385	2738	2559
2 Manufacturing Industries and Construction	5493	5493	5965	6097	5660	5839	5765	5782	5784	5779	5745	5719	5762	5507	5274	5257
3 Transport	10529	10700	12051	12251	13219	13583	14150	13846	14083	13528	13608	13688	13751	13902	14040	14849
a Civil Aviation	246	246	202	157	136	144	109	163	164	164	164	165	164	172	185	196
b Road Transportation	9418	9427	10763	11379	12368	12741	13349	12993	13229	12674	12754	12832	12896	13036	13148	13928
c Railways	300	300	306	230	234	229	230	228	229	230	231	231	230	236	249	267
d Navigation	566	727	780	485	480	470	462	462	461	460	460	459	460	458	458	458
4 Other Sectors	9359	9150	8878	7622	7356	7049	6483	7129	6965	6763	6552	6351	6752	5826	5230	4853
a Commercial/Institutional	1419	1419	1139	918	958	975	813	972	965	932	870	828	914	705	682	678
b Residential	5208	5183	5253	4282	4144	3920	3625	3813	3645	3472	3312	3137	3476	2729	2137	1732
c Agriculture/Forestry/Fisheries	2732	2549	2486	2422	2254	2154	2045	2343	2354	2358	2369	2386	2362	2392	2412	2443
5 Other	120	120	254	112	274	128	177	155	155	155	155	155	155	155	155	155
B Fugitive Emissions from Fuels	304	304	426	676	543	557	496	494	515	480	478	479	489	482	468	340
2 Oil and Natural Gas	304	304	426	676	543	557	496	494	515	480	478	479	489	482	468	340
a Oil	32	32	48	73	93	121	123	66	62	29	32	33	45	37	38	36
b Natural Gas	6	6	12	5	5	7	3	5	5	5	5	5	5	5	4	3
c Venting and Flaring	267	267	367	598	445	429	370	423	448	445	442	441	440	441	426	300
Flaring	267	267	367	598	445	429	370	423	448	445	442	441	440	441	426	300
2. Total Industrial Processes	2470	2240	2724	3387	2435	2516	2533	2615	2587	2561	2546	2519	2566	2322	1913	1915
A Mineral Products	1072	1073	1407	1620	1548	1610	1607	1673	1663	1663	1664	1656	1664	1657	1649	1650
B Chemical Industry	1044	1044	905	1004	3	2	2	2	2	2	2	2	2	2	2	2
C Metal Production	64	60	74	62	16	0	0	45	45	45	45	45	45	45	45	45
F Consumption of Halocarbons and SF6	290	13	290	660	831	867	886	895	877	851	835	816	855	619	217	217
G Other		50	49	40	38	37	38									
3. Total Solvent and Other Product Use	137	179	141	127	113	130	124	124	120	117	117	117	119	117	117	117
4. Total Agriculture	13048	13010	11906	10582	9929	9586	10072	9866	9899	9932	9875	9818	9878	9647	9361	9361
A Enteric Fermentation	3259	3259	3133	2864	2675	2621	2787	2667	2702	2738	2710	2683	2700	2600	2462	2498
B Manure Management	1437	1436	1509	1556	1598	1580	1634	1612	1626	1639	1654	1669	1640	1712	1785	1740
D Agricultural Soils	8352	8314	7264	6162	5657	5385	5652	5587	5571	5555	5511	5467	5538	5335	5115	5122
6. Total Waste	1547	1548	1563	1498	1389	1379	1366	1395	1392	1388	1386	1384	1389	1379	1376	1373
A Solid Waste Disposal on Land	1334	1335	1301	1215	1077	1081	1063	1090	1089	1088	1088	1088	1089	1091	1099	1108
1 Managed Waste Disposal on Land	1334	1335	1301	1215	1077	1081	1063	1090	1089	1088	1088	1088	1089	1091	1099	1108
B Waste Water Handling	213	213	262	283	312	298	303	305	302	300	298	295	300	288	277	265
2 Domestic and Commercial Waste Water	213	213	262	283	312	298	303	305	302	300	298	295	300	288	277	265
Memo Items (not included above):																
International Bunkers	4923	4904	7049	6741	5293	6113	6361	6153	6155	6144	6125	6152	6146	6283	6528	6730
Aviation	1817	1755	1888	2376	2604	2612	2731	2640	2643	2632	2613	2640	2634	2771	3016	3218
Marine	3106	3149	5162	4365	2689	3501	3630	3512	3512	3512	3512	3512	3512	3512	3512	3512

Table E1-8: The result of Denmark's 'with measures' greenhouse projection 2008-2025 in the format recommended under the UNFCCC
Source: *Nielsen O.-K. et al., (*NERI, February 2009).

Projections of Denmark's greenhouse gas emissions and removals							
Scenario:	The base scenario, which is a 'with measures" projection, i.e. only includes the expected effects of implemented and adopted measures						
Year:	2010 = (2008-2012)/5						
Sector	Emissions and removals (in Gg CO2 equivalents)						
	CO2	CH4	N2O	HFCs	PFCs	SF6	Total
Energy	37622	581	326				38528
Transport	13585	21	145				13751
Industry*	1792	0	37	786	10	58	2684
Agriculture**		3763	6115				9878
LULUCF***	- ***	- ***	- ***				- ***
Waste****		1338	51				1389
Total	53000	5702	6674	786	10	58	66231

Projections of Denmark's greenhouse gas emissions and removals							
Scenario:	The base scenario, which is a 'with measures" projection, i.e. only includes the expected effects of implemented and adopted measures						
Year:	2020						
Sector	Emissions and removals (in Gg CO2 equivalents)						
	CO2	CH4	N2O	HFCs	PFCs	SF6	Total
Energy	27542	540	299				28382
Transport	13895	11	134				14040
Industry*	1775	0	37	152	6	59	2030
Agriculture**		3735	5627				9361
LULUCF***	- ***	- ***	- ***				- ***
Waste****		1324	52				1376
Total	43213	5610	6149	152	6	59	55189

Projections of Denmark's greenhouse gas emissions and removals							
Scenario:	The base scenario, which is a 'with measures" projection, i.e. only includes the expected effects of implemented and adopted measures						
Year:	2015						
Sector	Emissions and removals (in Gg CO2 equivalents)						
	CO2	CH4	N2O	HFCs	PFCs	SF6	Total
Energy	32287	553	309				33149
Transport	13752	14	136				13902
Industry*	1783	0	37	488	7	123	2439
Agriculture**		3764	5883				9647
LULUCF***	- ***	- ***	- ***				- ***
Waste****		1328	51				1379
Total	47822	5660	6417	488	7	123	60517

Projections of Denmark's greenhouse gas emissions and removals							
Scenario:	The base scenario, which is a 'with measures" projection, i.e. only includes the expected effects of implemented and adopted measures						
Year:	2025						
Sector	Emissions and removals (in Gg CO2 equivalents)						
	CO2	CH4	N2O	HFCs	PFCs	SF6	Total
Energy	26227	523	297				27047
Transport	14700	9	140				14849
Industry*	1777	0	37	152	6	59	2031
Agriculture**		3726	5635				9361
LULUCF***	- ***	- ***	- ***				- ***
Waste****		1321	52				1373
Total	42704	5578	6160	152	6	59	54660

Annex E2: A brief description of the work involved in preparing the energy projections.

The work involved in preparing the energy projections goes through the following stages:

1. Final energy consumption of businesses and the domestic sector (except transport)
2. Energy consumption for production of electricity and district heating
3. Own consumption by refineries and gas works
4. Own consumption by the North Sea, including flaring
5. Industrial cogenerated heating and power, mini cogenerated heating and power, biogas etc.
6. Energy consumption by transport

The economic macro model EMMA is calculated in item 1. Ramses, which is a technical/economic optimisation model, is used for calculations in item 2 based on input of the energy consumption from the housing models and EMMA. Item 3 is automatically projected based on the latest statistics. Item 4 is projected on the basis of the information from Mærsk and statements of the Danish oil and gas reserves. Item 5 is projected on the basis of current plans to expand – after which it remains unchanged. The Danish Road Directorate has provided the main part of the transport projection (item 6), however the Danish Energy Authority has prepared the very simple projections of international shipping, military transport and the size of cross-border trading. Moreover, the Danish Road Directorate's tender for electric trains is adjusted to the statistics. The different parts of the projection are collected in the Danish Energy Authority's collective model, which can be used to calculate gross energy consumption and energy-related CO_2 emissions. Extracts from this model are given to NERI, and NERI has calculated emissions from the energy sector.

As mentioned, projections of the final energy consumption in the business and domestic sectors are based on an ADAM/EMMA projection. EMMA is a macro model that describes the final energy consumption broken down into a number of sectors and seven types of energy. It is based on historical experience with the behaviour of businesses and households and is documented in *Environmental satellite models for ADAM*, NERI Technical Report no. 148, NERI 1995.

In EMMA, energy consumption is determined by three factors: production, energy prices/taxes and energy efficiencies/ trends. Increased economic activity will increase the demand for energy input, whereas increased energy prices and taxes will pull in the direction of a more limited demand for the fuels. Improved energy efficiency will mean that production can be maintained using less energy, and in EMMA this results in reduced energy consumption.

The EMMA system is structured based on the link between five energy-specific models developed at NERI and Risø National Laboratory. These models determine the use of seven types of energy (liquid fuels, solid fuels, gas, biofuels, transport energy, electricity and district heating) in the domestic and business sectors, conversion of fuels (solid fuels, liquid fuels, gas, biomass) by the supply sector to electricity and district heating, and it calculates the emissions this use of energy entails. EMMA is structured as a satellite model to ADAM, which is a widely used Danish macro-economic model that covers the entire economy.

The ADAM/EMMA system can calculate the effect of a number of initiatives. One of the most important aspects though, is that energy prices play an important role. The overall level for energy prices affects the total energy consumption, and the relationship between the prices of different types of energy affects the composition of energy consumption. Therefore the model can estimate the effect of CO_2 taxes, which in part raise all energy prices and in part change the relative energy prices, so that e.g. coal, which emits a lot of CO_2, is more expensive than natural gas that emits less CO_2.

The projection of production in the business sector and inflation is based on ADAM projections prepared by the Ministry of Finance..

Projection of the production of electricity and district heating (item 2 above) has been calculated using the Danish Energy Authority's Ramses-model based on the demand for electricity and district heating as calculated in the projection of the consumer sectors. In the projection, the production of electricity and heating is broken down into existing and possibly new production facilities based on the facilities' technical specifications, price of fuel and CO_2 emissions trading prices. The model also determines electricity prices on the Nordic market and the scope of electricity exchange with the other Nordic countries and takes account of the limits to the trading capacity. The production of electricity has been liberalised throughout the Nordic countries and therefore there is no close link to Denmark's demand, rather, it is based on the characteristics of the individual facility and the market prices. Industrial and local mini combined heat and power production are not projected in the Ramses model, therefore a separate (bottom-up) projection of this production has been prepared.

A more detailed description of Ramses can be found in the following.

Ramses (version 6) is a technical-economic model that describes the production of electricity and district heating in a random number of electricity areas, at present in the Nordic countries. It is a partially linear optimisation model that can calculate the production and fuel consumption at a great number of installations on a hourly basis. As the model is mainly designed for analysing the effects in Denmark, at present the Danish installations are described in more detail than utilities in the other Nordic countries.

The model calculates the price of electricity that creates equilibrium on the market. As regards electricity, the Nordic countries are divided into five areas separated by transmission connections with a maximum transfer capacity. If the need for transmissions exceeds the capacity, the price of electricity differs in the areas. The five areas are Finland, Sweden, Norway, western Denmark and eastern Denmark. As regards district heating there are far more isolated areas that each have their own price.

In addition to information concerning the transmission connections and detailed information on the type, efficacy and size of installation, the following input are used in the model: fuel prices, CO_2 allowances prices, fuel taxes as well as the demand for electricity and district heating in the area. Output from the model includes production, fuel consumption and emissions from each installation, and the price of electricity in each area.

In the model, all installations in each area are sorted according to the short-term, marginal production costs for electricity. Production is set in motion at the utilities one after another – starting with the cheapest one, and this continues until the demand (including any need for exports or imports) in each operational hour is met. The marginal costs of the most expensive producing installations thus set the price of electricity in the area. The largest hydropower plants have been given special treatment because they can adjust the time of production for strategic reasons using the water reservoirs.

The decision concerning investments in new utilities is kept separate from the model. Investments are only made if model calculations show that the installation can recover the investment, assuming specific rates of subsidies for RE (particularly wind turbines) are given, and free CO_2 allowances for fossil-based installations, etc. Installations placed in an area where district heating is needed typically have a competitive advantage due to income from the sale of heat.

In addition to prices and amounts, the model can estimate the overall system's security of supply as regards electricity. This is done on the basis of stochastic input on the probability of damage to installations and transmission connections, time series for production from wind turbines and hydropower as well as the variation in consumption.

Ramses is used both for projection and analysis purposes. For example, it has been used to analyse the effect of new transmission connections, new wind turbine farms, changes in electricity consumption or changes in the prices of fuels and CO_2 allowances.

Annex F Description of selected programmes/projects to advance and/or finance transfer of technologies to other countries

Description of selected projects or programmes to advance and/or finance transfer of technologies to developing countries.

Project/programme title: Energy Sector Support Programme			
Purpose: Increase access to sustainable energy in rural areas			
Recipient country	**Sector**	**Total funding**	**Years in operation**
Nepal	**Energy**	**191 Mill. DKK**	**99-07, 7 years**
Description: The Programme has assisted in developing sustainable energy solutions with micro-hydro installations (off-grid), solar PV home systems and energy efficient household cooking stoves. The support has been both in terms of subsidies and technical support. The programme in its first phase also succeeded to develop a renewable energy policy for Nepal. In total 1.5 million people benefitted from the assistance – despite the difficult political situation. The households equipped with improved cooking stoves have experienced significant improvement in health conditions in households equipped with improved cooking stoves as well as 30% reduction in requirement for firewood due to more efficient stoves. A new phase of support has been initiated in 2007 with support from Denmark, Norway and the government of Nepal with a total budget of approx. 300 Mill. DKK.			
Indicate factors which led to project's success: Decentralised approach, working through locally based NGOs and other partners including private business. Combining subsidy packages, quality assurance system and capacity building.			
Technology transferred: Micro hydro power plants, PV solar panels, quality assurance system. End-user ownership and maintenance responsibility.			
Impact on greenhouse gases emissions/sinks (optional): Reduction in use of firewood. Reduction in use of kerosene lamps.			

Project/programme title: Zafarana Wind Farm Project, Component III			
Purpose: Increase production of wind power to benefit economic growth in a sustainable manner			
Recipient country	**Sector**	**Total funding**	**Years in operation**
Egypt	**Energy**	**319.4 Mill. DKK**	**05-10, 5 years**
Description: The project is the grant contribution to a mixed credit loan for the extension of the Zafarana Wind Farm at the Gulf of Suez. The project owner is the New and Renewable Energy Agency (NREA) in Egypt The extension of 120 MW is the third part of Danish support to Zafarana Wind Farm. The first component of 30 MW was financed by grant funds, the second phase of additional 30 MW was partly grant partly mixed credit. The 120 MW will together with support from other bilateral donors bring the total capacity of the farm up to 545 MW. The development of Zafarana Wind Farm is a result of efforts initiated in 1997 with development of a wind map for Egypt and with detailed wind mapping of the Zafarana site, as well as institutional support to NREA. The electricity produced is fed into the national electricity grid and off set use of natural gas for electricity production. The total cost of the project is approximately 956 Mill. DKK.			
Indicate factors which led to project's success: Significant wind resources. Step by step experiences gained with the location and the organisation.			
Technology transferred: Wind turbines, operation and maintenance skills. Tariff structures.			
Impact on greenhouse gases emissions/sinks (optional): Reduction in $C0_2$ emissions due to avoided use of natural gas for electricity production.			

Project/programme title: Danish-Chinese Wind Energy Development Programme

Purpose: To promote winder energy in the overall energy supply.

Recipient country	Sector	Total funding	Years in operation
China	**Energy**	**45 Mill. DKK**	**06-08**

Description: The programme had three elements: 1) Wind energy planning; 2) Support to Institutions; 3) Training of Stakeholders.
1) The Wind Energy Planning element had the following immediate objectives: (a) National regulations and standards are established, which will guide the implementation of the 2020 targets for wind energy, (b) provincial authorities to provide planning framework for sustainable development of large scale wind energy at provincial level;
2) The Support to Institutes of Excellence had the following immediate objectives: (a) Centres of excellence have the capacity to be a driving force in the wind energy development, (b) institutes of excellence understand the concept of MESO-scale wind models and can use output as input for the WAsP (Wind Atlas Analysis and Application Programme) model and conduct training in wind energy measurement techniques, wind data analysis, preparation of wind atlases and micro-siting;
3) Finally the Training of Stakeholders had the immediate objective: Wind farms in North-eastern provinces are better developed managed and operated.

The WED programme was originally anchored in the National Development and Reform Committee (NDRC) with China Electric Power Research Institute (CEPRI) as implementing agency assisted by the three Provincial Development and Reform Committees and China Meteorological Administration as key partners.

A new phase was committed in 2008 to be implemented from 2009.

Indicate factors which led to project's success: High level interest in wind energy and timely intervention coherent with the approval of the Chinese Renewable Energy Act. Assistance modality adjusted to Chinese conditions and programme refined after some implementation experience.

Technology transferred: Wind mapping, integration of wind energy into transmission system, feasibility format for wind farm development, wind farm management skills.

Impact on greenhouse gases emissions/sinks (optional): Positive effect due to improved conditions for wind energy.

Project/programme title: Sustainable utilisation of fire wood

Purpose: A socio-economic sustainable utilisation of renewable energy and local energy resources based on decentralised self administration of these resources.

Recipient country	Sector	Total funding	Years in operation
Burkina Faso	**Energy/NRM**	**6 Mill. DKK**	**00-08, 8 years**

Description: Support to fuel wood was included in the Danish energy support from 1999. Groups of woodcutters have been trained in forest management, fuel wood cutting and storing and in management including price negotiations. The fuel wood activity is performed by men in the otherwise inactive dry season. The forest area is managed in 12 slots, one a year for harvest and 11 for regeneration. The collected fuel wood is gathered at a loading place assessable to a dealer and his truck. Half of the income from the fuel wood is going to the collector himself. Forest management and forest assistance is taking 40 % and the remaining 10% is given to the village management fund. The cash income reduces the villagers' vulnerability to draught as it makes them able to buy food. Cash is also used for medicine and village improvements. Several other villages have expressed keen interest in being trained in fuel wood management, as they have seen the direct benefits to the participants – whom themselves say "We have fallen in the honey and the animals are even coming back to the forest".

Indicate factors which led to project's success: Local ownership and possibility for cash income. Time of work load coherent with season with minimal traditional work load. Appropriate capacity building methodologies based on learning by doing and adjusted to the base knowledge of the trainees.

Technology transferred: Forest management tools, small scale business development.

Impact on greenhouse gases emissions/sinks (optional): Increased forest cover

Project/programme title: Mangrove Management Information System as tool for mitigating the effects of climate change

Purpose: To establish and operate an environmental information system monitoring changes in the mangroves along the coast of northern Vietnam on a yearly basis, and facilitating the expansion of these areas as buffers against rising sea-levels and more frequent storms that are resulting from climate change.

Recipient country	Sector	Total funding	Years in operation
Vietnam	**Coastal Zone Management**	**3 Mill. DKK**	**06-09, 2 years**

Description: The project contained the following elements:
• A "Mangrove Management Information System" (MMIS) integrated into the Ministry of Agriculture and Rural Development/Dyke Management Department's computer network.
• A core team of 5 personnel are trained in GIS/EIS and spatial analysis and to take action on the results. Other staff are trained in accessing the MMIS in support of their job responsibilities to take appropriate action accordingly.
• Digital maps of mangrove areas based on satellite imagery are completed for 2005/2006 and 2006/2007.
•Case study report on critical areas for 2006/2007 and 2007/2008 are written.
•Policy recommendation report is written for 2006/2007 and 2007/2008.
•Draft action plan detailing the activities that will be taken to implement the recommendations is written for 2006/2007 and 2007/2008.

Indicate factors which led to project's success: Sea level rise is a crucial issue to Vietnam due to its long and low laying coast line and this fact has high political awareness. Conservation and monitoring of the coastal mangrove is essential as a tool to mitigate the impact of climate change. The project activities are therefore in great demand. The close cooperation between the responsible ministry and the resource base at a university has proven beneficial, however not always easy.

Technology transferred: GIS monitoring technology and Monitoring Information System knowledge.

Impact on greenhouse gases emissions/sinks (optional): Indirectly effect on sink

Annex G List of selected climate-related research projects

<u>Contributing institutions:</u>

- *The Danish Meteorological Institute (DMI)*
- *Geological Survey of Denmark and Greenland - GEUS*
- *Aarhus University (Geological Institute)*
- *Aarhus University (Danish Institute of Agricultural Sciences)*
- *Aarhus University (NERI)*
- *University of Copenhagen*
- *University of Copenhagen (Life)*
- *University of Copenhagen (Life - Forest and Landscape Denmark)*
- *Technical University of Denmark*
- *Technical University of Denmark (Risø DTU)*
- *The Danish National Space Center*
- *Danish Energy Agency*
- *The Danish Coastal Authority*
- *Institute of Local Government Studies*

The Danish Meteorological Institute (DMI)

The research projects for the period 2008-2009 below have been financed by the European Commission's research programme, the European meteorological satellite organisation, EUMETSAT, as well as national research councils and programmes.

- ENSEMBLES. The ENSEMBLES project.
- CECILIA. Central and Eastern Europe Climate Change Impact and Vulnerability Assessment.
- Climate Cost. The full cost of climate change
- CES. Climate and Energy Systems.
- PRECIOUS. Prediction of Climatic Impacts on Pesticide Leaching to the Aquatic Environments
- HYACINTS. HYdrological Modelling for Assessing Climate Change Impacts at differeNT Scales
- Quantify Quantifying the Climate Impact of Global and European Transport Systems
- Ice2Sea Estimating the future contribution of continental ice to sea-level rise
- CarboNorth Quantifying the carbon budget in Northern Russia
- AG2020 Foresight analysis for world agricultural markets (2020)
- Permafrost Recent and future permafrost variability, retreat and degradation in Greenland and Alaska: An integrated approach
- Combine Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection
- WATCH Water and Global Change
- CIRCE Climate Change and Impact Research: The Mediterranean Environment
- FreshNor The freshwater budget of the Nordic Seas

- DEMETER. Development of a European Multi-model Ensemble system for seasonal to inter-annual prediction.
- PREDICATE. Mechanisms and predictability of decadal fluctuations in Atlantic-European climate.
- DETECT. Detection of changing radiative forcing over the recent decades
- PROMISE. Predictability and variability of monsoons, and the agricultural and hydrological impacts of climate change.
- PRISM. Programme for Integrated earth System Modelling.
- PRUDENCE. Prediction of Regional scenarios and Uncertainties for Defining European Climate change risks and effects. The project is coordinated by DMI.
- STARDEX. Statistical and Regional Dynamical downscaling of Extremes for European regions.
- CAL. Coupling of Atmospheric Layers.
- GLIMPSE. Global Implications of Arctic climate processes and feedbacks.
- CWE. "Climate, Water and Energy.
- SAT-MAP-CLIMATE. Satellite based bio-geophysical parameter mapping and aggregation modelling for CLIMATE models. (The Risø Wind Energy Department also contributes.)
- Application of seasonal climate forecasts for improved management strategies for crops in Western Africa.

- Consequences of climate change for the oceanic environment near Greenland.
- CONWOY. Consequences of Weather and climate changes for marine and freshwater ecosystems.
- PSC Climate. Polar Stratospheric Clouds and ozone depletion: The role in global climate change.
- MAPSCORE. Mapping of polar Stratospheric Clouds and Ozone levels relevant to the Region of Europe.
- SAMMOA. Spring-to-Autumn Measurements and Modelling of Ozone and Active species.
- CANDIDOZ. Chemical And Dynamical Influences on Decadal Ozone Changes.
- GREENICE. Greenland arctic shelf ice and climate experiment.
- MOEN. Meridional Overturning Exchange with Nordic Seas.
- CONVECTION. Greenland Sea Convection Mechanisms and their Climatic Implications.
- EUMETSAT OZON and UV SAF. The development and implementation of certain activities of a EUMETSAT Satellite Application Facility on ozone monitoring.
- HIBISCUS. Impact of tropical convection on the upper troposphere and lower stratosphere at global scale.
- OFR-cirrus. Subvisible cirrus clouds and the effect on the transport of water vapour to the stratosphere.
- VOGUE. Validation of ENVISAT ozone and NO_2 products from ground based measurements in Greenland.
- RAMAS. Radiometer for atmospheric measurements of Summit.
- ENSEMBLES. The ENSEMBLES project.
- QUANTIFY. Quantifying the climate impact of global and European transport systems.
- GRAS SAF. The development of a EUMETSAT Satellite Application Facility for GRAS meteorology, including a visiting scientist programme. The project is run by DMI.
- Ocean and Sea Ice SAF. The development of a EUMETSAT Ocean and Sea Ice Satellite Application Facility.
- West Nordic Ocean Climate. Circulation in the North Atlantic, transport across the Greenland-Scotland ridge. Financed by the Nordic Council of Ministers.
- SCOUT-O3: Stratosphere-Climate links with emphasis on the UTLS
- UVG: Effects on UV-radiation in Greenland as a consequence of climate change
- CALISTO: Cross validation and interpretation of stratospheric observations over Greenland by satellite and grounbased measurements
- GEMS: Global Earth-System Monitoring Using Satellite and In-Situ Data
- GEOMON: Global Earth Observation an Monitoring
- MST-Ozon & UV: Monitoring of ozone and UV in Greenland
- OFR-CIRRUS: Subvisible cirrus and their influence on transport of water vapourto the stratosphere
- FNU-Cirrus: Cirrus clouds and transport of water vapour in the tropical tropopause layer
- PROMOTE: UV service for Greenland
- ICEPURE: The impact of climatic and environmental factors on personal ultraviolet radiation exposure and human health
- O3-UV SAT: Satellite Application Facility (SAF) on Ozone and Atmospheric Chemistry Monitoring

Geological Survey of Denmark and Greenland - GEUS

- ICEMON. Ice-edge monitoring Collection of time series of melt from the ice sheet in southern Greenland. Project period: 2003-2006.
- EUROSTRATAFORM. Analyses of marine systems and present processes on the European continental margin with a view to improve understanding of long climate data series. Project Period: 2002-2005.
- Green Ice. Studies of the sea ice north of Greenland to determine changes in thickness etc. caused by climate changes. Project period: 2003-2006.
- Euro Clim. Establishment of monitoring and warning system for climate changes based on ice and water data in Greenland. Project period: 2001-2009.
- Cryosat. Participation in establishment of the programme for the CRYOSAT satellite for monitoring ice sheets, glaciers and sea ice. Project period: 2003-2005.
- ANCIENT BEECH FOREST: Studies of the range of beech forests in Europe based on fossil DNA and pollen with a view to illuminate the evolution of beech seen in a climatic context. Project period:2004-2007
- “Norse – Climate. Studies of the natural conditions in the period 1000-1500 AD in order to cast light on the Norse's living conditions in Greenland. Project period: 2001- 2006.
- History of the ice sheet. Studies of the extent of the ice sheet during the last Ice Age in the northern part of west Greenland. Project period 2002-2006.
- Davies Strait Arctic Gateway. Studies of surface and deep water circulation in Davies Strait at west Greenland with the aim of understanding links between oceanographic changes and climate change since the last glacial maximum. Project period: 2005-2007.
- Effects of climate changes. Development of a concept for monitoring climate changes in Denmark, the Faroe Islands, Greenland and adjacent areas. Project period 2003-2006.
- METROL. Investigations of methane emissions from the seabed in the North Sea and Danish inland waters with a view to possible climate impacts. Project period: 2002-2006.
- PACLIVA. Comparison of the climate system in the North Atlantic in the relatively cold year 2000 with the climate system that prevailed from 8,000 to 6,000 years ago. Project period 2002-2006.
- PASTFIRE. Studies of the relation between climate changes and past fires in forests and steppes. Paleofire incidence and emergence are analysed to understand causes of future fires. Project period 2005-2006.
- DEGVEC. Studies of vegetation response and feedback on climate changes in eight European countries. Development of dynamic vegetation models to assess vegetation-climate interactions. Project period: 2005-2007.
- Glacial earth quakes. Studies and site determination of near-surface earth quakes caused by movements of glaciers and the ice sheet in Greenland. A possible tool to monitor glacier movement and its relation to climate changes. Project period: 2005-2006.
- CO2STORE. On-land and long term Saline Aquifer CO_2 storage: Assessment of geology, safety and economy of future potential storage-sites for CO_2 in Europe. The project includes detailed studies of four potential storage-structures. Continuation of geophical monitoring of CO_2 injection at the Sleipner field (SACS project). Project period: 2003-2006.

- CASTOR. CO_2 from Capture to Storage: GEUS is co-ordinating mapping of geological storage capacity in eight eastern European countries. The project also includes research on separation of CO_2 and a demonstration plant for CO_2 separation in Esbjerg (Elsam and Energi E2). Project period: 2004-2008.
- CO2SINK. In-situ R&D Laboratory for Geological Storage of CO_2: Pilot study and construction of demonstration plant for CO_2 storage at Berlin. It is expected that injection of limited amounts of CO_2 will take place in the period 2006-2009. The injection will be monitored with a suite of geophysical instruments, and a risk-assessment will be made based on the collected data. Project period: 2004-2009.
- ULCOS. Ultra Low CO_2 Steelmaking: Development of new technology for reducing CO_2-emission from the steel industry. GEUS is participating with a subproject on potential geological storage of CO_2 from selected European steel plants. Project period: 2004-2009.
- EOCAPACITY: Mapping of geological storage capacity in Europe (eastern and southern European countries). The project is a continuation of the methodologies and objectives from the GESTCO project. The project includes co-operation and exchange of experience with China. Project period: 2006-2009.
- The NEWGREEN. The project "Late Holocene records of sea ice and iceberg drift offshore West Greenland and Newfoundland – impact on human living" is a contribution to the IPY 120 NORCLIM initiative. Project period: 2007-2010.
- PROMICE: Programme for Monitoring of the Greenland Ice Sheet Margin. The program will monitor the development of the Greenland ice sheet in a changing climate. The programme includes: an extensive network of automatic mass-balance stations positioned in situ on the Greenland ice margin, repeated airborne surveys of the entire ice margin to obtain surface elevation and ice thickness, an ongoing effort to process satellite radar data to determine ice sheet surface velocity, modelling of the climatic and dynamic mass loss of the Greenland ice sheet and maintenance of an open access database. Project period: 2007 – 2012.
- GLIMS. The worldwide effort to monitor land ice masses, Global Land Ice Measurements from Space - GLIMS. Within this framework, GEUS acts as the GLIMS Regional Center for Greenland (RC1) and formally coordinates the GLIMS activities in Greenland through contact with regional stewards working in different parts of Greenland. Project period: 2008-2012.
- GlacioBasic. Part of the comprehensive environmental monitoring programme, Zackenberg Basic, in Northeast Greenland. The GEUS is in charge of GlacioBasic, which will monitor the glaciated parts of the Zackenberg basin. Project period: 2008-2012.
- EGGCITE. A project to reveal the connection between the Greenland ice sheet and the recently discovered, mysterious glacial earthquakes .Understanding the link between the ice stream dynamics and the glacial earthquakes may provide a much-needed insight into the recent dramatic mass loss of the Greenland ice sheet. Project period: 2008-2010.
- FreshLink. The study of the relationship between climatic changes and dynamics of the Greenland ice cap as well as the circulation variability in (adjacent) ocean waters. Study of bottom melting processes at major North Greenland outlet glaciers and investigations of past circulation changes in the Nordic Seas and North Atlantic form part of the present research activities. Project period.: 2008-2010.
- CO2GeoNet. Support for the formation of en European research network for CO2- storage with the goal of decrease the climate changes and ocean acidification.
- Impact assessment of Climate Change on Water Resources at catchment scale. Evaluation of effects of climate changes on the groundwater resource in Denmark, Project period: 2007-2009.
- HYACINTS. Hydrological Modelling for assessing Climate change impacts at different scales. Project period: 2008-2012.
- HOBE. A hydrological Observatory and Exploratorium in a well documented area for understanding the hydrological cycle under future changed climate conditions. Project period: 2009-2012.
- Climate change impact on ecological conditions in streams. An integrated study of the water cycle with the focus on climate changes and effect of groundwater abstraction. Project period: 2006-2009.
- CLIWAT: Adaptive and sustainable water management and protection of society and nature in an extreme climate. Project period: 2009-2011.
- BaltCICA. Climate change: Impacts, Costs and Adaptations in the Baltic Sea Region. Project period: 2009-2011.
- Prediction of effects of Climate Changes on the transport of pesticides in the aquatic environment. Evaluation of the climate change effect on the transport from the root zone and transport in the groundwater zone to the streams. Project Period: 2008-2010.

Aarhus University (Geological Institute)

- The EU project HOLSMEER. Late Holocene Shallow Marine Environments of Europe. The focus of the project is climate changes in the last 2,000 years. The investigations are being carried out on, inter alia, marine drilling cores from Portugal in the south to the coastal areas of Iceland and Norway in the north. Project period: 2001-2003.
- KRONPAL. Chronology and paleoclimate: Integration of marine cores from Iceland with AMS 14C datings, ash chronology and ice cores. The project examines large and small oceanographic shifts in the North Atlantic in the last 15,000 years and problems concerning exact dating of these. Project period: 2003-2006.
- PACLIVA. see under Danish Meteorological Institute.
- Varved, Holocene and interglacial lake sediments in Denmark. Lake sediments from the last 11,500 years from interglacial periods with rhythmic stratifications (year strata, layers of glacial deposit) are being studied with a number of detailed stratigraphic methods. One of the aims is to determine how quickly the terrestrial environment and the aquatic environment have reacted to climate changes in the past. Project period: 2003-2005.
- CONWOY: see under Danish Meteorological Institute.
- Constraining the age and extent of Scandinavian Ice Sheet advances during the last glaciation in its type area in Poland with absolute dating techniques, SNF, 2004-2006. Goal: The project intends to date Weichselian sediments in central and northern Poland using the luminescence method to determine the age and extent of ice sheet fluctuations with special reference to the controversial Isotope Stage 4 glaciation, and to evaluate these fluctuations in the context of global climatic trends of the last 100,000 years.
- DASARG. "The Davies Strait Arctic Gateway: Ocean circulation and West Greenland Climate Change since the Last Glacial Maximum". The project studies changes in ocean circulation, ocean ice extent, climate and meltwater from Greenland at the west Greenland coast since the Last Glacial Maximum (the last 25,000 years). The project is also focusing on the possible anti-phase between south-western Greenland and north-western Europe, which has been observed in recent

weather patterns. The project is supported by the Research Council for Nature and the Universe. International Polar Year Expression-of-Intent no. 1003. Project period: 2005-2007.

- Quaternary paleoclimate in northern Russia and arctic Siberia. Paleoecological studies in northern Russia and arctic Siberia, with the purpose of studying the coupling between climate changes and variations in ocean currents and water exchange between the Arctic Ocean and the Atlantic during the last 150,000 years.
- Paleoenvironment and paleoclimate in the Baltic region in the last interglacial. Studies of climate and hydrographics in the Baltic region during the last interglacial 130,000- 115,000 years BP.
- Consequences of weather and climate changes for marine and freshwater ecosystems (www.conwoy.ku.dk). Part of the funding is for a PhD-project “influence of temperature changes on phytoplancton”. The research aims to quantify the influence of temperatures on species composition and functioning in bacterial and phytoplancton communities in both fresh and marine waters. Project period: 2002-2005.
- Mapping on the influence of climate on fish resources in the Limfjord. In a co-operation between NERI and the counties involved.
- Parasites, Climate Changes and Biodiversity. Parasite-mediated climatic impacts on diversity and structure of marine floral and faunal communities. The research aims to map the extent of the influence of expected climate changes on coastal floral and faunal communities solely through changes in parasite-host interactions. Project during: 3 years.
- Analysis of climate signals in long time-series of fish catch data in waters around the Faroe Islands.
- Impact of climate changes on migration patterns of fish in Danish waters.
- Evolutionary and physiological adaptations to climatic conditions and their changes, with special interest in temperature adaptations (see www.biology.au.dk/aces). In co-operation with Skejby Hospital, NERI and DIAS, Foulum. Project period: 2002-2005.
- A macroecological, biogeographical perspective on plants’ biocomplexity under global change. The project aims to improve the understanding of the impact on natural ecosystems of the ongoing global environmental changes, with special focus on climatic influences on plant ranges and diversity. A co-operation with NERI. Project period: 2005-2008.
- DENIMOB: Benthic invertebrate guts as “mobile microsites” in sediments: hot spots for denitrification and N2O production?. A Marie Curie Intra-European Fellowship project. Project period: 2005-2006.

Aarhus University (Danish Institute of Agricultural Sciences)

- DINOG. Dinitrogen fixation and nitrous oxide losses in organic grass-clover pastures: An integrated experimental and modelling approach. The purpose is to quantify nitrogen fixation and nitrous oxide emission from grasslands through monitoring, laboratory tests and modelling of nitrification and denitrification. Project period: 2001-2004.
- MIDAIR. Greenhouse gas mitigation for organic and conventional dairy production. The purpose of this project is to identify and quantify the main sources of greenhouse gas emissions from organic and conventional milk production and to indicate strategies for mitigating these emissions. Project period: 2001-2004.
- GREENGRASS. Sources and Sinks of Greenhouse Gases from managed European Grasslands and Mitigation Strategies. The purpose of this project is to quantify exchange of carbon dioxide, nitrous oxide and methane from grassland in Europe through monitoring and modelling, and to evaluate the potential for mitigation in selected operating strategies. Project period: 2002-2004.
- PRUDENCE. Prediction of Regional scenarios and Uncertainties for Defining European Climate change risks and Effects. The purpose of this project is to improve the basis for projecting climate effects through modelling and to interpret predictions and uncertainties in relation to the EU's policy for adaptation to and mitigation of climate changes. Project period 2002-2004.
- Knowledge synthesis on energy in organic farming. Purpose: to gather knowledge about energy consumption, possible savings and energy production in organic farming and to evaluate the possibilities for requirements on the use of fossil energy in organic production. Project period: 2002-2003.

Aarhus University (NERI)

Department for Marine Ecology

- MARINBASIS. Environmental monitoring in Zackenberg. Marine monitoring of abiotic and biotic reactions on year-to-year variations and long-term climate changes with a view to being able to predict and document the effects of the expected climate changes. Project period: 1995 - and following decades.
- RECLAIM. REsolving CLimAtic IMpacts on fish stocks. Climate change will impact fisheries resources and challenge managers to develop sustainable exploitation strategies. Knowledge on the impacts of climate on fisheries resources is still fragmentary. RECLAIM is scientific research project funded by the European Union which will summarize current knowledge, test process understanding, improve predictive capacity and formulate future research hypotheses about the impact of climate change on North-East Atlantic fish stocks. The principal objectives of RECLAIM are to increase our understanding of the impacts of climate change on fish and shellfish populations by reviewing existing knowledge and conducting a variety of data analyses and modelling activities and to formulate hypotheses to be tested in future research programs 2007-2009.
- SUNFISH. SUstaiNable FISHeries, climate and the North Sea Ecosystem. Global climate change will seriously challenge the governance of fisheries in the North Sea and elsewhere. Changes in temperature, wind conditions, river runoff and currents will affect primary and secondary production and the distribution, feeding, growth and survival of commercially exploited fish at all stages of life. The project will provide an integrated modelling framework for developing sustainable fisheries management strategies superior to using simple extrapolations of observed historical trends to predict the likely outcome of climate change on the North Sea ecosystem. 2008-2012.
- MEECE - Marine Ecosystem Evolution in a Changing Environment. Through the performance of experimental synthesis and simulation activities, MEECE will provide the European Commission with an increased understanding of the impacts of climate change and anthropogenic drivers on the marine ecosystems and provide the numerical simulation tools to assess these impacts on a regional basis. MEECE will develop methodologies to integrate the dynamic response of marine ecosystems to the combined effects of various anthropogenic and natural drivers. 2008-2010.
- BALTIC GAS. The mission of BALTIC METHANE is to quantify and map the distribution and flux of methane in the Baltic Sea analyze the controls on the relevant key biogeochemical sediment processes model the dynamics of methane in

the past, present and future predict the fluxes of methane gas and hydrogen sulfide from the seafloor in relation to future climate change and continued eutrophication. Eutrophication and enhanced organic deposition to the sea floor strongly enhance anaerobic biogeochemical processes and expand the sub-seafloor methane zone towards the sediment surface. 2009-2011.

- Ecosystem metabolism. Climate change and increased eutrophication can be expected to cause large-scale changes in our coastal ecosystems in the future. Such effects need to be assessed at the ecosystem level. Net ecosystem metabolism (NEM), the net effect of autotrophic and heterotrophic processes in the pelagic and benthic compartments, is an integrated measure of the state of an ecosystem against which effects of external factors can be evaluated. NEM is also of interest because it is relates to the capacity of the ocean to take up or release atmospheric CO2. When NEM is positive the system is net autotrophic and functions as sink of atmospheric CO2 and when NEM is negative it becomes a source of atmospheric CO2. This project assesses NEM, air-sea CO2 fluxes and associated variables in Kobbe Fjord, Nuuk, Greenland. 2007-2009.

<u>Department of Arctic Environment</u>

- The biological monitoring programme BioBasis, in Zackenberg, northeast Greenland. Monitoring of biotic reactions on year-to-year variations and long-term climate changes with a view to being able to predict and document the effects of the expected climate changes. Project period: 1995 and following decades.
- The natural geographic monitoring programme GeoBasis in Zackenberg, northeast Greenland. Monitoring of abiotic reactions on year-to-year variations and long-term changes in the climate with a view to being able to predict and document the effects of the expected climate changes. Project period: 1995 and following decades.
- Environmental monitoring in Zackenberg - Marine Basis. Project period 1995 and following decades.
- FRAGILE. FRagility of Arctic Goose habitat: Impacts of Land use, conservation and Elevated temperatures. The purpose of this study is to provide a predictive framework of the outcomes for fragile tundra ecosystems of European land use policy and conservation management scenarios affecting goose populations, in tandem with climate change. One of the key outcomes is to identify tundra ecosystem processes which are most vulnerable to the combined drivers of high goose grazing pressure and climatic warming. 2003-2007.
- Ecological effects of climate change in high-arctic Greenland. PhD project with the purpose of analysing monitoring data collected under the Zackenberg programme in northeast Greenland in order to understand how species and ecosystems respond to climatic variations. 2004-2007.
- REKRUT. Recruiting and diversity in arctic vegetation. The project investigated the effects of microclimate, soil and disturbance on the establishment of seedlings and the resulting patterns in species and diversity along a productivity gradient in the arctic tundra. 2005-2007 .
- The influence of snow and ice on the winter functioning and annual carbon balance of a high-arctic ecosystem. This project describes and analyses the influence of snow and ice on the functioning of the terrestrial, limnic and marine compartments of a high-arctic ecosystem. One focus area will be how the winter season affects the annual carbon budget and net feedback of carbon gas fluxes to/from the atmosphere. Through the temporal and spatial up-scaling of the present data available from the Zackenberg valley and Young Sund, this project will provide yet unavailable high arctic, quantitative ecosystem data with high spatial and temporal coverage, including estimates of annual plant growth dynamics, ecosystem metabolism in the terrestrial, marine and limnic environments (including C02 budgets), and data on the winter ecology of the most important herbivores. 2007-2008.

<u>Department for Policy Analysis</u>

- Projection models for greenhouse gases. Models are being set up at a level of detail that makes it possible to project emissions in relation to technological development and political measures. Project period: 2008-2009.
- Inventory of Denmark's greenhouse gases for the Climate Convention, the Kyoto Protocol and the EU. Denmark's total greenhouse gas emission is being calculated and reported in accordance with current guidelines. Project period: 1990 onwards.
- Nordic Nature Indicators of Climate Change (NICC). The aim of the project is to develop a set of indicators for impacts of climate change on nature in the Nordic countries. The project is supported by the Nordic Council of Ministers. Project period: 2007-2009.
- Policy Integration, Coherence and Governance. The purpose of the project will first and foremost aim at an increased understanding of the features and conditions for better integrated and coherent policies and governance processes in relation to climate policies. In addition, the goal is also prescriptive, i.e. which methods, approaches and institutions, at different policy levels, could contribute to foster climate change policy integration and increase coherence. Project period: 2008-2009.
- E-LUP Interact. e-tool for Land Use Process. E-LUP is a STREP-project within the FP6 thematic area: Sustainable development, global change and Ecosystems, funded by the European Commission. The main goal is training in sustainability impact assessment (SIA) for land use issues and the main output an electronic freeware textbook or tool in parallel English-Russian. The strength of the SIA approach, is paying equal attention to all “three pillars” of sustainable development (environment, economy, society) and their holistic integration, at the same time making a proportionate analysis and integrative weighing of their importance in particular issues. Project period: 2006-2009.
- Pricing of the effects on climate change. The aim of the project is to make an overview of existing valuation studies in Denmark as well as abroad being relevant to climate change adaptation. Project period: 2008-2009.
- Risk perceptions and lifestyle changes in relation to climate change adaptation. The purpose of this study is to investigate social aspects of climate change adaptation. How do people perceive and relate to climate change adaptation, what risks are associated with climate change, and how are those risks balanced with other risks and concerns of everyday life and long-range choices. Project period: 2008-2009.
- Modelling allocation of agricultural land use to improve biodiversity. The model for agricultural land use will be utilised to develop scenarios with the purpose to investigate how future climate changes and structural changes within the agricultural sector will affect the geographical placement of permanent grass and fallow. 2008-2012
- SINKS. Documentation and reporting of the Danish emissions from the LULUCF sector under article 3.3 and 3.4 under the Kyoto Protocol. The project is divided into several subprojects, e.g. documentation of changes in living biomass in forests and soils, improved mapping of organic soils, documentation of the trend in area of hedgerows, satellite monitoring of Danish land use and new biomass expansion factors for different types of trees. The project is carried out in cooperation with the department of Forestry and Landscape at Copenhagen University. 2007-2013

- Comparing National Adaptation Strategies in Europe. The project aims to support both European adaptation policy development and the research agenda of the PEER institutions (PEER: Partnership for European Environmental Research). In this context the participating partners formulated the following two major objectives: Policy support: develop a position paper providing initial innovative ideas for development and implementation of adaptation strategies, based on experiences in EU member states, and aiming at supporting the PEER-countries, other EU countries and the EU in further policy development; Research agenda: identify interesting new research areas to strengthen PEER research activities in the area of climate adaptation (PEER as innovating research community). 2008.

Department for Terrestrial Ecology, Soil Ecology and Ecotoxicology

- IGLOO. The national environment and nature surveillance programme – NOVANA – was initiated in 2004. In connection with the revision of the programme this project contributed with a description of the expected effects of climate change on terrestrial nature and provided recommendations on parameters to be included in future terrestrial monitoring. 2008.
- CLIMAITE. The project will particularly focus on two issues related to biological processes and climate change, which are believed to play a key role for the biological effects of climate change: multiple environmental changes and temporal variation patterns. Multiple environmental changes are of central importance for the biological effects because the climatic changes will include simultaneous changes in at least three factors: atmospheric CO2 concentrations, temperature and water availability. 2004-2012.
- Desiccation tolerance in Collembola - Physiological and evolutionary role of LEA and heat shock proteins. The project aims at investigating environmental adaptation in collembolans, with special emphasis on the physiological and evolutionary role of LEA and other stress induced proteins. The project are thus directed at increasing our understanding of drought and cold adaptation in soil organisms, but also help us understand how populations have adapted to environmental stress and how they will be affected by a global change in climate patterns. 2009-2010.

Department for Atmospheric Environment

- EU project AEROCARB. "Airborne European Regional Observations of the Carbon Balance. The objective of AEROCARB is to demonstrate the feasibility of an integrated approach to estimate and monitor the net European carbon balance as a mean to corroborate EU-wide controls of CO_2 emission. Closely connected to this, is the study of spatial and temporal variations of the CO_2 sources and sinks over the European continent.
- Arctic Monitoring of atmospheric Pollution in Greenland. The project monitored a range of air pollutants including heavy metals, persistent organic pollutants and perflourocarbons. The results from the project will be used in the validation and further development of the Danish Eulerian Hemispheric Model (DEHM) by including new parameters in the programme. 2006-2008.
- Atmospheric particles in the Arctic. Atmospheric particles influence the climate indirectly through particle formation and directly through absorption and scattering of radiation. According to the 4th IPCC assessment report particle formation, composition and transport is one of the largest uncertainties in climate models. The goal of this project is to investigate the abundance and composition of particles in Arctic in order to estimate the formation and transformation of particles and the potential to form clouds in changed climate conditions. 2008-2009.
- NICCA Network for Interaction of Climate in Arctic. The objective of the network NICCA is to establish a Danish platform which will be the foundation for a project to be proposed in a coming EU call. The scientific objective is to study the effects of particles, ozone and other pollutants on climate and the feed back of climate on particle formation and ozone concentrations in the Arctic in order to identify gaps in our knowledge of processes and feedbacks controlling interactions in the earth system. 2008-2009.

Department for wildlife biology and biodiversity

- Consequences of climate change on species biodiversity in Denmark. The project analysed the potential consequences on species of plants as a consequence of climate change predicted by the IPCC in the year 2100. The scenarios A2 and B2 were analysed. 2005.
- Effects of sea level rise and climate change on wading birds in the South West Jutland coastal mudflats. The project investigates the effects of climate change on wading birds in the South West Jutland coastal mudflats. The project will describe the possible changes that have occurred during the last 20 years and will use the output to project the future effect of climate change on wading birds in the South West Jutland coastal mudflats. 2008-2011.

University of Copenhagen

Department of Geophysics

Projects are in progress within the following areas:

- Ice cores and climate parameters, datings.
- The carbon cycle/the ocean's circulation and physical properties.
- The stability of the climate.
- Atmospheric CO_2 transports.
- Large-scale meteorology.
- Statistical analyses of climate data.

Geological Institute

Projects are in progress in the following areas:

- Long lake cores from Denmark and this and the previous interglacial period.
- Correlation between Greenland ice cores and lake cores in Denmark by means of well-dated ash strata from Iceland or the Eifel area in Germany.

Institute of Geography

- FITES. Fire in Tropical Ecosystems. FITES has studied the distribution, controls/causes and effects, including climatic ones, of savannah fires in the Sudanese and south-Sahelian zone of Africa. Project period: 1986-2003.
- INTEO. Integration of Earth Observation Data in Distributed Hydrological Models. INTEO studies the use of Earth Observation data for running, calibrating and validating hydrological models, at the scale of large river basins, allowing assessment of the effect of climatic change on water resource availability. Project period: 1996 – 2005.

- Land use and carbon cycle in Senegal. The project studies the impact of land use change on carbon storage in vegetation and soils in Senegal. Project period: 1999 – 2002.
- NECC. Nordic Centre for Studies of Ecosystem Carbon Exchange and its interaction with the climate system. The interaction between CO_2 and climate is being studied over selected Nordic ecosystems, ranging from agricultural areas on Zealand to the tundra in north Sweden. Project period: 2003-2007.
- EO-FLUX. Earth observation data for up-scaling carbon Flux and water Budget at Zealand. CO_2 and H_2O exchange over Zealand is being determined on the basis of satellite data, CO_2 measurements and hydrological modelling. Project period: 2001-2003.

Institute of Molecular Biology
- Forest Carbon – Nitrogen Trajectories (FORCAST). The objective was to investigate carbon and nitrogen pools and fluxes in European forest ecosystems. Project period: 1999-2003.

Institute of Chemistry, The Atmosphere Group
- Establishment of relevant physical and chemical quantities: IR absorption spectra, velocity and photolytic constants, uptake coefficients, formation of CCN (Cloud Condensation Nuclei) etc. Project period: ongoing.

Botanical Institute
- Biogeochemistry in the Arctic – processes, controls and sensitivity to global change. Measurement of drivers and controls of biogeochemical nutrient and carbon cycling in arctic ecosystems and probable impacts on the cycles of a predicted climate change. Project period: 2000-2002.
- Processes in the plant-microbe-soil interface: Implications for ecosystem function. Experimental assessment of probable impact of future projected climate change on processes in the plant-microbe-soil system in Arctic ecosystems that have been manipulated to mimic future changes in environmental conditions. Project period: 2003–2005.
- FITES - Fire in Tropical Ecosystems. Studies of the effect of fire on decomposition of matter, biodiversity and greenhouse gas emissions in savannah ecosystems. The Botanical, Geographic and Zoological Institutes and the Botanical Museum are participating in the project.

University of Copenhagen (Life)

- EO-FLUX-BUDGET. Earth Observation data for up-scaling carbon FLUX and water BUDGET at Zealand. In this project the CO_2 and water balance for a region (Zealand) are being determined on the basis of satellite pictures and modelling. The results complement point measurements of CO_2 and water balance in a climate context. Project period: 2000-2004.
- EPN: European Phenological Network. Thematic Network on the analysis of phenological information in relation to climate variability/ change and exploration of possibilities to predict climate change effects on the timing of life cycle events. Project period: 2000-2003.
- Plant community context and reproduction of Sorbus torminalis along a large-scale gradient in Europe - analysing the species' response to climatic change. Project period: 2001- 2004.
- EC Karnal Bunt: 'Pest Risk Assessment for Karnal bunt - Tilletia indica'. Project period: 2000-2004.

University of Copenhagen (Life - Forest and Landscape Denmark)

- EU project CNTER. Carbon Nitrogen Interactions in Forest Ecosystems. Methods for calculating carbon binding in forest soil. The importance of nitrogen deposition for carbon binding in forest soil. Project period: 2001-2004.
- Carbon and Nitrogen Sequestration in Forest Soils – Evaluation of estimation methods. Methods for calculating carbon binding in forest soil. Guest researcher Bjørn Berg. Project period: 2005-2006.
- CLIMAITE – see under Risø National Laboratory.
- Carbon binding and water quality in forests of the future – interactions between tree species and soil type. Danish Agricultural and Veterinary Research Council project. Carbon and nitrogen cycles in five different deciduous tree species at six locations in Denmark. Measurement of carbon pools and CO_2 efflux from soil. Project period: 2004-2005.
- Carbon and nitrogen interactions in deposition gradients from forest edges. Danish Agricultural and Veterinary Research Council project. The effect of varying nitrogen inputs on N and C circulation and dynamics is studied in areas at the fringe of the woods where N deposition is high. How the characteristics of areas at the fringe of the woods distinguish themselves biogeochemically from the inner part of the woods is also studied. Project period 2005-2006.
- Estimation of carbon storage in forest biomass in the Nordic and Baltic countries - common methods, protocol and tools for obtaining comparable biomass expansion functions (BEF). Danish Forest and Nature Agency project. The aim is to give an overview of how data on biomass distribution from national forest inventories and other easily accessible sources are used and potentially can be used in the national Land Use, Land Use Change, and Forestry (LULUCF) reporting. Also, available knowledge on expansion factors and functions should be synthesised, starting with Norway spruce, with special attention to the root fraction. Project period: 2004-2007.
- Emissions of the greenhouse gases methane and nitrous oxide from wet soils in the forest. Measurement of the climate gases CO_2, methane and nitrous oxide along topo-sequences from well-drained to poorly drained conditions in afforestation and in old forests. Project period: 2004-2005.
- CO_2 removals in forests – contributions to an improved inventory of changes in biomass and soil carbon stocks. A pilot project concerning biomass equations (expansion functions) for above ground and below ground biomass in Norway spruce and a design for a soil module in the new forest statistics. Project period: 2003-2005.
- EU project WOOD-EN-MAN. Wood for energy - a contribution to the development of sustainable forest management. Research-based development of operational recommendations for sustainable forest operation using woodchips for energy purposes (economy, social economy and ecology), together with policy recommendations on increased use of forest biomass for energy purposes. Project period: 2001-2005.
- ForestFocus: the European monitoring of forest ecosystems, including effects of climatic change on forests. Project period: 2003-2006.
- Forest Statistics. National sample based collection of Danish forest data. Results will be used to monitor forest resources, condition, development, effects of climate change and carbon sequestration. Project period: 2002- .

- EFORWOOD: EU-FP7 integrated project (tools for sustainability impact assessment of the forestry-wood chain), including carbon sequestration in forest ecosystems in relation to forest management and climate change.
- Spreading wood-chip ash in Danish forestry - ecological consequences. The ecological consequences of ash recirculation under different conditions are being examined on the basis of experiments with spreading ash. Project period: 1999-2004.
- Pre-treatment and recirculation of wood-chip ash. The objective of this project is to develop a well-documented concept for recycling wood-chip ash and at the same time to break down the barriers that make recycling difficult today. Project period: 2004-2007.
- CoReWOOD – Bioenergy. The main aim of the project is to enable and promote synergetic co-operation, co-ordination of activities and knowledge sharing between RecAsh, WOOD-EN-MAN and Bio2003-2005energy. Project period: 2004-2005.
- Bioenergy as an environmental factor in the Nordic-Baltic-North-West-Russian Region. The overall aim is to contribute to overcoming present barriers to increased sustainable use of bio-energy within the Nordic-Baltic-Russian region. The main activity is an open seminar on the above topics in 2005. Project period: 2004-2006.
- IEA Bioenergy Task 31: Biomass Production for Energy from Sustainable Forestry. Project period: 2004-2006.
- IEA Bioenergy Task 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems. Project period: 2004-2006.
- The logistics of improving economic accessibility to the forest fuel resource in Denmark. Investigation on integration of planning, harvesting, wood chip production, transportation and storage of wood chips. Project period: 2004-2006.
- BIONORM: EU project on the scientific basis for a possible European standard on biofuels with participation from 17 countries. Project period: 2002-2005.

Technical University of Denmark

- Solar activity and terrestrial climate: An analysis of some purported correlation. The project's critical analyses revealed serious (misleading) errors in a number of scientific articles concerning the sun's effect on the earth's climate. Project period: 2001- 2003.

Technical University of Denmark (Risø DTU)

Department for Plant Research

- EU project CarbonEuroflux. Exchange of CO_2 between the atmosphere and the forest ecosystem. Project period: 1996 - .
- EU CORE project. Climate –Atmosphere Interaction. Its goal is to produce continuous field measurements on atmosphere-biosphere interactions on six field research stations run by four participants (University of Helsinki, Finnish Meteorological Institute, National University of Ireland, Galway, and Risø National Laboratory. Project period: 2000-2003.
- EU project VULCAN. Effect of heating and drying out on heath ecosystems' function, biodiversity and plant composition. In the project experimental heating and drying out of semi-natural ecosystems is being carried out in six European countries to study the effects on the ecosystems. Project period: 2001-2004.
- EU project GREENGRASS. Sources and sinks of greenhouse gasses from managed European grasslands and mitigation scenarios. The purpose is to acquire detailed knowledge about CO_2, CH_4 and N_2O fluxes from grassland along European climate gradients and under varying forms of use and cultivation with a view to evaluating possible mitigation options by changing cultivation and land-use practice. Project period: 2001- 2004.
- EU project NOFRETTE. Nitrogen oxide emissions from European forest ecosystems. The project covers emissions of NO and N2O from forest ecosystems. Its purpose is partly to determine the size of these emissions and partly to describe the fundamental processes that drive the NO/N2O emissions from European forest ecosystems under the influence of geographically determined variations in nitrogen deposition, climate and soil conditions and types of forest. Project period: 2001 – 2004.
- Emissions of greenhouse gases and nitrogen fixation in alfalfa. The project aims at clarifying emissions of N2O from grazed alfalfa fields and determine what share of biologically fixed nitrogen is released as N2O. Project period: 2000-2004.
- Recovery of forest ecosystems from acidification - impacts of climate change. In this project model calculations are being carried out of the effect of climate changes on the recovery processes for soil acidification under the agreed protocols for reduction of sulphur and nitrogen emissions. Project period 2001-2003.
- UV impacts on the vegetation in Zackenberg, Greenland. The main purpose of the project is to establish a relatively simple and robust method for continuous monitoring of the effects of UV radiation on selected Arctic species of plant in Zackenberg, Greenland. Project period: 2001- 2004.
- CLIMAITE - Climate change effects on biological processes in terrestrial ecosystems. A Danish climate centre aimed at creating a cohesive understanding of how interacting climate changes will affect biological processes in nature. Based on large-scale field tests with realistic manipulations of temperature, precipitation and CO_2. Project period 2005-2009.

Energy System Group

- Assessment and Dissemination activity on major Investment Opportunities for renewable electricity in Europe using the REBUS tool - Admire Rebus. Funded by the EU ALTERNER programme. Project period: 2002-2003.
- Green-X Deriving optimal promotion strategies for increasing the share of RES-E in a dynamic European electricity market. The core objective of this project is to facilitate a significantly increased electricity generation from renewable energy sources (RES-E) in a liberalised electricity market with minimal costs to European citizen. To identify most important strategies the dynamic toolbox Green-X will be developed. Project period 2002-2004.

Department for Wind Energy

- SAT-MAP-CLIMATE. Satellite based bio-geophysical parameter mapping and aggregation modelling for CLIMATE models. The purpose of the project was to extract information from satellite pictures of surface roughness over land, sea and land temperatures, albedo and plant cover and to utilise the resulting maps in weather forecasting and climate models. Project period: 1999-2002 (DMI also participated.).

- WATERMED. Water use Efficiency in natural vegetation and agricultural areas by remote sensing in the Mediterranean basin. The purpose of the project is to map water balance and vegetation in the Mediterranean area, in both Europe and Africa, on the basis of satellite pictures and modelling. Project period: 2000-2003.
- EO-FLUX-BUDGET. Earth Observation data for up-scaling carbon FLUX and water BUDGET at Zealand. The purpose of the project is to determine the CO_2 and water balance for a region (Zealand) on the basis of satellite pictures and modelling. The results complement point measurements of CO_2 and water balance in a climate context. Project period 2000-2004.
- EU project AutoFlux. The objective of the AutoFlux project has been to develop an instrumentation system AutoFlux for routine unattended use on Voluntary Observing Ships or unmanned buoys, for monitoring climate relevant surface fluxes over the oceans. Project period 1998-2002.
- NEAREX. Modelling and measuring the transport of CO_2 to the Greenland Sea from Eastern/Central Europe. Project period: 1998-2002.

The Danish National Space Center

- EU project SITHOS. Sea Ice Thickness Observing System. Project period: 2002-2005.
- EU project GREENICE. Greenland arctic shelf Ice and Climate Experiment. Project period: 2003-2006.
- CRYOSAT. Cal/val and preparation for ESA's cryosphere monitoring satellite CryoSat. Project period: 2001-2004.
- EU project GOCINA. Geoid and Ocean Circulation in the North Atlantic Region. Project period 2002-2005.
- EU project ESEAS. European Sea Level Service - monitoring of sea-level changes by satellite. Project period: 2002-2005.

Danish Energy Agency

The following research projects are being supported by the Energy Research Programme in 2005:

<u>Biogas</u>

- Precision steering of the biogas process, project manager the Danish Institute of Agricultural Sciences.
- Reasons for process instability in biogas plants and strategies for prevention and restoration of the process, project manager Technical University of Denmark.

<u>Liquid biofuels</u>

- Maxi-Fuels: Testing and further development at pilot scale of a Fermentations platform for maximum production of bioenergy (ethanol, hydrogen and methane) from biomass residual products such as straw, project manager Technical University of Denmark BioCentrum.

<u>Bio incineration</u>

- Optinox at biomass-fired plants, project manager COWI A/S.
- Efficient biofuel trading, analysis of biofuel supply, description of e-trade business models and basic understanding of pelleting. Project manager Danish Technological Institute.

<u>Hydrogen</u>

- Use of the natural gas grid for clean hydrogen distribution, phase II, project manager DGC a/s.

<u>Energy efficiency</u>

- Ultra low-energy buildings and passive houses in Stenløse Syd, project manager Stenløse Municipality
- Energy optimisation by means of retrofitting of industrial process facilities, project manager Weel & Sandvig Energi og Procesinnovation Aps
- Innovative and energy efficient refurbishment of public buildings – Danish parallel project to BRITA in PuBs, a demonstration project under the EU Sixth Framework Programme, project manager Danish Building and Urban Research.
- Reduced energy consumption for ventilation of buildings where low-polluting materials and furniture have been chosen systematically, project manager Technical University of Denmark.
- Individual or collective heating supply for new housing areas in the near and distant future, project manager RAMBØLL
- Energy efficient production and distribution of domestic hot water in dwellings in light of the EU Building Directive and coming national requirements regarding energy consumption in buildings, project manager Technical University of Denmark.
- OPTIPOLYGEN (OPTimum Integration of POLYGENeration in the Food Industry), project manager FORCE Technology.
- Development of low-energy classification 1 standard houses, project manager Technical University of Denmark.

<u>Society</u>

- Consequences of quota regulations on developments in the Danish energy sector – scenario analyses, project manager RAMBØLL a/s.

<u>Solar energy</u>

- Solar City Horsens – solar cell roofs in low-energy buildings of the future, project manager Byfornyelse Danmark.
- Solar cells – the significance of the spread of solar cells on price reductions, as well as the need and consequences for operational targets, project manager PA Energy A/S.

<u>Heat pumps</u>

- Demonstration of gas-fired diffusion-absorption heating pumps for one-family houses, project manager DGC a/s.

<u>Wind energy</u>

- Programme for Research in Applied Aeroelasticity, project manager Risø National Laboratory.
- Improved design basis for large wind turbine wings made of fibre composites (Phase 3), project manager Risø National Laboratory.
- Soil-Structure interaction of foundations for offshore wind turbines, project manager Aalborg University.

Project supported by the Energy Research Programme – 2004:

<u>Biomass</u>

- Use of straw in biogas plants and possibilities to increase energy utilisation, project manager the Danish Institute of Agricultural Science.
- Methods to optimise biogas yield at manure-based biogas facilities, project manager Technical University of Denmark (Environment & Resources).

- Collective biogas plants of the future – the interplay between separation of manure and biogas production, project manager the Food and Resource Economics Institute.
- Possible after-treatment of separated solid fraction from biogas production, preliminary project, project manager Rambøll a/s.
- IEA, Fischer Tropsch fuels for transport, project manager Technical University of Denmark (Mechanics, Energy and Construction).
- Bioethanol production part 3 (follow-up of parts 1 and 2), project manager Technical University of Denmark (Biocentrum).
- IEA, Bioenergy Agreement Task: Biomass Combustion and Co-firing. Danish representation 2004-06, project manager dk-TEKNIK ENERGI & MILJØ.
- IEA, Bioenergy Agreement Task: Thermal Gasification of Biomass. Danish representation 2004-06, project manager dk-TEKNIK ENERGI & MILJØ.
- Integration of SOFC fuel cell and two-step process, project manager COWI A/S.
- GreenFuelCell – Integrated gasification fuel-cell plant (SOFC), project manager TK Energi A/S.
- Dissemination of research results within bioenergy, project manager BioPress.
- IEA, Task: Biomass Production for energy from Sustainable Forestry (2004-06), project manager Forest and Landscape Denmark.
- IEA, Task: Greenhouse Gas Balances of Biomass and Bioenergy Systems (2004-06), project manager Forest and Landscape Denmark.

<u>Energy efficiency</u>

- Development of process optimisation in a U-loop fermentor, project manager UniBio A/S.
- High insulated glass structures in multi-storey dwellings, measurements and evaluation, Phase 2, project manager SBI/Danish Building and Urban Research.

<u>Fuel cells</u>

- Development of 2 kW natural gas reformer for high and low temperature PEM fuel cells, project manager DGC – Danish Gas Technology Centre.
- DK-SOFC b, Long-term SOFC development, project manager Risø National Laboratory.

<u>Solar energy</u>

- Standard house with integrated photovoltaic panels, project manager EnergiMidt A/S.
- IEA, SHC, Management of Task PV/Thermal Solar Systems (Maximisation of energy yield from photovoltaic systems), project manager Esbensen Rådg. Ing.
- Development, production and demonstration of a new and improved ARCON HT-SA solar collector, project manager Planenergi.

<u>Wind energy</u>

- Electrical design and optimisation of wind turbines, project manager Aalborg University (Energy Technology).
- Dynamical wake model for detailed aeroelastic simulation of wind turbines in farms, project manager Risø National Laboratory.
- Programme for Research in Applied Aeroelasticity, project manager Risø National Laboratory.

<u>Projects concerning social aspects</u>

- Short-term flexibility in electricity consumption - quantification, stimulation and valuation, project manager Risø National Laboratory.
- Energy taxes, environment and competitiveness, project manager Institute of Local Government Studies Denmark.
- Energy consumption in the domestic sector: An econometric analysis of the effect of the energy label scheme and building regulations, project manager Institute of Local Government Studies Denmark.

<u>Energy storage and system integration</u>

- Electrolysis for energy storage and grid balancing, project manager INCOTECO.
- The Integration of Micro-CHP and Renewable Energy Systems (Micro-CHeaP), project manager dk-TEKNIK ENERGI & MILJØ.

Projects supported by the Energy Research Programme - 2003

<u>Biomass</u>

- Production of bioethanol - part 2, project manager Technical University of Denmark/BioCentrum/CPB (Risø National Laboratory/Plant Research Department, Novozymes).
- LIFTOFF gasification plant in Gjøl 3A) dk-TEKNIK (CIRAD, Gjøl CHP Company, TKE, National Technical Univ. of Athens, ARMINES/Ecole des Mines d'Albi-Carmaux).
- The pyrolysis conditions influence on the tar content in the gas from a staged biomass gasifier, project manager TK Energi AS (CIRAD/CEA).
- Optimisation of straw-fired boilers for district heating, project manager dk-TEKNIK (manufacturers of boiler plant).

<u>Wave power</u>

- Wave power: Development project for prototype design of AquaBuOY and incorporation of Power Take Off system, project manager Rambøll a/s.

<u>Energy efficiency</u>

- Low energy lighting sources and fixtures based on light diode technologies for outdoor lighting, e.g. for road lighting, project manager Lumistrator Aps.
- Deamonification - significant energy-saving new biological method for removing nitrogen from industrial wastewater, project manager C.P. Kelco (Envicare, Hannover University, Herning Municipality, Aalborg University.
- IEA Annex 36 Retrofitting educational buildings, project manager Danish Building and Urban Research.

<u>Solar energy</u>

- Solar cells and architecture - BIPV in refurbishment projects and new buildings, project manager Byfornyelse Danmark.
- Electricity producing sun screens, project manager Danish Building and Urban Research (Dasolas Internat., Gaia Solar, TI-SolEnergi-Centret, Servodan, Esbensen).
- IEA PVPS work in 2004 and 2005 (co-financed with PSO), project manager EnergiMidt A/S.

<u>Wind energy</u>

- Wind measurements. Development and documentation of new and existing methods for remote and in-situ measurements of wind, project manager Risø National Laboratory.

- Research of material technology for surface coating of wind turbine wings and development of testing methods for lifetime of coatings, project manager FORCE (Risø National Laboratory, Aalborg University).
- Improved design basis for large wind turbine wings made of fibre composites (phase II), project manager Risø National Laboratory (Technical University of Denmark; Aalborg University, LM Glasfiber, Vestas).

System integration

- Advanced storage concepts for solar thermal systems in low energy buildings, project manager Department of Civil Engineering/Technical University of Denmark (participants form a number of European countries).
- Expressor heat pump for heat production in small-scale CHPs, project manager TI (Association of Danish CHPs, City Univ./London).

The Danish Coastal Authority

- COMCOAST. The project is sponsored by the EU, and the pilot project aims at carrying out a socio-economic cost-benefit analysis of moving a dike at Rømø farther in land, as an alternative to strengthening the existing dike. Project period 2004-2007.
- Effects of Climate Change on the Coast. The project aims at establishing calculation models for coastal erosion as a function of climate change. Project period 2002-2006.

Institute of Local Government Studies

- International trade and CO_2. The purpose is to analyse the effect on the national CO_2 emissions of trade between countries and the possibilities for reducing the global CO_2 emissions by changing the pattern of trade. The project is intended to deliver results of value to the officials attending international climate negotiations. Project period: 2003.

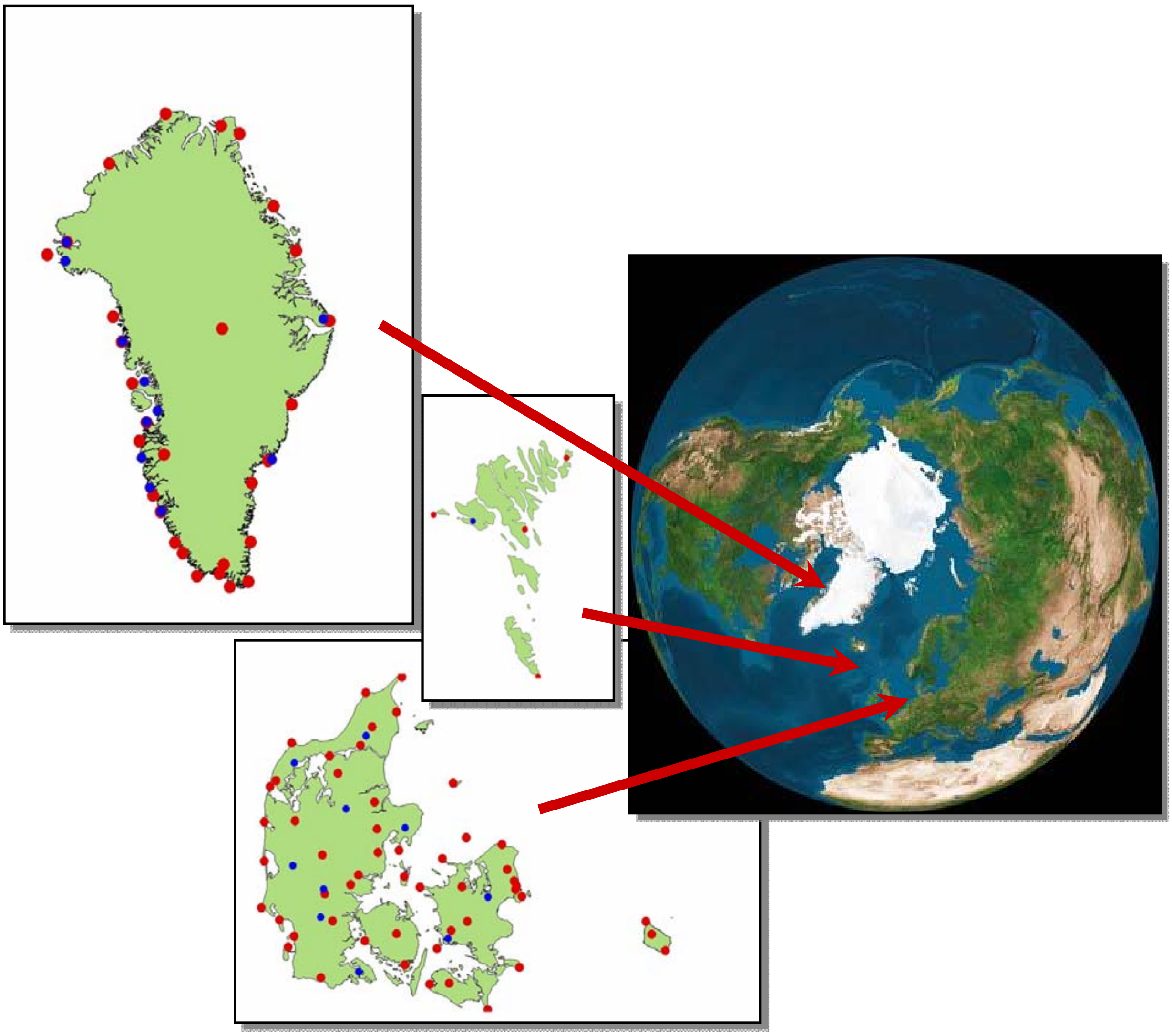
Annex H Denmark's report on systematic climate observations for the global climate observing system (GCOS)

DENMARK'S REPORT ON SYSTEMATIC OBSERVATIONS FOR THE GLOBAL CLIMATE OBSERVING SYSTEM (GCOS) IN CONNECTION WITH THE FIFTH NATIONAL COMMUNICATION UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)

from

The National Report on Global Climate Observing Systems in Denmark, Greenland and the Faroe Islands 2008

Status report to provide input to UNFCCC – SBSTA on national GCOS activities
Compiled by Claus Kern-Hansen, Danish Meteorological Institute (DMI)
October 2008 – Updated March 2009



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Disclaimer

The information in this report represents the best knowledge available to the compiling editor by the time of issue.

Contents

Introduction

This status report has been prepared to give an update on the Danish contribution to the systematic climate observations in the Global Climate Observing System (GCOS).

The present report is the first report based on the reporting guidelines contained in decision 11/CP.13, by the United Nations Framework Convention on Climate Change (UNFCCC) Subsidiary Body for Scientific and Technological Advice (SBSTA) focussing on Essential Climate Variables.

More detailed information is contained in "Denmark's report on systematic climate observations for the Global Climate Observing System (GCOS)" provided as part of Denmark's Fourth National Communication on Climate Change in December 2005.

The purpose of this report has been to provide to the Global Climate Observing System (GCOS) Secretariat additional information at national level for its detailed progress report on the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC, given at SBSTA-30 in June 2009.

1 Common Issues

1.1 National coordination

Climate research and the generation of climate-related observations are carried out by various government departments in order for them to meet their responsibilities.

Currently, no national plan exists for the whole area of climate research and observations.

In its capacity as National Meteorological Service, The Danish Meteorological Institute (DMI) represents Denmark at World Meteorological Organization (WMO), and therefore currently undertakes the role as national focal point for GCOS (NFP-GCOS), with the Terms of Reference to undertake GSN and GUAN issues related to data availability, exchange and quality.

Currently, no national GCOS coordinator or secretariat has been established in Denmark.

1.2 Efforts undertaken to ensure high-quality climate data records.

A number of agencies in Denmark engage in the systematic observation of elements of the climate system.

Invariably the capture, quality control and archiving of such data are designed to meet the integrated needs of these agencies, deriving from their overall missions.

Typically the drivers for long-term systematic observation of environmental or ecological characteristics arise from an operational, regulatory or research need.

Examples of the former are to be found in the capture of meteorological data for predictive and statistical services by the Danish Meteorological Institute (DMI).

The resulting observation programmes tend to be long term, but the resulting individual data may be seen as perishable and focus might not always be on maintaining stability and reliability in the records.

The general need for systematic and reliable time series is increasingly being understood in the scientific community and incorporated in the collection and data processing procedure.

In this report relevant climate observations for Denmark, Greenland and the Faroe Islands will be described.

1.3 Efforts undertaken to ensure the data exchange and availability

In general the data are available from the institutions operating the observing station / collecting the data, but many can also be found on the web, for instance www.dmi.dk.

Where data such as contributions to GCOS are submitted to the appropriate data centres, they are also available from these centres.

Additionally, all meteorological data and products that are produced by WMO Members (national meteorological services) to the WMO programmes such as the WWW are available under the terms of WMO Resolution 40 (WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities).

Such data are freely available without charge (i.e. at no other cost than the cost of reproduction and delivery, without charge for the data and products themselves and with no condition on their use)

Similarly hydrological data and products are covered under WMO Resolution 25.

2 Atmospheric Essential Climate Variables (ECV)

2.1 General information

Denmark participates fully in the GCOS Surface Network (GSN) and the GCOS Upper Air Network (GUAN), and in the Global Ozone Observing System (GO3OS) as part of the Global Atmospheric Watch (GAW).

2.2.1 Contributions to the GCOS Surface Network (GSN)

The seven designated GSN stations in Denmark, Greenland and on the Faroe Islands are all run by DMI and include (Numbers are WMO station numbers):

Greenland: 4211 Upernarvik, 4250 Nuuk, 4320 Danmarkshavn, 4360 Tasiilaq, 4390 Prins Christian Sund;

The Faroe Islands; 6011 Tórshavn

Denmark: 6186 Copenhagen.

All of these stations currently meet the required standard for surface observation.

2.2.2 Contributions to the GCOS Upper Air Network (GUAN)

Only one GUAN station is designated for Denmark, Greenland and the Faroe Islands and it is situated in Narsarsuaq (WMO nr. 6186), Greenland.

The station is run by DMI and is operated in accordance with the required standard.

2.2.3 Contributions to the Global Atmosphere Watch (GAW)

As part of the GAW programme, Denmark contributes to the Global Ozone Observing System (GO3OS) with three stations in Greenland and one in Denmark.

The stations in Greenland are: Kangerlussuaq, Pituffik and Illoqqortoormiut

The station in Denmark is located in Copenhagen

The stations in Greenland participates in the Network for the Detection of Atmospheric Composition Change (NDACC) that is supported by the International Ozone Commission

TABLE 1A. NATIONAL CONTRIBUTIONS TO THE SURFACE-BASED ATMOSPHERIC ESSENTIAL CLIMATE VARIABLES

Contributing networks specified in the GCOS implementation plan	**ECVs[a]**	**Number of stations or platforms currently operating**	**Number of stations or platforms operating in accordance with the GCMPs**	**Number of stations or platforms expected to be operating in 2010**	**Number of stations or platforms providing data to the international data centres**	**Number of stations or platforms with complete historical record available in international data centres**
GCOS Surface	Air temperature	7	7	6-7	7	7
Network (GSN)	Precipitation	7	7	7	7	7
Full World Weather Watch/Global Observing System (WWW/GOS) surface network	Air temperature, air pressure, wind speed and direction, water vapour	37	37	37	37	37
	Precipitation	12	12	15	12	Not known
Baseline Surface Radiation Network (BSRN)	Surface radiation	0	0	0	0	0
Solar radiation and radiation balance data	Surface radiation	5	5	7	7	Not known
Ocean drifting buoys	Air temperature, air pressure	0 **(note1)**	0 **(note1)**	0 **(note1)**	0 **(note1)**	0 **(note1)**
Moored buoys	Air temperature, air pressure	0	0	0	0	0
Voluntary Observing Ship Climate Project (VOSClim)	Air temperature, air pressure, wind speed and direction, water vapour	0	0	0	0	0
Ocean Reference Mooring Network and sites on small isolated islands	Air temperature, wind speed and direction, air pressure	0	0	0	0	0
	Precipitation	0	0	0	0	0

Note 1: Denmark (DMI) participates in the EUMETNET programme SURFMAR, which operates approximately 80 drifting buoys

TABLE 1B. NATIONAL CONTRIBUTIONS TO THE UPPER-AIR ATMOSPHERIC ESSENTIAL CLIMATE VARIABLES

Contributing networks specified in the GCOS implementation plan	ECVs	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2010	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
GCOS Upper Air Network (GUAN)	Upper-air temperature, upper-air wind speed and direction, upper-air water vapour	1	1	1	1	1
Full WWW/GOS Upper Air Network	Upper-air temperature, upper-air wind speed and direction, upper-air water vapour	6	6	6	6	6

TABLE 1C. NATIONAL CONTRIBUTIONS TO THE ATMOSPHERIC COMPOSITION

Contributing networks specified in the GCOS implementation plan	ECVs	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2010	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
World Meteorological Organization/ Global Atmosphere Watch (WMO/GAW) Global Atmospheric CO_2 & CH_4 Monitoring Network	Carbon dioxide	0	0	0	0	0
	Methane	0	0	0	0	0
	Other greenhouse gases	0	0	0	0	0
WMO/GAW ozone sonde network[a]	Ozone	2	2	2	2	2
WMO/GAW column ozone network[b]	Ozone	3	3	3	3	3
WMO/GAW Aerosol Network[c]	Aerosol optical depth	2	2	2	2	2
	Other aerosol properties	0	0	0	0	0

2.3 SATELLITE OBSERVATIONS AS BASE FOR ATMOSPHERE RELATED ECV OBSERVATIONS

Denmark is member state in EUMETSAT and ESA.

Especially through EUMETSAT Denmark takes functional part in activities related to the utilization of satellite data in analyses related to ECVs and climate monitoring.

The table below is indicating **in blue** areas where the Danish participation is more significant.

TABLE 2. GLOBAL PRODUCTS REQUIRING SATELLITE OBSERVATIONS – ATMOSPHERIC ESSENTIAL CLIMATE VARIABLES

ECVs/ Global products requiring satellite observations	Fundamental climate data records required for product generation (from past, current and future missions)
Surface wind speed and direction Surface vector winds analyses, particularly from reanalysis	Passive microwave radiances and scatterometry
Upper-air temperature Homogenized upper-air temperature analyses: extended MSU-equivalent temperature record, new record for upper-troposphere and lower-stratosphere temperature using data from radio occultation, temperature analyses obtained from reanalyses **EUMETSAT GRAS-SAF / CM-SAF**	Passive microwave radiances, GPS radio occultation, high-spectral resolution IR radiances for use in reanalysis
Water vapour Total column water vapour over the ocean and over land, tropospheric and lower stratospheric profiles of water vapour **EUMETSAT GRAS-SAF / CM-SAF**	Passive microwave radiances, UV/VIS radiances, IR imagery and soundings in the 6.7um band, microwave soundings in the 183 GHz band
Cloud properties Cloud radiative properties (initially key ISCCP products)	VIS/IR imagery, IR and microwave soundings
Precipitation Improved estimates of precipitation, both as derived from specific satellite instruments and as provided by composite products	Passive microwave radiances, high-frequency geostationary IR measurements, active radar (for calibration)
Earth radiation budget Top-of-atmosphere Earth radiation budget on a continuous basis	Broadband radiances, spectrally-resolved solar irradiances, geostationary multi spectral imagery
Ozone Profiles and total column of ozone **EUMETSAT O2M-SAF**	UV/VIS and IR microwave radiances
Aerosol properties Aerosol optical depth and other aerosol properties	VIS/NIR/SWIR radiances
Carbon dioxide, methane and other long-lived greenhouse gases Distribution of greenhouse gases, such as CO_2 and CH_4, of sufficient quality to estimate regional sources and sinks	NIR/IR radiances
Upper-air wind Upper-air wind analyses, particularly from reanalysis	VIS/IR imagery, Doppler wind lidar
Atmospheric reanalyses	Key FCDRs and products identified in this report, and other data of value to the analyses

2.4 OTHER NETWORKS FOR MONITORING WEATHER AND ATMOSPHERIC COMPOSITION.

2.4.1 Climatological/meteorological surface stations

DMI operates and receives data from a network of approximately 100 automatic meteorological stations in Denmark, Greenland and on the Faroe Islands. Measurements are made in accordance with the WMO recommendations.

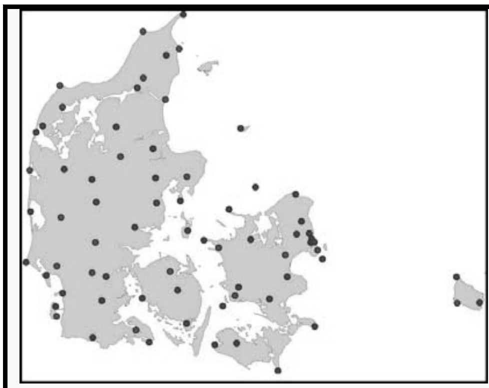


Fig. 1 – DMIs network of weather stations in Denmark	Fig. 2 – DMIs network of weather stations in Greenland	Fig. 3– DMIs network of weather stations on the Faroe Islands

As of 2001 a special dedicated network of (manual) stations for climatological observations has been discontinued, due to the convergence between the different network technologies. The objectives behind this decision are to eliminate human errors, to benefit from potential savings due to this rationalisation, and to reach a higher observation frequency. Climatological data are now obtained from the automatic network described above.

Climatological data are collected to define the climate in Denmark, Greenland and on the Faroe Islands and to create a national database for a wide range of enquiries and research activities. Climatological work mostly consists of preparing annual and monthly statistics, including calculation of averages, percentiles and standard deviations.

Substantial recorded data are needed to establish reliable averages and trends. In 2008 the daily inflow of data from Denmark, Greenland and the Faroe Islands was 100,000 observations, and the central database at DMI currently contains more than 300,000,000 observations. Some of the recorded data are from as early as 1872.

A monthly summary is prepared for the three stations in Denmark, one on the Faroe Islands and eight in Greenland using the CLIMAT format. These data are routinely submitted via the GTS.

2.4.2 Precipitation observation networks (stations and radar)

For national purposes, more data concerning precipitation is needed than can be provided from the overall surface climatological and meteorological network described above. In Denmark the precipitation observation network consists of approximately 350 stations. Roughly 100 of these provide data on precipitation intensity on an ongoing basis. They are jointly operated by DMI and The Water Pollution Committee of the Society of Danish Engineers (Spildevandskomitéen -

SVK). The remaining 250 stations collect daily values of precipitation, and data from these are electronically transmitted to DMI on a daily basis.

On the Faroe Islands a network of 7 precipitation station observe daily precipitation.

Information on precipitation can also be obtained from weather radar data. In Denmark, DMI runs a network of four weather radars which provides 100% coverage of Danish land areas and coastal marine areas. The network's geographical coverage is unsurpassed, and hence provides detailed information about precipitation on national and local scales. By calibrating radar data against point measurements of precipitation the latest scientific results show a high absolute accuracy.

2.4.3 Surface radiation observation networks

Radiation is measured as 10- minute mean values of global radiation at the DMI operated weather station.

2.4.4 Solar ultraviolet (UV) radiation and stratospheric ozone stations

Solar Ultraviolet (UV) radiation at different wavelengths is measured by DMI at two stations in Greenland, namely Pittuffik and Kangerlussuaq. In addition, DMI performs weekly ozone soundings at Illoqqortoormiut as well as sporadic ozone soundings at Pituffik during the winter months.

2.4.5 Upper air strata measurements – Radio sounding observations

DMI runs radio sounding stations at the following six locations: Tórshavn (the Faroe Islands), Danmarkshavn, Illoqqortoormiit, Tasiilaq, Narsarsuaq and Aasiaat (Greenland). Two soundings are made every day at these stations.

A monthly summary (CLIMAT TEMP) from all stations is prepared and transmitted routinely on the GTS.

2.4.6 Ice observations

DMI is responsible for the systematic surveillance of sea ice conditions in the Greenland waters. Observations concerning ice conditions have been collected for approximately 125 years and an extensive volume of data is available in a graphic format as monthly summaries, ice maps etc.

Since 1959 special emphasis has been on the waters south of Cape Farewell (the southern tip of Greenland) in order to improve navigation safety in what is an important navigation area. Ice maps containing detailed information on the relevant ice conditions are prepared several times a week. The most recent maps are available in vector graphic format.

Since 2000 weekly summaries of the ice conditions for all Greenland waters have been prepared. These summaries, which are based on satellite data, are generated semi-automatically and are primarily intended for climatological analyses as the energy radiation from the sea is highly dependent on whether it is covered with ice or not.

2.4.7 Climatological data sets

Over the years, DMI has established a number of very long climatological series with differing periods of information representing Denmark, Greenland and the Faroe Islands.

The long daily time series include: precipitation, temperature, atmospheric pressure and cloud cover for a number of Danish locations as well as precipitation and temperatures for two Greenland Stations 1874-2007

The long monthly time series include: temperatures, precipitation, atmospheric pressure, cloud cover and snow for stations in Denmark, Greenland and on the Faroe Islands

The long annual time series include: temperature for a number of stations in Denmark, Greenland and on the Faroe Islands (1873-2007), as well as temperatures, precipitation, hours of sunshine and cloud cover given as national averages for Denmark

All the above mentioned datasets are freely available through the annual updates of DMI Technical Reports at www.dmi.dk

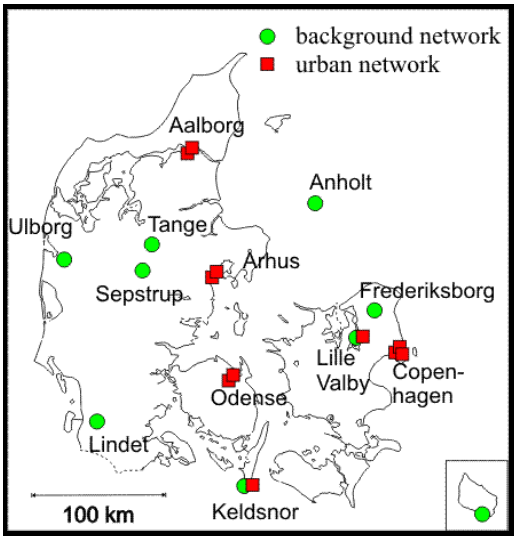
2.4.8 Air quality monitoring

Air pollution is automatically monitored in both urban and rural areas across Denmark. This monitoring network is operated by NERI and measures a wide range of pollutants:

- Nitrogen monoxide (NO)
- Nitrogen dioxides (NO_2)
- Ozone (O_3)
- Sulphur dioxide (SO_2)
- Total Suspended Particulate matter, TSP (PM_{10})
- The chemical composition of particles (sulphate, sea salt, heavy metals etc.)
- Nitrogen compounds (ammonia (gas), particulate ammonium, sum of nitric acid and particulate nitrate)
- Carbon monoxide (CO)

Furthermore, at a number of NERI stations deposition of air pollution via precipitation is monitored. Figure 4 shows the types and distribution of air quality monitoring stations across Denmark.

FIGURE 4 – NERIS NETWORK OF AIR QUALITY MONITORING STATIONS IN DENMARK



Current monitoring data from air monitoring stations, reports from previous quarters as well as development trends for the air quality in Denmark can be found on NERI's website (www.dmu.dk).

3 Oceanic essential climate variables (Oceanic ECV)

3.1 NATIONAL CONTRIBUTION TO OCEANOGRAPHIC ECV

Oceanographic observations for GCOS are based on the GOOS climate module for the open ocean, which comprises the following programmes: drifting and moored buoy programmes managed by the DBCP (Data Buoy Co-operation Panel), the Ship of Opportunity Programme (SOOP), the Argo array of profiling floats, the Global Sea Level Observing System (GLOSS), the Voluntary Observing Ships Programme (VOS) and the Automated Shipboard Aerological Programme (ASAP).

Denmark participates in the ASAP programmes as described in paragraph 3.2.

TABLE 3A. NATIONAL CONTRIBUTIONS TO THE OCEANIC ESSENTIAL CLIMATE VARIABLES – SURFACE

Contributing Networks specified in the GCOS implementation plan	ECVs	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2010	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
Global surface drifting buoy array on 5x5 degree resolution	Sea surface temperature, sea level pressure, position-change based current	0 **(note 2)**	0 **(note 2)**	0 **(note 2)**	0 **(note 2)**	0 **(note 2)**
GLOSS Core Sea-level Network	Sea level	0	0	0	0	0
Voluntary observing ships (VOS)	All feasible surface ECVs	0	0	0	0	0
Ship of Opportunity Programme	All feasible surface ECVs	0	0	0	0	0

Note 2: Denmark (DMI) participates in the EUMETNET programme SURFMAR, which operates approximately 80 drifting buoys

TABLE 3B. NATIONAL CONTRIBUTIONS TO THE OCEANIC ESSENTIAL CLIMATE VARIABLES – WATER COLUMN

Contributing Networks specified in the GCOS implementation plan	ECVs	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2010	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
Global reference mooring network	All feasible surface and subsurface ECVs	0	0	0	0	0
Global tropical moored buoy network	All feasible surface and subsurface ECVs	0	0	0	0	0
Argo network	Temperature, salinity, current	0	0	0	0	0
Carbon inventory survey lines	Temperature, salinity, ocean tracers, biogeo-chemistry variables	0	0	0	0	0

3.2 Automated Shipboard Aerological Programme (ASAP).

The ASAP in its present form began in the mid1980s.

The programme’s objective is to record profile data from the upper air strata in ocean areas using automated sounding systems carried on board merchant ships plying regular ocean routes.

Several national meteorological services operate ASAP units and the collected data are made available in real time via GTS.

ASAP data are archived alongside other radio sounding data by many national meteorological services. ASAP is an important contribution to both the WWW and GCOS.

Today most of the soundings are from the North Atlantic and north-west Pacific, but the programme is expanding to other ocean basins through a new, co-operative World-wide Recurring ASAP Project (WRAP).

Denmark operates two ASAP units mounted on ships plying fixed routes from Denmark to Greenland.

The European meteorological cooperation EUMETNET started a special E-ASAP programme in December 2000.

The programme aims at joint operation of the ASAP programmes under the European meteorological institutes.

3.3 Satellite observations as base for oceanic ECV observations

Denmark is member state in EUMETSAT and ESA.

Especially through EUMETSAT Denmark takes functional part in activities related to the utilization of satellite data in analyses related to ECVs and climate monitoring.

The table below is indicating **in blue** areas where the Denmark participation is more significant.

Table 4. Global products requiring satellite observations – oceans

ECVs/ Global products requiring satellite observations	Fundamental climate data records required for product generation (from past, current and future missions)
Sea Ice Sea ice concentration EUMETSAT O&SI SAF	Microwave and visible imagery
Sea Level Sea level and variability of its global mean	Altimetry
Sea Surface Temperature Sea surface temperature EUMETSAT O&SI SAF	Single and multi-view IR and microwave imagery
Ocean Colour Ocean colour and oceanic chlorophyll-a concentration derived from ocean colour	Multi-spectral VIS imagery
Sea State Wave height and other measures of sea state (wave direction, wavelength, time period)	Altimetry
Ocean Salinity Research towards the measurement of changes in sea surface salinity	Microwave radiances
Ocean Reanalyses Altimeter and ocean surface satellite measurements EUMETSAT O&SI SAF	Key FCDRs and products identified in this report, and other data of value to the analyses

3.4 ADDITIONAL NATIONAL OCEANOGRAPHIC MONITORING

3.4.1 Sea temperatures

Denmark has a network for the collection of sea temperatures at 13 coastal stations around Denmark. The stations are operated by DMI, the Royal Danish Administration for Navigation and Hydrography, the Danish Coastal Authority, and local authorities respectively. Data are available from each of the responsible bodies. Furthermore, sea surface temperatures are monitored using satellites, and DMI prepares daily maps for the North Sea and Baltic Sea areas.

3.4.2 National tide gauge network

In Denmark an extensive national network of tide gauges are operated jointly by DMI, the Royal Danish Administration for Navigation and Hydrography, local authorities and the Danish Coastal Authority. The network consists of 81 automatic stations.

In Greenland a tide gauge station is operated by National Survey and Cadastre (KMS). Data are available from the responsible bodies.

3.4.3 Hydrographic and marine surveys

The National Environmental Research Institute has the overall responsibility for surveillance of the Danish waters. Surveillance of fjords and coastal waters is carried our by the regional authorities, while NERI is responsible for mapping the open waters.

All of the surveys are part of the Danish nationwide monitoring programme NOVANA

All marine NOVANA data (regional and state) are collected annually in the national marine database, MADS, by NERI. For further reading and data see http://mads.dmu.dk .

The Danish Institute for Fisheries Research carries out yearly surveys in Danish waters, primarily in the North Sea and the Baltic Sea. Relevant oceanographic parameters are measured and recorded for these areas.

Furthermore, DMI is involved in the following projects:

- Measurements of water transports across the Greenland-Scotland Ridge
- Monitoring of the oceanographic conditions along West Greenland
- Monitoring of the oceanographic conditions around the Faroe Islands.

4 Terrestrial Essential Climate Variables (ECV)

4.1 General information

The terrestrial observation system is not as well established as the atmospheric or the oceanographic one. The reason is that most of the terrestrial observations are not part of international observation routines with a regular/daily exchange of data.

4.2 Global Terrestrial Network – Hydrology (GTN-H)

The GTN-H is a joint effort of the World Meteorological Organization / Climate and Water Department (WMO/CLW), the GCOS, and the Global Terrestrial Observing System (GTOS12), co-sponsored by WMO, UNESCO, ICSU, UNEP and FAO.

GTN-H represents the observational arm of the Group on Earth Observations / Integrated Global Water Cycle Observations Theme (GEO/IGWCO).

The following hydrological variables have been identified as essential for the GTN-H13 network: Precipitation, river discharge, groundwater, water vapour, lake level/ area, isotopic composition, soil moisture, water use, snow cover, glaciers and ice caps, evapotranspiration, water quality/ biogeochemical fluxes.

For most of the variables a global network is defined and a contact established.

The **Global Precipitation Climate Centre (GPCC)** based at German Meteorological Institute/Deutsche Wetterdienst (DWD) and operating under the auspices of the World Meteorological Organization (WMO), as well as

Global Runoff Data Centre (GRDC), based at the Bundesanstalt für Gewässerkunde (Federal Institute of Hydrology, BfG) in Koblenz, Germany, and operating under the auspices of the World Meteorological Organization (WMO), are both parts of the GTN-H Panel and represent their respective networks on precipitation and river discharge.

DMI contributes to GPCC with precipitation data, and NERI is reporting to GRDC under GTN-R (see paragraph 4.3).

4.3 Global Terrestrial Network for River Discharge (GTN-R)

NERI is reporting to the Global Runoff Data Centre (GRDC), based at the Bundesanstalt für Gewässerkunde (Federal Institute of Hydrology, BfG) in Koblenz, Germany, and operating under the auspices of the World Meteorological Organization (WMO).

GTN-R is a GRDC contribution to the Implementation Plan for the Global Observing System for Climate and to GTN-H.

Denmark is reporting 14 stations as shown in Table 5.

4.4 Global Terrestrial Network for Lakes (GTN-L)

As with several other data types, lake level data are recorded by both local authorities as well as at national level.

NERI is operating a database, from which data from lakes may be available upon request.

4.5 Global Terrestrial Network on Glaciers (GTN-G)

The Geological Survey of Denmark and Greenland (GEUS), is mapping the mass-balance of the Greenlandic Icecap.

As part of these activities, a new net of stations (PROMICE) is under establishment. The PROMICE network will – when fully established – run 20 automatic mass balance stations in Greenland, as shown in Table 5.

4.6 Global Terrestrial Network for Permafrost (GTN-P)

Soil or rock that is permanently frozen throughout the year is called permafrost.

Permafrost is present in Greenland, and monitored at selected sites as part of (primary) individual research projects.

There is no information on any nationwide monitoring or reporting, neither nationally or internationally.

TABLE 5. NATIONAL CONTRIBUTIONS TO THE TERRESTRIAL DOMAIN ESSENTIAL CLIMATE VARIABLES

Contributing networks specified in the GCOS implementation plan	ECVs	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2010	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
GCOS baseline river discharge network (GTN-R)	River discharge	14	14	14	14	14
GCOS Baseline Lake Level/ Area/Temperature Network (GTN-L)	Lake level/area/ temperature	0	0	0	0	0
WWW/GOS synoptic network	Snow cover	If present (12)	If present (12)	If present (12)	If present (12)	Not known
GCOS glacier monitoring network (GTN-G)	Glaciers mass balance and length, also ice sheet mass balance	15	N/A	20	Data are presently available upon request	0
GCOS permafrost monitoring network (GTN-P)	Permafrost borehole temperatures and active layer thickness	0	0	0	0	0

4.7 SATELLITE OBSERVATIONS AS BASE FOR TERRESTRIAL RELATED ECV OBSERVATIONS

Denmark is member state in EUMETSAT and ESA.

Especially through EUMETSAT Denmark takes functional part in activities related to the utilization of satellite data in analyses related to ECVs and climate monitoring.

At present DMI does not operate any activities in the areas shown in Table 6.

Table 6. Global products requiring satellite observations – terrestrial

ECVs/ Global products requiring satellite observations	Fundamental climate data records required for product generation (from past, current and future missions)
Lakes Maps of lakes, lake levels, surface temperatures of lakes in the Global Terrestrial Network for Lakes	VIS/NIR imagery and radar imagery, altimetry, high-resolution IR imagery
Glaciers and ice caps Maps of the areas covered by glaciers other than ice sheets, ice sheet elevation changes for mass balance determination	High-resolution VIS/NIR/SWIR optical imagery, altimetry
Snow cover Snow areal extent	Moderate-resolution VIS/NIR/IR and passive microwave imagery
Albedo Directional hemispherical (black sky) albedo	Multispectral and broadband imagery
Land cover Moderate-resolution maps of land-cover type, high-resolution maps of land-cover type, for the detection of land-cover change	Moderate-resolution multispectral VIS/NIR imagery, high-resolution multispectral VIS/NIR imagery
fAPAR Maps of fAPAR	VIS/NIR imagery
LAI Maps of LAI	VIS/NIR imagery
Biomass Research towards global, above ground forest biomass and forest biomass change	L band/P band SAR, Laser altimetry
Fire disturbance Burnt area, supplemented by active fire maps and fire radiated power	VIS/NIR/SWIR/TIR moderate-resolution multispectral imagery
Soil moisture[a] Research towards global near-surface soil moisture map (up to 10 cm soil depth)	Active and passive microwave

5 Additional information

5.1 Detailed reporting

Denmark provided a detailed report to the UNFCCC 2005 using the same format as the report for the previous National Communication in 2001.

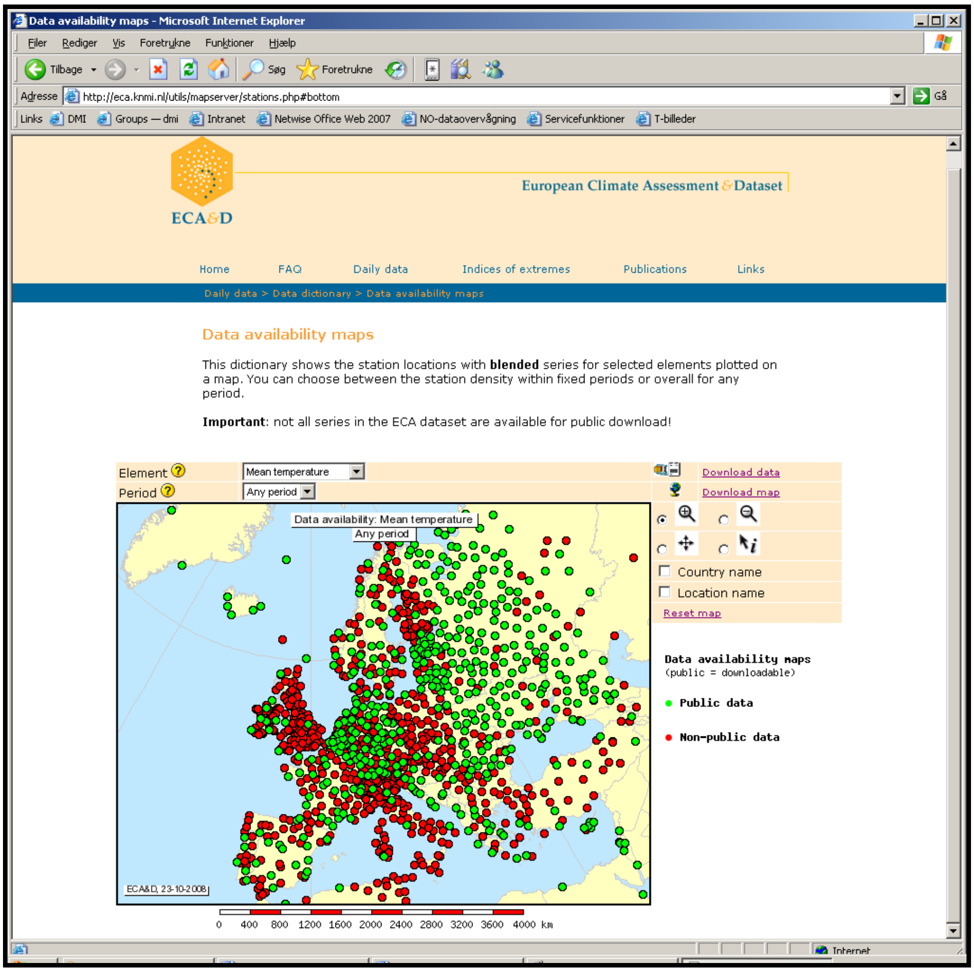
Both reports are available from www.mst.dk in English, and from www.dmi.dk in Danish.

5.2 European Climate Assessment & Dataset (ECA&D).

Through DMI's active participation in the EUMETNET programme ECSN (European Climate Support Network) Denmark contributes very actively to the European Climate Assessment & Dataset (ECA&D) – at present the most comprehensive climate dataset and analysis for Europe.

For further information, please consult http://eca.knmi.nl/.

FIGURE 5 HOMEPAGE OF THE EUROPEAN CLIMATE ASSESSMENT & DATASET (ECA&D).



6 List of acronyms

ASAP	Automated Shipboard Aerological Programme
CHAMP	Challenging Mini-satellite Payload
CLIMAT	Climate message encoded for the WMO network
CLIMAT-TEMP	CLIMAT from upper air soundings
CLIMAP	Climate and environment Monitoring with GPS based Atmospheric Sounding
DIAS	Danish Institute of Agricultural Science
DMI	Danish Meteorological Institute
DBCP	Data Buoy Cooperation Panel
EO	Earth Observations
ERS	European Research Satellite
ESA	European Space Agency
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
GAW	Global Atmospheric Watch of WMO
GCN	Global Core Network (of GLOSS)
GCOS	Global Climate Observing System
GLOSS	Global Sea Level Observing System
GNSS	Global Navigation Satellite System
GO3OS	Global Ozone Observing System
GPS	Global Positioning System
GPS/MET	GPS Meteorology
GRAS	GNNS Receiver for Atmospheric sounding
GSN	GCOS Surface Network
GTS	Global Telecommunications System
GOOS	Global Ocean Observing System
GUAN	GCOS Upper Air Network
HELCOM	Helsinki Commission - Baltic Marine Environment Protection Commission
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
LEO	Low Earth Orbiting
MSD	Meteorological Services Department (Ghana)
NDSC	Network for the Detection of Stratospheric Change
NERI	National Environmental Research Institute
NOVA2003	Danish Aquatic Environment monitoring and Assessment Programme
OSPARCOM	Oslo and Paris Commissions on the North East Atlantic Sea
SAC-C	Satélite de Aplicaciones Científicas-C
SAF	Satelite application facility
SFC	Surface (Drifters)
SOOP	Ship of Opportunity Programme
SVK	The Water Pollution Committee of the Society of Danish Engineers
UV	Ultraviolet
VOS	Voluntary Observing Ships
WMO	World Meteorological Organization
WRAP	World-wide Recurring ASAP Project
WWW	World Weather Watch (of WMO)

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