DANISH MINISTRY
OF THE ENVIRONMENT

Environmental
Protection Agency

Denmark's Climate Policy Objectives and Achievements

Report on Demonstrable Progress in 2005 under the Kyoto Protocol

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Preface

It is a pleasure for me to present this progress report on Denmark's climate policy objectives and achievements. The report has been prepared to be forwarded to the UN secretariat for the Climate Convention and to the European Commission. The report presents progress made in Denmark in the endeavours to fulfil its international climate commitments.

The report is an important signal to the international community that Denmark is complying with its international commitments on climate. With this report, Denmark is able to demonstrate progress as a result of considerable efforts to reduce greenhouse gas emissions.

During the period 2008-2012, Denmark must reduce greenhouse gas emissions by 21% compared to emissions in 1990. As early as in 1990 Denmark adopted its first action plan with reduction of CO_2 emissions as the objective. A new analysis of the efforts from 1990 up to 2001 demonstrates that the total reduction effects from domestic initiatives implemented can be estimated at approx. 21 million tonnes annually in 2008 - 2012.

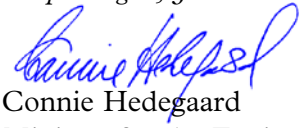
New projections of emissions in Denmark in 2008-2012 demonstrate that the so-called climate deficit including the effect of measures adopted since 2003 as a follow up to the Government Climate Strategy, has been reduced to 8-13 million tonnes of CO_2 equivalents annually in the period of commitment. The deficit reduction is also due to, e.g. anticipated reductions in exports of electricity and anticipated effects of the allocation of funds to JI and CDM projects in 2003-2008 corresponding to approx. 4.5 million tonnes of CO_2 equivalents annually in 2008-2012. The interval of 8-13 million tonnes of CO_2 equivalents annually in the commitment period reflects that the question of Denmark's base year has not yet been clarified.

In connection with the Government Climate Strategy, the deficit was previously set at 20-25 million tonnes of CO_2 equivalents annually in the period 2008-2012.

It is gratifying that Denmark's commitment is now assessed to be less than previously stated and that our efforts to fulfil our very considerable climate commitment are now paying off. It is, however, too early to rest on our laurels. The new climate deficit is still a great challenge and it will take considerable efforts to eliminate the deficit completely. With the new projections, we now have an up-dated basis for continued efforts.

The most important future measure will be allowance regulation with a reduction of allowances for businesses subject to allowance-regulation, as a follow-up to the Government Climate Strategy of 2003. This will happen in connection with the Allocation Plan for 2008-2012, which will be prepared in 2006. In connection with the preparation of this plan, the measures in all major sectors will also be reviewed.

Copenhagen, June 2005



Connie Hedegaard
Minister for the Environment

Introduction

This report is about Denmark's demonstrable progress made under the Kyoto Protocol. The report has been prepared according to the guidelines for reporting under the United Nations Framework Convention on Climate Change and the Kyoto Protocol[1].

The report has been prepared on the basis of *Denmark's Fourth National Communication on Climate Change under the United Nations Framework Convention on Climate Change*. The Fourth National Communication is the first National Communication after the Kyoto Protocol entered into force. Compared to the Third National Communication, the Fourth National Communication is extended with supplementary information in accordance with the additional reporting requirements for parties to the Protocol.

Since the information in the Fourth National Communication corresponds to a great extent to the information that must be included in this report, Denmark has chosen to prepare the two reports in parallel. Except information on Greenland and a few updates the present report contains the same information as the progress report published and forwarded to the European Commission in June 2005. The present report will be forwarded to the UN Climate Secretariat together with the Fourth National Communication whereto references for further information are made.

1 Progress in 2005

Since the report of the Brundtland Commission "Our Common Future" from 1987, Denmark's climate policy has developed as an interaction between all sectors, international climate policy, and results from related scientific research.

Thus, since the end of the 1980s and during the 1990s a considerable number of measures to reduce the emissions of greenhouse gases have been implemented.

The developments in Denmark's emissions and removals of greenhouse gases from the base year to 2003 (the most recent inventory year), as they are to be inventoried under the Kyoto Protocol, are shown in Table 1.1.

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 1.2 with corrections made for exchange of electricity and variations in temperature.

TABLE 1.1: DENMARK'S EMISSIONS AND REMOVALS OF GREENHOUSE GASES INVENTORIED ACCORDING TO REGULATIONS UNDER THE KYOTO PROTOCOL

	Base year[1]	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Million tonnes of CO_2 equivalents	69.6	80.0	73.8	76.2	79.7	76.8	90.0	80.2	76.0	72.9	68.2	69.6	68.9	73.9
Index (base year=100)	100	115	106	109	114	110	129	115	109	105	98	100	99	106

1 In accordance with the Kyoto Protocol, the base year is composed of emissions of CO2, methane and nitrous oxide in 1990 and emissions of so-called industrial greenhouse gases in 1995. In accordance with Denmark's legal commitment under the EU burden sharing of the total EU reduction commitment of 8% under the Kyoto Protocol, the base year is shown here without correction for imports of electricity in 1990. The base year – and thereby Denmark's exact reduction commitment – will be set finally in 2006.

TABLE 1.2: DENMARK'S GREENHOUSE GAS EMISSIONS AND REMOVALS CORRECTED FOR EXCHANGE OF ELECTRICITY AND TEMPERATURE VARIATIONS

	Base year[1]	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Million tonnes of CO_2 equivalents	77.5	80.0	77.9	77.0	76.6	76.2	75.4	74.7	72.8	71.9	70.3	69.6	68.4	67.9
Index (base year=100)	100	102	101	99	99	98	97	96	94	93	91	90	88	88

1 The base year is composed of emissions of CO2, methane and nitrous oxide in 1990 and emissions of so-called industrial greenhouse gases in 1995. Since Denmark's legal commitments under the EU burden sharing of the total EU reduction commitment of 8% under the Kyoto Protocol is to be seen in relation to a base year without corrections, the figures in the table can only be used to illustrate the effects of measures taken to limit CO2 emissions associated with Denmark's own energy consumption.

Denmark's efforts and progress with national measures, e.g. relating to national energy consumption, preferably by choosing other fuels (especially natural gas instead of coal and oil), expansion in decentralised cogeneration of heating and power and renewable energy, and energy saving are reflected in Table 1.2, since there is a 12% drop in total emissions of greenhouse gases from 1990 to 2003.

These results are not less remarkable, if compared to economic development in Denmark, where the GDP has grown, on average, 2% annually during the same period. Furthermore, it has been possible to keep the corrected gross energy consumption fairly constant. In the Annex to this report, a number of indicators illustrate progress concerning emissions, emissions seen in relation to economic development, emissions per capita, share of renewable energy, decentralised cogeneration of heating and power as part of electricity and district heating production, gross energy consumption, CO_2 intensity in energy consumption, etc.

How the various measures have contributed to progress has also been investigated more closely with the *Effort Analysis* published in April 2005. As described in section 4.1 together with the basis for the analysis, this analysis demonstrates that the effect of the Danish efforts in 1990-2001 corresponds to approx. 21 million tonnes of CO_2 annually in 2008-2012. Only about 16 million tonnes of CO_2 annually in 2008-2012 correspond to the effect on emissions of greenhouse gases in Denmark in the former projection from February 2003. The remaining 5 million tonnes would not have been realized as a reduction in Danish emissions, since considerable exports of electricity were expected in 2008-2012, according to the projection from February 2003. In spite of a reduction due to exports of electricity, the effect of the Danish efforts in 1990-2001 is still substantial. This previous effort will also lead to reductions in emissions of greenhouse gases in 2008-2012.

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 part of the internal EU Burden Sharing Agreement, Denmark has committed itself to a 21% reduction.

The Climate Strategy of 2003 stipulated that further cost-effective measures should be implemented with a view to Denmark's compliance with its legal reduction commitment. Since the Kyoto Protocol provides the possibility to arrange climate efforts including international as well as domestic reduction efforts, a significant element of the Government's Climate Strategy is to combine cost-effective domestic measures with the flexible mecha-

nisms of the Kyoto Protocol – Emissions Trading and the project mechanisms Joint Implementation and Clean Development Mechanism.

The implementation of the Climate Strategy includes:

1) Establishment of an interdepartmental climate committee, to ensure follow-up on the Climate Strategy,

2) Implementation of the EU Emission Trading Scheme (EU ETS), which has led to allowance regulation of about half of the Danish greenhouse gas emissions since 1 January 2005 and establishment of a national allowance registry,

3) Initiation of a policies and measures project, which is to investigate the possibilities of implementing additional cost-effective measures and forwarding a report on this to the Climate Committee in 2006,

4) Agreement on the Action Plan for the Aquatic Environment III (VMP III), which will also reduce emissions of nitrous oxide from agriculture,

5) Allocation of funds to JI and CDM projects and making agreements and entering into contracts on specific projects with other countries as well as implementation of such projects.

The interdepartmental climate committee will follow up regularly on whether the new measures implemented are sufficient to secure Denmark's compliance with its commitments under the Kyoto Protocol and the EU Burden Sharing Agreement.

An up-dated projection of Denmark's emissions and removals of greenhouse gases in 2004-2030 was prepared in May 2005. This up-dated baseline projection ('with (existing) measures' projection) is based on, e.g. an updated energy projection, which now includes expected effects of the implemented EU allowance directive (only the cost effects of introducing the allowance system – i.e., without the effect of the actual allowance, which for the period 2008-2012 will not be decided until 2006). Concerning agriculture, the expected effects of the VMP III have now been included in the baseline projection.

The result of this projection of emissions is shown in Table 1.3 together with the expected effects of allocations of funds to JI and CDM projects in 2003-2008.

As shown in Table 1.3, the Danish deficit is estimated at 13 million tonnes of CO_2 equivalents annually, based on Denmark's legal commitment according to the EU Burden Sharing Agreement. This is based on a situation where no correction has been made for the particularly large imports of electricity in 1990.

Taking into account Denmark's assumption regarding corrections being made for imports of electricity in the base year 1990, cf. the political declarations of the Council and the Commission, the deficit is reduced to approx. 8 million tonnes of CO_2 equivalents annually in 2008-2012, as shown in Table 1.3.

In connection with the Government's proposal for a Climate Strategy for Denmark, a projection showing the expected developments without additional measures was presented in February 2003. Here the deficit was set at 20-25 million tonnes of CO_2 equivalents annually in 2008-2012. The new projection from May 2005 thus represents a reduction of approx. 12 million tonnes of CO_2 equivalents annually in 2008-2012.

With the choice of method, the deficit expresses the need to purchase allowances from abroad or to implement new measures outside the sectors subject to allowances. So, as a result of the introduction of the

TABLE 1.3 THE RESULTS OF DENMARK'S LATEST "WITH EXISTING MEASURES ONLY" PROJECTION OF GREENHOUSE GAS EMISSIONS AND THE DEFICIT COMPARED TO THE EU BURDEN SHARING OF THE EU REDUCTION TARGET UNDER THE KYOTO PROTOCOL.

Source: 1990-2003: The National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2005.
2004-2030: Projection of greenhouse gas emissions, Memorandum to the Danish EPA, NERI, May 2005.

Million tonnes of CO2 equivalents	Base year 1990/95[1]	2003	"2010"[2]	"2015"[3]	2020	2025	2030
CO_2[4]	52.9	59.2	59.0	58.8	55.2	54.2	54.9
Methane (CH_4)	5.7	5.9	5.6	5.3	5.2	5.2	5.2
Nitrous oxide (N_2O)	10.7	8.1	6.9	6.8	6.6	6.5	6.5
Industrial gases, HFCs, PFCs, and SF_6	0.3	0.7	0.8	0.5	0.2	0.2	0.2
Total emissions	**69.6**	**73.9**	**72.3**	**71.4**	**67.2**	**66.1**	**66.8**
Of which is export of electricity: (- means import)	-6.3	6.9	4.4	2.3	1.4	0.9	2.7
Kyoto target (–21%)			55.0				
Reductions in other countries from funds allocated to JI and CDM projects			4.5				
Deficit incl. JI and CDM			7.8/12.8[5]				

1 Base year for CO2, methane, and nitrous oxide is 1990. In accordance with the Kyoto Protocol, 1995 is chosen as the base year for industrial gases.

2 "2010" stands for mean emissions in 2008-2012

3 "2015" stands for mean emissions in 2013-2017

4 Here net emission of CO2 inventoried under the Kyoto Protocol, because removal of CO2 in forests planted since 1990 is included cf. protocol article 3.3.

5 The deficit has been inventoried both on the basis of the assumption of taking imports of electricity in 1990 into account, cf. the political statement of the Council and the Commission and on the basis of Denmark's legal commitment under the EU Burden Sharing Agreement.

TABLE 1.4: GREENLAND'S CO_2 EMISSIONS 1990-2003

Source: 1990-2003: The National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2005.

	Base year[1]	1991	1992	1993[2]	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Mill. tonnes of CO_2-equivalents	0.6	0.6	0.6	-	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.6	0.6	0.6
Index (base year =100)	100	98	95	-	79	84	90	92	88	94	106	99	92	102

1 In accordance with the Kyoto Protocol, the base year for Greenland's CO2-emissions is 1990.

2 There are no data available for 1993.

CO_2 allowance scheme, the deficit is in principle not directly comparable to the deficit in the Government's Climate Strategy, since the cost effects of the allowances are included, whereas ultimately the allocation of allowances decides the climatic effects of the scheme. Note that projection, and therefore also the deficit, is based on model predictions, which are subject to uncertainty. This applies, not least, to expected developments in energy prices, prices of CO_2 allowances, and the developments in the Nordic electricity market, which have a direct influence on the size of exports of electricity. The implementation of the EU allowance scheme has, however, created a basis for greater certainty regarding the fulfilment of Denmark's climate commitments under the Kyoto Protocol and the EU Burden Sharing Agreement.

As shown in Table 1.3, there will still be a deficit compared to Denmark's target under the Kyoto Protocol, in spite of the implementation of the additional measures mentioned above.

With the EU allowance scheme, the primary instrument for fulfilling Denmark's climate commitments is secured. Other cost-effective measures will also be considered. In this context, the *Policies and Measures Project's* identification of additional cost-effective measures is expected to contribute to removing the deficit entirely.

Furthermore, sector-policy measures that can be of climatic relevance in the short or long term will be implemented. This includes the long-term energy strategy – *Energy Strategy 2025* and the Action Plan for Strengthened Energy-Saving Efforts[2].

Greenland is a part of the Realm[3]. In 2002, Greenland agreed to that no territorial reservation should be taken in connection with the Kingdom of Denmark's ratification of the Kyoto Protocol[4].

As it is shown in Table 1.4, Greenland's CO_2 emissions are less than 1% of Denmark's total greenhouse gas emissions, and in 2003 they were almost at the same level as in 1990.

Since the 1970s the Home Rule has been interested in using hydropower for energy supply. After several systematic studies and the adoption of energy policy guidelines, the first hydropower plant could be taken into use in 1993. It supplies Nuuk with electricity and has since it was commissioned resulted in an annual reduction of CO_2 emissions of around 55,000 tonnes, or about 10% of the total CO_2 emissions in Greenland. In 2005 another hydropower plant in Tasiilaq commenced operation, with an expected CO_2 reduction of 3,446 tonnes CO_2 per year. A small hydropower plant in South Greenland is now under construction to supply Qaqortoq and Narsaq. When it starts operation in early 2008, it is expected to contribute with displacement of oil corresponding to 4,800 m^3 or 12,700 tonnes CO_2 annually.

Progress has also been made within the waste sector, with the establishment of waste incineration plants at the six largest towns - covering about 70% of the population - and use of some of the surplus heat from the incineration process for district heating. Waste incineration to some extent replaces fuel oil for heating and reduces methane emissions that would otherwise occur if the waste were deposited at landfill sites.

Greenland is facing new and great challenges, partly because of the country's increasing energy consumption and the increasing oil prices, and partly because global climate change is especially affecting the Arctic and threatens Greenland's way of life and hunting culture. Greenland has a global obligation to live up to the Climate Convention and the Kyoto Protocol.

Greenland will work to promote use of renewable and environmentally friendly energy (water, wind power, solar energy, hydrogen) which in the long term will reduce CO_2 emissions and make Greenland less dependent on fossil fuels.

2 Policies and measures with effect on greenhouse gas emissions and removals

2.1 The policy-making process and the legal basis for implementing and enforcing the Kyoto Protocol

The legal basis for the division of powers into the legislative, executive, and judicial power is the Danish Constitution, *Danmarks Riges Grundlov*.
On the motion of the Government, the Danish Parliament (*Folketinget*) gave its consent in 2002, allowing Her Majesty Queen Margrethe the Second, on behalf of the National Community and with territorial reservations for the Faroe Islands, to ratify the Kyoto Protocol. This happened 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 measures, 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.

The total set of regulations can be accessed via Retsinformation[5]. Furthermore, reference to the specific legal basis for each of the concrete measures dealt with is, as far as possible, included in the Fourth National Communication, just as it is mentioned whether it implements EU legislation.

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 can 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 and establishment and operation of a national allowance registry, the general delegation of tasks is as follows, although the Danish Environmental Protection Agency (EPA) also has activities concerning the CDM:

JI and The National Allowance Registry :
The EPA under the Ministry of the Environment

CDM:
The Danish Ministry of Foreign Affairs

The Danish Energy Authority under the Ministry of Transport and Energy is responsible for legislation and administration concerning the EU allowance directive.

2.2 Denmark's climate policy, targets and strategy

2.2.1 Denmark's climate policy

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 and during the 1990s, a considerable number of measures have been implemented that have led to reduced greenhouse gas emissions.

These measures 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 been on making efforts to reduce emissions cost-effectively.

In order to be able to monitor the development in the total effect of these efforts on greenhouse gas emissions from Denmark's national energy consumption, the basis for and the follow-up on Denmark's reduction efforts has included emissions inventories corrected for annual temperature variations and variations in Denmark's imports of electricity.

2.2.2 International climate targets

Since 1990, Denmark has undertaken or committed itself to several targets aimed at reducing greenhouse gas emissions:

- In accordance with the Climate Convention, to reduce total greenhouse gas emissions in Denmark, Greenland, and the Faroe Islands to the 1990 level by 2000. This target was achieved if only emissions are included. Up-dated figures for 2000 concerning emissions from and removals by forests (reduced removal due to windfalls are now included) and new data for land (not previously included) brings the Realm to within 1% of the target, when these emissions and removals are included in the inventory.

- As a contribution to stabilization 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 the industrial greenhouse gases. 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 the respective emission levels

must be given in tonnes of CO_2 equivalents. In this connection, 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.

2.2.3 Denmark's Climate Strategy

The Folketing approved Denmark's present climate strategy in March 2003. The Climate Strategy lays down a framework for Denmark's future efforts on climate. The point of departure in the Climate 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 efforts are to be arranged cost-effectively.

Although many substantial measures have already been taken in order to comply with the climate target, a considerable effort is still needed if Denmark is to fulfil its very ambitious Kyoto target. In the 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 the Strategy – it was estimated that there would be a deficit of 20-25 million tonnes of CO_2 equivalents annually in 2008-2012 compared to Denmark's Kyoto commitment, if no additional measures were implemented[6, 7].

The Kyoto Protocol makes it possible to plan climate action that is more flexible. The Climate Strategy combines cost-effective domestic measures with the 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 and include implementation of concrete projects to reduce greenhouse gas emissions in foreign countries. They are JI projects (joint implementation of projects in other Annex I 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. In addition to this the value of other possible benefits of the implemented measure, e.g., other environmental benefits can be added.

The Government platform of February 2005 is based on the Climate Strategy. A number of elements with climate-policy aspects are also emphasized. These elements include:

- that the Government will put forward a long-term energy strategy up to 2025,
- that the Government will enhance energy-saving efforts and put forward an action plan,
- that the Government will put forward a proposal for the design of future energy and CO_2 taxes in light of the EU's introduction of CO_2 allowances from 1 January 2005,
- that the Government will appoint a committee which is to investigate the possibilities for, over a number of years, re-arranging the total automobile taxation scheme in a revenue-neutral and environmentally advantageous manner, and
- that the Government, with regard to scientific research and development:
- will put forward an action plan aimed at public authorities and private businesses together increasing their efforts regarding scientific research and development,
- via a high technology fund will promote high-technological research and innovation, e.g. within the health-care and energy area, and
- will strengthen the development of green technologies, e.g. within the energy and bio-fuel area.

In 2005, the Government took action on these elements. Some information on the Government's Energy Strategy 2025 and The Energy Saving Action Plan are included in this report. Further information on the Governments follow-up on these and all other elements mentioned above, is given in Denmark's Fourth National Communication on Climate Change.

2.2.4 Progress in general concerning follow-up on the Climate Strategy

2.2.1.1 The Climate Committee

In order to ensure cost-effectiveness in climate policy, as part of the follow-up on the Climate Strategy the Government decided to appoint a standing climate committee to follow up regularly on the deficit and

ensure cost-effective implementation of the climate policy. The committee is composed of the Ministry of Finance, the Ministry of Economic and Business Affairs, the Ministry of Food, Agriculture and Fisheries, the Ministry of Foreign Affairs, the Ministry of Taxation, the Ministry of Transport – now the Ministry of Transport and Energy – including the Danish Energy Authority, and the Ministry of the Environment – including the Danish Environmental Protection Agency (EPA). The EPA chairs the committee and provides the secretariat.

The climate committee is to monitor the Danish climate deficit on a regular basis, i.e., the difference between the Danish target for greenhouse gas emissions in 2008-2012 and the expected emissions. On the basis hereof, the committee is to ensure proper co-ordination and prioritisation between different measures, which can contribute to the fulfilment of Denmark's reduction commitment, including the use of flexible mechanisms (international allowance trade, Joint Implementation and Clean Development Mechanism), allowance regulation, and other national measures across various social sectors. In this connection, the committee is to assess the socio-economic, state-financial, environmental, distributional and competition related consequences of implementing various measures and of various measures and initiatives.

In 2006 the climate committee is also to co-ordinate the preparation of a progress report on the fulfilment of Denmark's reduction commitment and up-date calculations concerning measures with regard to costs and potentials, aimed at a possible revision of Denmark's Climate Strategy.

2.2.1.2 The Policies and Measures Project

In *Denmark's Third National Communication* to the Climate Convention, the main results of the analyses, which formed the basis for the Climate Strategy with respect to potentials and socio-economic reduction costs were presented. 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 should be viewed in light of the fact that Denmark already made a great national effort during the 1990s.

On this basis the Government's cost-effective strategy for the fulfilment of Denmark's reduction commitment emphasises the use of flexible mechanisms – Emissions 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. The actual composition of the efforts depends on the degree to which the businesses included choose to implement their own reduction measures or to purchase 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 a interdepartmental project, *the Policies and Measures Project*, which e.g. continues to investigate the potential of new domestic measures, where previous calculations have shown relatively low reduction costs. It also investigates more closely whether new information exists that could contribute to reducing previously calculated costs further. Finally, the project also investigates whether additional, new cost-effective domestic measures exist.

The project is expected to end in 2006, where the result are to be a part of the Climate Committee's status 2006 report as a basis for the allocation plan 2008-2012.

2.2.1.3 General progress 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 2005-2007 are in the process of preparing 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 is dealt with in greater detail in section 2.3.1.1.

As mentioned, using the flexible mechanisms under the Kyoto Protocol is also part of a cost-effective Danish Climate Strategy. Section 2.3.1.2 reports on progress with respect to allocation of funds and specific JI and CDM projects.

Section 2.3.1.3 reports in greater detail on progress regarding taxes of importance to Denmark's greenhouse gas emissions. The Government tax freeze eliminates tax increases, but re-allocations may prove to be the outcome of the committee's deliberations, which are expected to conclude in 2007.

Within the energy sector, measures have been implemented to enhance further energy saving and improve energy efficiency. Denmark's Fourth National Communication on Climate Change reports on progress with regard to the specific plans, the Action Plan for Strengthened Energy-saving Efforts, and the Energy Strategy 2025, both of which have been finalized in 2005.

The *Policies and Measures Project* also investigates possibilities in the transport sector. In most cases, however, new measures in the transport sector demand a common effort within the EU to become sufficiently effective.

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 3.2.4, this is, however, no longer an issue, since Denmark ceased to produce nitric acid in 2004. Denmark's important contribution to reducing the use and emission of fluorine-containing greenhouse gases is also described in greater detail in the Fourth National Communication.

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. the Fourth National Communication. Therefore, in continuation hereof, additional concrete measures are being studied at present as part of the *Policies and Measures Project*. The provisional results are expected to be presented and discussed at a project day in 2005 that will be open to the public.

Apart from the measures concerning afforestation which have already been implemented and can be referred to article 3.3 of the Kyoto Protocol, in connection with the *Policies and Measures Project,* it is being investigated whether article 3.4 of the Protocol can include cost-effective reduction potentials in connection with forests and land (revegetation, forest management, cropland management, and grassland management).

Concerning the waste sector, the *Policies and Measures Project* is investigating whether there are cost-effective potentials connected to further expansion of extraction and utilization of energy from methane from landfills.

2.2.1.4 Denmark's efforts in 1990-2001 and associated costs

In March 2005 a major analysis of Denmark's efforts in 1990-2001 to reduce emissions of CO_2 and other greenhouse gases, and associated costs was finalized and published in the report "*Danmarks udledning af CO2 – indsatsen i perioden 1990-2001 og omkostninger herved*" (Denmark's CO_2 emissions – the effort in the period 1990-2001 and the associated costs*)*[8], 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 mea-

sure was followed by an ex-post evaluation. A major reason for only performing ex-post evaluations of a few measures is that in many cases it is difficult to ascribe unequivocally an observed reduction in greenhouse gas emissions to a certain measure, since many areas (sectors/sources) are affected by several measures simultaneously.

In the analysis of the importance of selected and 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 emission 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's Climate Strategy and described in *Denmark's Third National Communication* to the Climate Convention.

The outcome of the *Effort Analysis* is described in greater detail in section 4.1.1.

2.3 Measures limiting greenhouse gas emissions

2.3.1 Measures and effects across sectors

2.3.1.1 Allowance regulation

On 1 January 2005 the EU allowance scheme replaced Denmark's national allowance scheme. In accordance with the Climate Strategy, this extended allowance regulation scheme has become part of the new central measures associated with the efforts to reduce Denmark's greenhouse gas emissions.

In its present form the EU allowance scheme will be valid in 2005-2007, and in Denmark it will include CO_2 emissions from, e.g. a number of energy-producing facilities (over 20 MW), refineries, steel works, a number of mineral-processing facilities (cement, lime, glass, tiles) and facilities for the production of paper and cardboard (over 20 tonnes of paper or cardboard daily).

Denmark's national allowance scheme only included the major producers of electricity in the energy sector. Via the national allocation plan, the present allowance regulation in Denmark includes individual emission limits 2005-2007 for CO_2 emissions from 377 Danish production facilities within several sectors, which together produce approx. half of Denmark's total greenhouse gas emissions[9].

The Danish Allocation Plan entails a total allowance allotment of 15% be-

low the baseline projection (with existing measures) for the sectors subject to allowances – with the greatest reduction from the production of electricity. Provided that emissions from the other sectors remain fairly constant, the reduction as a result of the Allocation Plan 2005-2007 constitutes approx. 7.4% of all projected emissions. Thus, Denmark will be on its way to fulfilling its climate target for the period 2008-12 as set by the EU burden sharing of the reduction target under the Kyoto Protocol.

The anticipated reduction effect of 7.4% of the new allowance regulation corresponds to a reduction of 6 million tonnes of CO_2 annually in 2005-2007.

The effect in 2008-2012 cannot be estimated before the Allocation Plan for this period has been prepared in 2006.

Changes to the EU allowance directive and/or to Denmark's implementation of it may have been made by then – e.g. regarding activities, sectors, and greenhouse gases to be included in the scheme.

Denmark has had an active, environmentally-oriented energy policy since the 1970s, and since 1990 this has been supplemented by a climate policy, 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 that are not subject to allowances. Therefore the cheap reduction potentials are to a certain degree exhausted in these sectors. The additional reduction efforts needed to fulfil Denmark's climate commitment will, therefore, primarily affect sectors subject to allowances.

Denmark's national allowance registry
In connection with the new allowance regulation that entered into force on 1 January 2005, Denmark's national allowance registry[10] (DK ETR – Emission Trading Registry), which is used to allot allowances to production facilities subject to allowances and enables trade in allowances among the allowance holders found in the registry, also opened. The allowance registry has also been prepared to contribute to Denmark's implementation of the Kyoto Protocol in such a way that Denmark's EU allowance registry can also be made to function as the national allowance registry ("National Registry"), which is to be established pursuant to the Kyoto Protocol as a prerequisite for the application of the Kyoto mechanisms. Additional information on the national allowance registry is found in the Fourth National Communication.

2.3.1.2 The Kyoto mechanisms
As mentioned above, the starting point in the Government's Climate Strategy is that efforts aimed at fulfilling the international climate commitment under the Kyoto Protocol and the subsequent EU Burden Sharing Agreement are organized cost-effectively.

The flexible mechanisms are, therefore, important elements of the Government's 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. The market for CO_2 credits is, however, still in the making. By involvement in project development, the Government will contribute to "starting 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 DKK 1,130 million for the purchasing of CO_2 credits from JI and CDM projects in 2003-2008.

With a mean allowance price in the projects of DKK 50 per tonne of CO_2, the allocated funds correspond to approx. 4.5 million tonnes of CO_2 annually for 5 years (2008-2012). A target-fulfilment projection that includes the effects of these additional measures in 2008-2012 is 4.5 million tonnes of CO_2 lower than the baseline projection, which is a projection of Denmark's greenhouse gas emissions and removals inventoried under the Kyoto Protocol with implemented and adopted measures.

The implementation of specific JI and CDM projects is described in more detail in the Fourth National Communication.

2.3.1.3 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 (53%) 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 30%.

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 placed on mineral oil, tobacco, and alcohol in accordance with EU legislation.

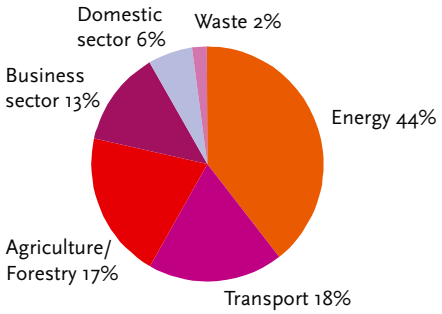
Taxes influencing Denmark's greenhouse gas emissions include energy taxes and taxes on mineral oil, gas, coal, and electricity as well as CO_2 taxes, and taxes on consumption of the potent greenhouse gases (HFCs, PFCs, and SF_6). Registration taxes and annual taxes for cars are differentiated to promote development towards more energy-effective cars. These taxes are specified in the Fourth National Communication.

2.3.2 Policies and Measures and their effects in Denmark's economic sectors

Denmark's Fourth National Communication describes the other measures of importance to greenhouse gas emissions and removals in the following 6 economic sectors: energy, transport, business, agriculture/forestry, the domestic sector, and waste. Table 2.1 shows how the sector categories, which is to be used in connection with the annual emission inventories, is aggregated into the 6 economic sectors.

The main results of this aggregation in 1990/95[11], 2003, 2008-12, and 2013-17, as well as in 2020, 2025, and 2030 without emission and removal in connection with land use, land-use change and forestry (LULUCF) are shown in Table 2.2, however the effect of removal by afforestation since 1990 is included[12]. The data on which this table is based are shown graphically in the first figure in the Annex. Figure 2.1 illustrates the emissions by sector in 2003.

FIGURE 2.1 DENMARK'S GREENHOUSE GAS EMISSIONS IN 2003 BY ECONOMIC SECTOR.
Source: The National Environmental Research Institute and the Danish Environmental Protection Agency



2.3.3 Energy

The energy sector's extraction, conversion and distribution of energy led to greenhouse gas emissions which in 2003 made up 44% of Denmark's total emissions, of which CO_2 was the primary emission. 97.5% of the emissions from the energy sector are CO_2, 1.5% are methane (CH_4), and the remaining 1% is nitrous oxide (N_2O).

The introduction of the CO_2 allowance regulations as a common EU instrument has thus been pivotal for Denmark's possibilities to comply with the climate commitments:

Table 2.1 Aggregation of sources/sectors in the CRF/IPCC format into the 6 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. Fugetive 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

- EU CO_2 allowances for the production of electricity and heating (includes parts of the business sector's energy consumption and process emissions, cf. section 2.3.5, and parts of the domestic sector's energy consumption, cf. section 2.3.7)

New measures, which can have consequences for greenhouse gas emissions, are also being implemented within the framework of the energy policy:

- Biomass agreement
- Price supplement for environmentally-friendly electricity
- Tenders for offshore wind turbines
- Scrapping scheme for old wind turbines
- Energy research

The measures are described in more detail in Denmark's Fourth National Communication.

The most recent progress includes a common CO_2 allowance scheme that came into effect on 1 January 2005. Since this allowance scheme covers several sectors, it was dealt with above in the cross-sectoral section. Most of the activities and facilities included under this measure, however, belong in the energy sector. This also applies to where the anticipated effect with a reduction of approx. 6 million tonnes of CO_2 annually in 2005-2007 is expected to occur.

As announced in the Government's platform in February 2005, a new long-term energy strategy – *Energy Strategy 2025* was presented in June 2005[13].

Table 2.2 Denmark's Greenhouse Gas Emissions in 1990/95, 2003 and the May 2005 "With Measures" Projections until 2030 by Economic Sector and by gas[1].

Source: The National Environmental Research Institute and the Danish Environmental Protection Agency

	1990 /95 Mt CO_2 equiv-alents	1990 /95 %	2003 Mt CO_2 equiva-lents	2003 %	Chang-es from 1990 /95 to 2003	2008-2012 Mt CO_2 equiva-lents	2008-2012 %	Chang-es from 1990 /95 to 2008-2012	2013-2017 Mt CO_2 equiva-lents	2013-2017 %	Chang-es from 1990 /95 to 2013-2017	2020 Mt CO_2 equiva-lents	2020 %	Chang-es from 1990 /95 to 2020	2025 Mt CO_2 equiva-lents	2025 %	Chang-es from 1990 /95 to 2025	2030 Mt CO_2 equiva-lents	2030 %	Chang-es from 1990 /95 to 2030
Energy	**26.8**	**38.6**	**32.8**	**44.4**	**22%**	**30.3**	**41.9**	**13%**	**29.5**	**41.3**	**10%**	**25.3**	**37.6**	**-6%**	**23.9**	**36.1**	**-11%**	**24.3**	**36.4**	**-10%**
CO_2	26.4	38.0	32.0	43.2	21%	29.5	40.9	12%	28.8	40.4	9%	24.7	36.8	-6%	23.3	35.2	-12%	23.7	35.5	-10%
Methane (CH_4)	0.1	0.2	0.5	0.7	278%	0.4	0.6	226%	0.3	0.5	153%	0.3	0.4	116%	0.3	0.4	106%	0.3	0.4	110%
Nitrous oxide (N_2O)	0.3	0.4	0.3	0.4	19%	0.3	0.4	14%	0.3	0.4	14%	0.3	0.4	3%	0.3	0.4	-1%	0.3	0.4	-3%
Transport	**10.8**	**15.5**	**13.4**	**18.1**	**24%**	**14.6**	**20.2**	**36%**	**15.0**	**21.0**	**40%**	**15.4**	**22.9**	**43%**	**15.8**	**23.8**	**46%**	**16.1**	**24.0**	**49%**
CO_2	10.6	15.2	12.9	17.4	22%	14.0	19.4	33%	14.4	20.2	36%	14.8	22.0	40%	15.1	22.9	43%	15.4	23.1	46%
Methane (CH_4)	0.1	0.1	0.1	0.1	15%	0.1	0.1	-10%	0.0	0.0	-37%	0.0	0.0	-54%	0.0	0.0	-59%	0.0	0.0	-60%
Nitrous oxide (N_2O)	0.1	0.2	0.4	0.6	191%	0.5	0.7	266%	0.6	0.8	286%	0.6	0.9	300%	0.6	0.9	312%	0.6	0.9	323%
Agriculture/Forestry	**15.6**	**22.4**	**12.4**	**16.8**	**-20%**	**12.0**	**16.6**	**-23%**	**11.5**	**16.2**	**-26%**	**11.3**	**16.7**	**-28%**	**11.0**	**16.7**	**-29%**	**10.9**	**16.3**	**-30%**
CO_2	2.7	3.9	2.5	3.3	-83%	2.5	3.4	-9%	2.4	3.3	-12%	2.3	3.4	-15%	2.3	3.4	-16%	2.1	3.2	-21%
Methane (CH_4)	3.9	5.6	3.8	5.1	-3%	3.6	5.0	-6%	3.5	4.9	-10%	3.4	5.1	-12%	3.3	5.0	-14%	3.3	5.0	-14%
Nitrous oxide (N_2O)	9.0	13.0	6.2	8.4	-31%	5.9	8.2	-35%	5.7	7.9	-37%	5.6	8.3	-39%	5.4	8.2	-40%	5.4	8.2	-40%
Business	**9.6**	**13.8**	**9.7**	**13.1**	**1%**	**9.8**	**13.6**	**2%**	**9.9**	**13.8**	**3%**	**9.8**	**14.6**	**2%**	**10.0**	**15.2**	**4%**	**10.1**	**15.2**	**5%**
CO_2	8.2	11.7	8.0	10.8	-3%	8.9	12.3	9%	9.2	12.9	13%	9.5	14.1	16%	9.7	14.7	19%	9.8	14.7	20%
Methane (CH_4)	0.0	0.0	0.1	0.1	167%	0.1	0.1	232%	0.1	0.1	238%	0.1	0.1	242%	0.1	0.1	247%	0.1	0.1	247%
Nitrous oxide (N_2O)	1.1	1.6	1.0	1.3	-14%	0.1	0.1	-93%	0.1	0.1	-93%	0.1	0.1	-93%	0.1	0.1	-93%	0.1	0.1	-93%
Industrial gases	0.3	0.5	0.7	1.0	129%	0.8	1.1	136%	0.5	0.7	61%	0.2	0.3	-45%	0.2	0.3	-45%	0.2	0.3	-45%
Domestic sector	**5.2**	**7.4**	**4.1**	**5.6**	**-20%**	**4.2**	**5.9**	**-18%**	**4.2**	**5.9**	**-19%**	**4.1**	**6.1**	**-21%**	**4.0**	**6.1**	**-22%**	**4.0**	**6.0**	**-23%**
CO_2	5.0	7.2	4.0	5.4	-21%	4.1	5.6	-19%	4.0	5.6	-20%	3.9	5.8	-22%	3.8	5.8	-24%	3.8	5.7	-25%
Methane (CH_4)	0.1	0.1	0.1	0.1	48%	0.1	0.2	87%	0.1	0.2	96%	0.1	0.2	100%	0.1	0.2	106%	0.1	0.2	112%
Nitrous oxide (N_2O)	0.1	0.1	0.1	0.1	-11%	0.1	0.1	-2%	0.1	0.1	0%	0.1	0.1	1%	0.1	0.1	2%	0.1	0.1	3%
Waste	**1.6**	**2.3**	**1.5**	**2.0**	**-10%**	**1.3**	**1.8**	**-19%**	**1.3**	**1.8**	**-19%**	**1.4**	**2.0**	**-17%**	**1.4**	**2.1**	**-15%**	**1.4**	**2.1**	**-13%**
Methane (CH_4)	1.5	2.2	1.4	1.9	-9%	1.3	1.7	-18%	1.3	1.8	-18%	1.3	1.9	-16%	1.3	2.0	-14%	1.3	2.0	-12%
Nitrous oxide (N_2O)	0.1	0.1	0.1	0.1	-31%	0.1	0.1	-30%	0.1	0.1	-30%	0.1	0.1	-30%	0.1	0.1	-30%	0.1	0.1	-30%
Total	**69.6**	**100**	**73.9**	**100**	**6%**	**72.3**	**100**	**4%**	**71.4**	**100**	**3%**	**67.2**	**100**	**-3%**	**66.1**	**100**	**-5%**	**66.8**	**100**	**-4%**
CO_2	52.9	76.0	59.2	78.2	12%	59.0	81.6	12%	58.8	82.4	11%	55.2	82.1	4%	54.2	82.0	3%	54.9	82.1	4%
Methane (CH_4)	5.7	8.2	5.9	8	3%	5.6	7.7	-2%	5.3	7.4	-6%	5.2	7.8	-8%	5.2	7.8	-9%	5.2	7.8	-9%
Nitrous oxide (N_2O)	10.7	15.4	8.1	11	-25%	6.9	9.6	-35%	6.8	9.5	-37%	6.6	9.9	-38%	6.5	9.9	-39%	6.5	9.8	-39%
Industrial gases	0.3	0.5	0.7	1.0	129%	0.8	1.1	136%	0.5	0.7	61%	0.2	0.3	-45%	0.2	0.3	-45%	0.2	0.3	-45%

1 Trends in GHG emissions by gas and by sector can also be seen in Figure 5.1 in Chapter 5.

The strategy is an overall and coherent presentation of the government's long-term energy policy. At the core of the strategy is a clear marketbased energy-political objective, in which public authorities provide the framework for the market actors.

Thus, the Energy Strategy is based on:

- liberalised energy markets with common EU framework
- market-based cost-effective instruments, and
- public authorities providing the overall grid infrastructure and economic instruments, including the CO2 allowance scheme.

In line with this, the strategy does not propose quantitative objectives for the extension of renewable energy, however it sets the stage for and envisages a market-based increase in the use of renewable energy.

It also underlines the importance of strengthened research and development of new energy technologies. In this regard, the Government, also in June 2005, published three new research and development strategies: one for hydrogen technologies, one for liquid biofuels, and one for wave energy.

Finally, Energy Strategy 2005 focuses on the transport sector – a committee will be set up to discuss the overall perspectives for alternative propellants in the transport sector, including biofuels.

The Government will also promote energy-saving efforts, so Denmark can still be in the forefront concerning efficient energy use. In 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) shall be reduced. Strengthened efforts will be made to reach specific and verifiable energy savings corresponding to 7.5 PJ per year on average in the period 2006-2013.

Important parts of the energy savings will be achieved by better energy-saving results in grid and distribution companies within electricity, natural gas, district heating and oil. Moreover, energy savings will be achieved through stricter rules on energy in building regulations, new and better energy labelling, better inspection of boilers and ventilation equipment, special efforts within the public sector, and reorganisation of energy companies' energy-saving efforts.

Together, the government's action plan and the political agreement entail a significant strengthening of theoverall energy-saving efforts[14].

2.3.4 Transport

In 2003, the transport sector was responsible for 22% of Denmark's CO_2 emissions and 18% of total greenhouse gas emissions. The emissions from the transport sector are primarily CO_2. 13 million tonnes of CO_2 corresponded to 96.3% of emissions in 2003. Nitrous oxide made up 3.2% or 0.4 million tonnes of CO_2 equivalents and methane approx. 0.5% or 0.07 million tonnes of CO_2 equivalents.

In 2003, the transport sector's energy consumption – primarily oil products – made up 31.5% of total energy consumption in Denmark. Traffic, especially passenger transport, has risen uniformly in recent years. Associated energy consumption and greenhouse gas emissions have risen correspondingly. In 2003 total greenhouse gas emissions from the transport sector were 24% higher than in 1990. The most recent prognosis from 2002 predicts continued growth in the sector's CO_2 emissions, in spite of the fact that technological development has led to a reduction in energy consumption per km. Thus, the expected growth in traffic is expected to be approx. 17% from 2003 to 2012, whereas the growth in the transport sector's energy consumption is expected to be approx. 9% during the same period.

One of the most important international measures yet is the EU target of attaining a mean CO_2 emission from new passenger cars of 120 g of CO_2 per km before 2010. With the aim of fulfilling this target, agreements have been made with the automobile industry in Europe, Japan, and most recently Korea, which commit the industry to reducing the mean CO_2 emission per km. This measure is assessed to have had, and will in the future have, considerable effect and has been implemented with the reduction of CO_2 emissions as one of the primary targets.

The national environmentally motivated measures for the transport sector, which have also influenced CO_2 emissions, are usually characterized by aiming at limiting environmental impacts in general. "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 measures aiming directly or indirectly at reducing CO_2 emissions have been implemented within various areas. Denmark's Fourth National Communication contains additional information on the following:

- Higher fuel taxes
- Green owner tax on motor vehicles
- Information campaign on the fuel consumption of new cars
- Energy-correct driving techniques

- Initiative on enforcing speed limits
- Establishment of intermodal installations
- Promotion of environmentally friendly freight transport
- Reduced travelling time for public transport
- Spatial planning.

2.3.5 Business sector

The business sector covers industry, building and construction, and public and private services.

In 2003, this sector was responsible for approx. 13% of Denmark's total greenhouse gas emissions. 82% of these emissions were CO_2. This sector is, furthermore, the sole source of emissions of industrial gases. Climate measures within the business sector include:

- EU CO_2 allowances (parts of the business sector's energy consumption and process emissions are subject to the EU CO_2 allowance regulation, cf. section 2.3.3 on "Energy")
- Tax on HFCs, PFCs, and SF_6
- Regulation of use of HFCs, PFCs, and SF_6

The following substantial energy-saving measures which contribute to reducing domestic climate gas emissions (both outside and within areas subject to allowances), have also been implemented:

- Agreements on energy-efficiency improvements in the business sector
- Electricity grid, gas and district heating companies' energy-saving activities
- Circular on energy-efficiency in state institutions
- Electricity Saving Trust (Elsparefonden) – campaigns and A-club for institutions to promote efficient appliances (incl. electricity-heat conversion and efficient appliances in households)

The main efforts concerning the business sector's energy consumption have been based on the 1995 green business-sector tax package. This was a combination of duties and refunds of tax revenues to the business sector, e.g. as normal state subsidies to promote energy saving in businesses. Tax refunds could be obtained on the basis of agreements on energy-efficiency improvements.

The total effect of the green package was evaluated in 1999. The main conclusion is that the package had the intended effects. Considerable environmental gains were achieved in an economically efficient manner, taking account of international competitiveness. The environmental consequences of the energy package

have largely satisfied the expectations at the outset, and thereby they constitute an important part of the efforts to reduce the Danish CO_2 emissions.

The agreement scheme was evaluated in 2005. The main conclusion is that businesses with agreements in 1996-1999 saved approx. 5.5% in energy, 2.5% of which are due to the agreements. For the period 2000-2003 the corresponding figures are approx. 4.5% and 2% respectively.

In the Government's Climate Strategy from February 2003, it was estimated that there was still a potential for relatively inexpensive emission reductions in the energy-intensive part of the industry, which, until then, had paid lower CO_2 taxes than other parts of the business sector and the domestic sector, out of regard for competitiveness.

Certain energy-intensive businesses are subject to allowance regulation as a consequence of the EU allowance directive. With the common EU allowance scheme, CO_2 regulations without too serious effects on competitiveness could be imposed on energy-intensive industry. Allowance regulation is the main measure to be used with regard to these businesses.

Energy efficiency in the public sector has been an issue for more than 10 years, and substantial savings have been achieved.

In connection with the Finance Act for the fiscal year 2005, a political agreement on several areas including energy-saving measures was made. The agreement focuses particularly on energy saving in state institutions, as a consequence of the efforts of the Electricity Saving Trust (Elsparefonden), on new energy demands for state buildings, and on a new circular on energy-efficiency in state institutions.

Furthermore, the action plan for a renewed energy-saving effort proposes a number of activities aimed at public institutions.

Up to now, efforts with regard to the cement industry's energy consumption have been based on the green business sector tax package with a combination of taxes and agreements on energy efficiency. From 1 January 2005, all CO_2 emissions from cement production in Denmark are subject to the EU allowance directive.

The emission of nitrous oxide (N_2O) from the production of nitric acid in connection with the production of fertilizer in Denmark ceased in 2004. From 2005 this corresponds to a reduction in the annual emissions amounting to approx. 0.9 million tonnes of CO_2 equivalents.

The industrial sector is the only sector which in practice emits the industrial gases HFCs, PFCs, and SF_6. These gases are used for several purposes including as cooling and foaming agents, etc. (HFCs), cool-

ing 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 and also a statutory order on the phasing out of use of the gases in new facilities and products.

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.

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.

2.3.6 Agriculture, forestry, and fisheries

The primary occupational sectors agriculture, forestry, and fisheries are mainly dealt with as one economic sector in Denmark. The measures concerning agriculture and forestry include:

- Action Plan for the Aquatic Environment I+II and Action Plan for Sustainable Agriculture
- Action Plan for the Aquatic Environment III
- Ban on the burning of straw in fields
- Ammonia action plan and new Statutory Order on Manure
- Planting of windbreaks
- Biogas installations
- Grant scheme for private afforestation on agricultural land
- Afforestation by public authorities (state, counties, and municipalities)

Agriculture

In 2003, agriculture was responsible for 17% of Denmark's total greenhouse gas emissions. Approx. 80% consisted of methane and nitrous oxide and 20% of CO_2 from the burning of fuel.

In 2003, 176,000 tonnes of methane corresponding to 3.7 million tonnes of CO_2 equivalents were emitted. The emissions from agriculture consist primarily of methane from enteric fermentation and decomposition of manure.

Dairy cattle are the major contributors of methane.

Methane is a by-product from the digestion process, especially coming from roughage. Methane is also produced when manure decomposes anaerobically, if the temperature is sufficiently high. These conditions usually exist in manure stores and in

cow houses with slurry or deep bedding.

The emission of methane from agriculture is expected to be reduced in 2003-2012, corresponding to approx. 0.1 million tonnes of CO_2 equivalents, primarily due to improved efficiency in cattle farming.

Agriculture is the primary source of nitrous oxide emissions in Denmark. Of the total emissions of 26,000 tonnes in 2003, 77% or 20,000 tonnes, corresponding to more than 6.2 million tonnes of CO_2 equivalents came from agriculture.

The main sources of nitrous oxide are nitrogen in commercial and natural fertilizers and plant residues. Of the contributions of nitrous oxide from agriculture in 2003, 43% came from fertilizer and 31% from runoff. Evaporated ammonia also contributes to the greenhouse effect, since some of the ammonia nitrogen ends up in the atmosphere as a component of nitrous oxide.

The emissions of nitrous oxide from agriculture are expected to be reduced, corresponding to about 3 million tonnes of CO_2 equivalents or 32% during the period from 1990 to 2008-2012. Implementation of the Action Plan for the Aquatic Environment II and III will contribute the most to this reduction[16,17].

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, phosphorous, sensitive natural areas, and manure odour. The effect of the plan is estimated to be a reduction in emissions corresponding to 0.2 million tonnes of CO_2 equivalents annually[18] in 2008-2012.

Emitted ammonia will, by deposition, stimulate the emission of nitrous oxide. A reduction in the evaporation of ammonia will, therefore, reduce emissions of nitrous oxide. An Ammonia Action Plan adopted in 2001 will, together with 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 included in 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[215].

In 1987, an action plan on the expansion of common biogas installations was implemented. The Energy Policy Agreement of 29 March 2004 supports the production of biogas by raising the price of electricity from biogas installations from 2008. Expansions are, however, not being made as quickly as anticipated, but still to a degree allowing the baseline projection to be doubled in 2010 to approx. 0.5 million tonnes of CO_2 equivalents annually. About half of this effect is due to expected reductions in methane and nitrous oxide emissions. The other half is due to reduced CO_2 emissions from substitution of fossil fuels in energy supply.

Forestry

The influence from forestry stems from the removal and emission of CO_2 through the photosynthesis and respiration of the trees and their decomposition. Danish forests contain considerable stores of CO_2 retrieved from the atmosphere. Afforestation increases these stores.

The total CO_2 balance for forests is complicated and depends on many factors. In Denmark, forests have several purposes including recreation, landscape values, the production of wood products, e.g. firewood and timber, as well as hunting and nature. The net CO_2 budget for forests depends on many factors, including the age distribution of the trees, the species of trees planted, and the production considerations taken.

The political target that most directly influences an increased carbon binding is the declaration of intent from 1989, which states the Danish forested area is to be doubled within a 100-year period.

Several measures contribute to the fulfilment of this target. A state subsidy scheme supports afforestation on privately owned agricultural land. Afforestation is also carried out by the state and by private landowners without subsidisation.

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. 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 the implementation of the policy on afforestation on privately owned farmland and state property.

Afforestation on 12,000 hectares of privately owned farmland, corresponding to additional binding of 131,000 tonnes of CO_2, was subsidized in 1990-2004.

The state, counties, and municipalities have contributed approx. 6,400 hectares of new forest since 1990. Our knowledge of unsubsidised private afforestation is limited, but it is estimated at approx. 600 hectares annually.

Both the subsidized private afforestation and afforestation by public authorities will be less in the next 6-8 years, since work in connection with the Natura 2000 Areas has been given high priority.

Additional information on subsidized private afforestation, afforestation by public authorities, and total afforestation can be found in Denmark's Fourth National Communication.

Fisheries

The emission of greenhouse gases from fuels sold for use in fishing vessels are included in the figures on total greenhouse gas emissions and removals. The contribution from fishing vessels to total greenhouse gas emissions is primarily CO_2. No special measures have been implemented in relation to fishing vessels. But the reduction in fisheries in recent years has also resulted in lowering fuel consumption rates and thereby also CO_2 emissions.

2.3.7 The domestic sector

96% of greenhouse gas emissions from households in 2003, corresponding to 4.1 million tonnes of CO_2 equivalents, consisted of CO_2. The domestic sector also emits a small amount of methane and even less nitrous oxide. To this can be added emissions as a result of consumption of electricity and district heating. These emissions are included in the figures for producers and therefore they are also subject to allowance regulation in the energy sector.

The consumption of energy by households, including electricity and district heating, is responsible for almost 30% of the total energy consumption in Denmark.

Most of this energy goes to heating, where combustion of oil and gas produces CO_2. A large part of

heating is covered by district heating (approx. 43% in 2003). District heating produced by cogeneration or with the use of CO_2-friendly fuels such as natural gas end especially renewable energy entails great CO_2 savings compared to the use of individual heating based on, e.g. oil boilers.

Households also use considerable amounts of electricity. Most of the household consumption of electricity goes to household appliances and light sources, whereas less than 19% goes to electric heating. Consumption of electricity for heating has gone down in recent years due to efforts by, e.g. the Electricity Saving Trust (Elsparefonden), which has led to considerable conversion from electric heating to district heating and heating with natural gas.

In 2003, the domestic sector used 157 PJ of energy for heating (climate-corrected) and 32 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 as great as the increase in the number of appliances, since these have become steadily more energy efficient.

A great number of measures aimed at promoting electricity saving, reducing energy consumption for heating, and fuel conversion (from electric heating and the use of oil to district heating and the use of renewable energy) have been implemented for the purpose of reducing energy consumption and environmental impacts from households:

- EU CO_2 allowances (some of the domestic energy consumption – electricity and heating – are subject to EU CO_2 allowance regulation, cf. section 2.3.3 on "Energy")

- Energy labelling of small and large buildings (incl. the public sector and businesses)

- Energy labelling of electrical appliances

The action plan for a renewed energy-saving effort includes a proposal for implementation of a number of measures in the domestic sector, including:

- Tightening the energy-saving demands in building regulations by 25-30% from 2006.

- Further tightening of energy demands by approx. 25% from 2010.

- Abolishing mandatory linking and banning electric heating in new low-energy buildings.

- Demands in building regulations for existing buildings in connection with major renovations, changes in heating systems, re-

placement of boilers, windows and roofing.

- Maintaining and further developing an ambitious energy labelling scheme for buildings.
- Giving higher priority to international efforts concerning energy labelling and standards.
- Promoting visualisation of energy consumption and development of sophisticated energy meters.
- Strengthening dissemination of information on energy saving.

These measures will be part of the political discussions on the implementation of the action plan on renewed energy-saving efforts.

2.3.8 Waste and wastewater

The contribution of the waste sector to greenhouse gas emissions consists primarily of methane from decomposition of organic waste at landfill sites. Smaller contributions of methane and nitrous oxide come from wastewater treatment. Of the waste sector's total greenhouse gas emissions of close to 1.5 million tonnes of CO_2 equivalents in 2003 – corresponding to 2% of Denmark's total greenhouse gas emissions – landfill sites and wastewater treatment contributed 79% and 21% respectively.

Because all incineration of waste in Denmark is associated with energy utilization, the emission of CO_2 from the incineration of plastic waste is included under the energy sector. In accordance with the targets in Energy 21 and Waste 21, waste incineration plants are designed so as to optimise energy utilization.

In previous years, efforts within the waste sector have been based on "Action plan for waste and recycling 1993-97", which included targets on waste treatment to the year 2000. In addition to an objective of stopping landfilling of combustible waste, the plan contained a number of measures of relevance to waste containing industrial gases (HFCs and SF_6).

The waste sector's contribution to reducing greenhouse gas emissions consists primarily of:

- limiting landfilling of organic waste,
- utilising gas from closed/existing landfills,
- promoting oxidation of gas in landfill coverings,
- increasing recycling of plastics, and
- utilising waste as an energy source.

The emission of methane from Danish landfills is calculated to have been 64,000 tonnes gross in 1990, increasing to a maximum of 68,800 tonnes in 1996, corresponding to 1.2 million tonnes of CO_2 equivalents.

As a consequence of stopping landfilling combustible waste on 1 January 1997, the emissions of methane from Danish landfills will decrease in the years to come. The emission of methane in 2012 is, thus, calculated to be 55,400 tonnes, corresponding to approx. 20% of the maximum in 1996.

According to the Danish Energy Authority's figures in "Biogas: Production, prognosis and targets", Denmark had 25 gas installations at landfills in the autumn of 2002. These installations produced 10,000 tonnes of methane annually, compared to approx. 1,700 tonnes in 1993.

In addition to the direct influence of waste management on greenhouse gas emissions, emissions are also influenced indirectly by recycling of, e.g., paper and cardboard, due to a reduction in energy consumption and, thus, in CO_2 emissions. When organic material in domestic refuse is used in biogas plants and the methane produced is used in biogas motors, it is essential that emission of methane from these motors be reduced, either by use of new technologies or by afterburning exhaust fumes.

The implementation of national waste plans and fulfilment of targets set has necessitated the implementation of a wide range of measures:

- Obligation to send combustible waste to incineration (in practice a ban on landfilling)
- Waste tax
- Weight- and volume-based taxes
- Subsidy programme – special scheme for businesses
- Increased recycling of plastic packaging
- Implementation of the EU landfill directive
- Support for gas recovery at landfill sites
- Subsidy programme for cleaner products

Denmark's Fourth National Communication contains additional information on these measures.

On the basis of the EU landfill directive, demands on the arrangement and running of landfills have been tightened with Statutory Order No. 650 of 29 June 2001 on landfills. According to the new regulations, waste-gas in landfills for mixed waste must be monitored. Gas from landfills where not insignificant amounts of biodegradable waste are landfilled must be managed in an environmentally-sound way or be used to produce electricity or for heating purposes.

According to the new regulations on landfilling, transitional plans must be prepared for all existing landfills, and the validating authority must re-assess the environmental conditions at the site and decide whether the facility is to comply with the new regulations or must close in 2009 at the latest.

The new regulations are expected to lead to:

- a reduction in the number of landfills,
- a not insignificant rise in the tax on landfilled waste,
- a further reduction in amounts landfilled annually, and
- requirements that waste is generally characterized before it is received at the landfill.

3 Description of Trends in, and Projections of greenhouse gas emissions and removals

3.1 Past trends in greenhouse gas emissions and removals

In accordance with the Climate Convention, Denmark sends annual reports on greenhouse gas emissions and removals, etc. to the climate secretariat. The most recent inventory on emissions covering the period 1990-2003 was forwarded in April 2005 in the so-called National Inventory Report (NIR2005), which is referred to for further details.

Denmark's emission of the greenhouse gases CO_2 (carbon dioxide), CH_4 (methane), N_2O (nitrous oxide), and the so-called potent greenhouse gases (F gasses), which include HFCs (hydrofluorcarbons), PFCs (perfluorcarbons), and SF_6 (sulphurhexafluorid) during the period 1990-2003 are shown in Figures 3.1-3.4 aggregated into the IPCC's 6 main sectors and the most relevant sub-sectors. Denmark's total 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 3.1 and Figures 3.5 and 3.6 respectively.

3.1.1 Carbon dioxide (CO_2)

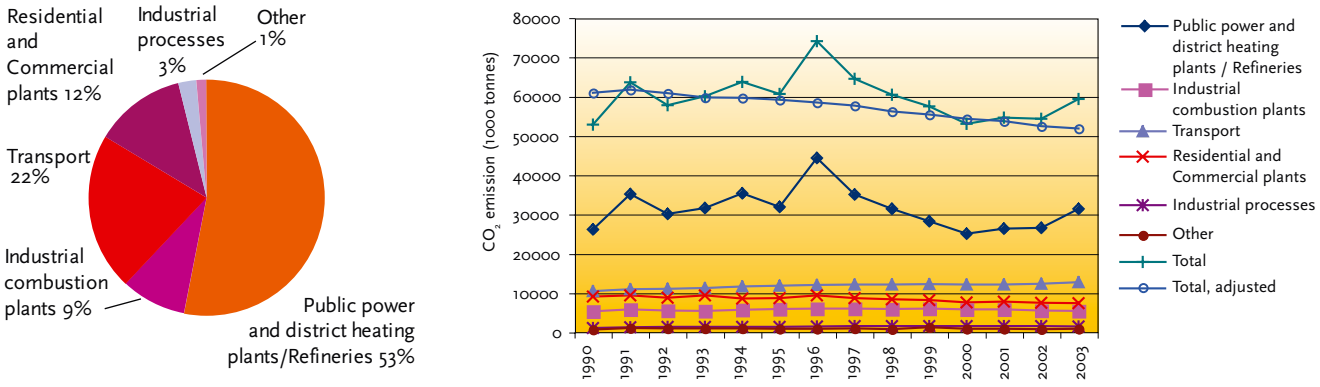
CO_2 emissions primarily stem from the combustion of coal, oil and natural gas at power plants and in the domestic sector. But road traffic also contributes substantially.

The relatively great variations in emissions from year to year are due to trading in electricity with other countries, especially Scandinavian countries. The large emissions in 1991, 1994, 1996, and 2003 are due to large exports.

Emissions tended to rise from 1990 to 1996, whereas they have dropped from 1997. This is due to the fact that more power plants change from using coal to using natural gas and

Figure 3.1: CO_2 emissions by sector and development in 1990-2003

Source: The National Environmental Research Institute



renewable energy. As a result of the reduction in the use of coal in recent years, most of the CO_2 emissions come from the burning of oil.

In 2003, road traffic was responsible for 22% of total CO_2 emissions.

In 2003, total actual CO_2 emissions inventoried under the Climate Convention, excluding land-use change and forestry (LUCF), were 12% higher than in 1990. If LUCF is included, net emissions were 10% higher. Corrected for exchange of electricity with other countries and annual temperature variations, CO_2 emissions dropped 13% with and 15% without LUCF during the same period.

3.1.2 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.

Emissions from agriculture stem from the digestive tracts of domestic animals (enteric fermentation) and from manure.

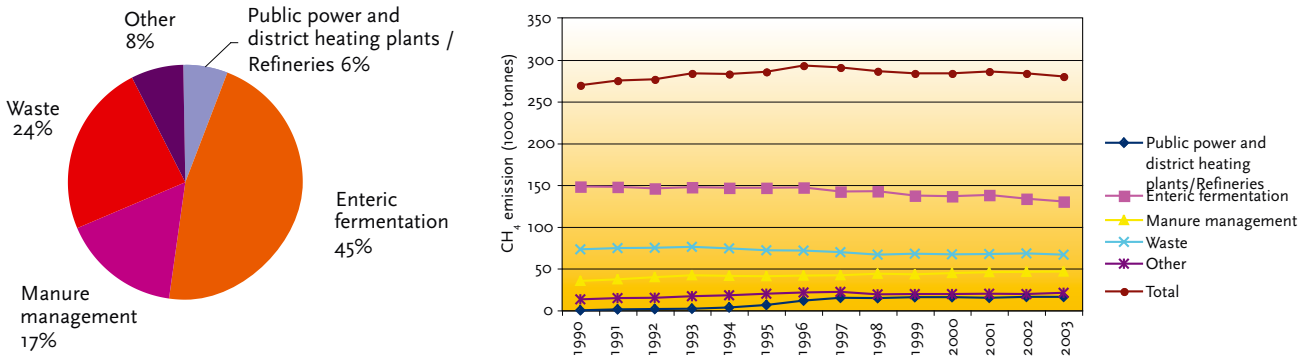
Emissions of methane from landfills are decreasing, because the production of methane has fallen year by year since the abrupt fall in landfilling in 1997.

Emissions of methane from the energy sector have been increasing due to an increased use of gas-driven engines, which emit large amounts of methane compared to other combustion technologies. These emissions are, however, expected to be reduced from 2006, when new emission limits for existing gas-driven engines come into force.

In 2003, total methane emissions were 3% above the 1990 level.

FIGURE 3.2 CH_4 EMISSIONS BY SECTOR AND DEVELOPMENT IN 1990-2003

Source: The National Environmental Research Institute



3.1.3 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. Bacteria can also convert nitrous compounds in drainage water and coastal waters. These compounds primarily originate from fertilizers. Therefore emissions from these sources are included under agriculture. From 1990, N_2O emissions from agriculture had dropped 30% 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.

In 2003, total nitrous oxide emissions were 25% below the 1990 level.

3.1.4 The potent greenhouse gases HFCs, PFCs, and SF_6

The contribution of the potent greenhouse gases, also known as F-gases (HFCs, PFCs and SF_6), to Denmark's total emissions of greenhouse gases is relatively modest. However, the emissions of these gases rose strongly 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 the refrigeration industry, are the biggest contributor to F-gas emissions. From 1995 to 2003 annual HFC emissions increased from 218,000 to 695,000 tonnes of CO_2 equivalents. PFC emissions rose in the same period from 1,000 to 19,000 tonnes CO_2 equivalents,

FIGURE 3.3 N_2O EMISSIONS BY SECTOR AND DEVELOPMENT IN 1990-2003
Source: The National Environmental Research Institute

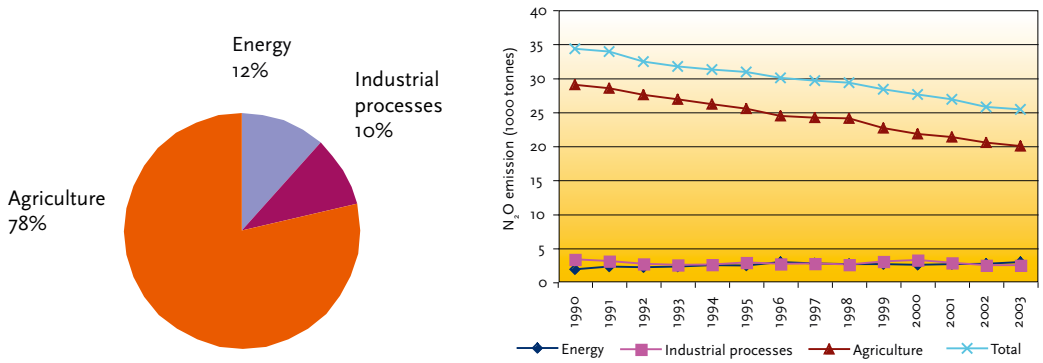
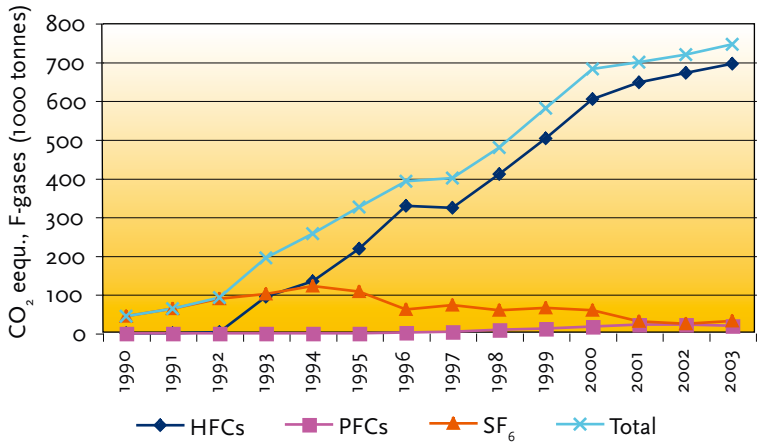


FIGURE 3.4 DEVELOPMENT IN HFC, PFC, AND SF_6 EMISSIONS IN 1990-2003
Source: The National Environmental Research Institute



however with a slight fall in 2003 compared to 2002. SF_6 emissions dropped by 71% from 107,000 to 31,000 tonnes of CO_2 equivalents in the period.

Total F-gas emissions rose by 129% from 1995 to 2003.

3.1.5 Denmark's total greenhouse gas emissions and removals

Table 3.1, figures 3.5 and 3.6 show the development in Denmark's greenhouse gas emissions and removals as CO_2 equivalents and by gases and sources according to inventory guidelines on 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. LUCF) corresponded to 90 million tonnes of CO_2 equivalents, there has been a general reduction until 2000, when total emissions corresponded to 68.3 million tonnes of CO_2 equivalents, whereas total greenhouse gas emissions corresponded to 74 million tonnes of CO_2 equivalents (excl. LUCF) in 2003. The increase of 7.3% from 2002 to 2003 is due to large exports of electricity to other Scandinavian countries. Of the total greenhouse gas emissions in 2003, CO_2 made up 80%, methane 8%, nitrous oxide 11%, and F-gasses 1%. If net contributions from forests and land and removal of CO_2 (i.e. with LUCF) are included, then net total Danish greenhouse gas emissions corresponded to 72.8 million tonnes of CO_2 equivalents in 2003.

TABLE 3.1 DANISH GREENHOUSE GAS EMISSIONS AND REMOVALS BY GAS AND SOURCE IN 1990 – 2003

Source: The National Environmental Research Institute (NERI)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	CO_2 equivalent (Gg)													
Net CO_2 emissions/removals	53045	63446	57503	59594	63333	60375	73613	64081	59590	56653	54858	53457	52812	58124
CO_2 emissions (without LUCF)	52887	63559	57755	60060	63663	60609	74035	64524	60409	57523	53076	54615	54288	59329
CH_4	5684	5785	5819	5994	6008	6108	6226	6099	6042	5953	5941	6029	5954	5873
N_2O	10713	10584	10125	9924	9778	9657	9379	9248	9149	8843	8615	8380	8035	8060
HFCs	0	0	3	94	135	218	329	324	411	503	605	647	672	695
PFCs	0	0	0	0	0	1	2	4	9	12	18	22	22	19
SF_6	44	64	89	101	122	107	61	73	59	65	59	30	25	31
Total (with net CO_2 emissions/removals)	**69487**	**79879**	**73539**	**75707**	**79376**	**76466**	**89610**	**79830**	**75260**	**72030**	**70095**	**68566**	**67521**	**72804**
Total (without CO_2 from LUCF)	**69328**	**79992**	**73791**	**76173**	**79706**	**76700**	**90033**	**80273**	**76079**	**72900**	**68314**	**69724**	**68996**	**74008**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	CO_2 equivalent (Gg)													
1. Energy	52390	63065	57130	59545	63309	60415	73998	64267	60148	57345	52802	54458	54121	59318
2. Industrial Processes	2155	2258	2292	2359	2433	2604	2673	2862	2905	3070	3259	3191	3095	3129
3. Solvent and Other Product Use	317	305	292	280	268	242	265	262	195	192	212	130	151	206
4. Agriculture	12845	12720	12429	12307	12052	11845	11526	11357	11368	10806	10565	10470	10138	9898
5. Land-Use Change and Forestry (LUCF)	158	-113	-252	-466	-330	-234	-422	-443	-819	-870	1782	-1158	-1476	-1204
6. Waste	1622	1645	1648	1683	1645	1593	1570	1525	1463	1487	1475	1475	1492	1457
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0

FIGURE 3.5 DANISH GREENHOUSE GAS EMISSIONS BY TYPE OF GAS IN 1990 - 2003.
Source: The National Environmental Research Institute

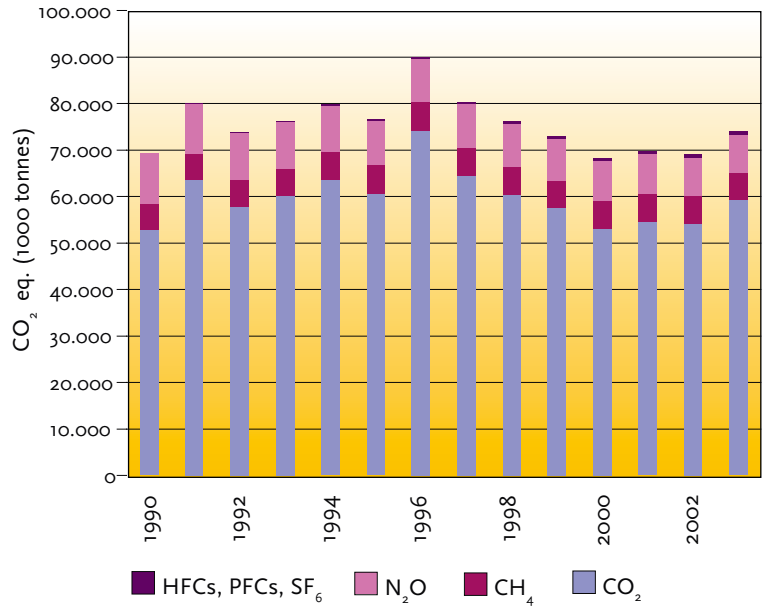
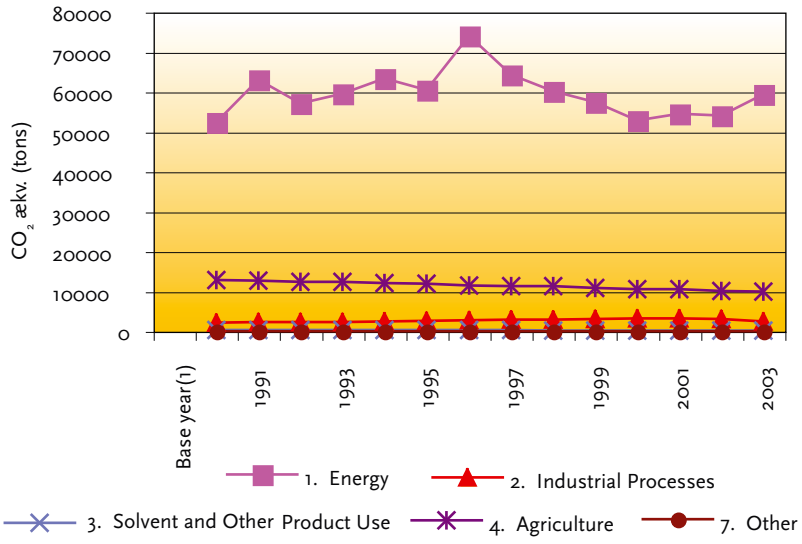


FIGURE 3.6 DANISH GREENHOUSE GAS EMISSIONS BY SOURCE/SECTOR IN 1990 – 2003
Source: The National Environmental Research Institute



3.2 PROJECTED TRENDS IN GREENHOUSE GAS EMISSIONS AND REMOVALS IN THE "WITH MEASURES" BASELINE SCENARIO

3.2.1 Total effect of 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. The government, therefore, aims at 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.

The shortfall in respect of fulfilling Denmark's obligations with the existing policies and measures has been calculated both for a situation in which account is taken of the electricity import in 1990 and for a situation in which account is not taken of this.

The projections are based on a number of sector-specific projections of domestic emissions for the 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 projections are also based on measures already adopted described in the Fourth National Communication (Chapter 4 and Annex B). Corresponding to the most recent inventory of greenhouse gas emissions, Denmark's reduction commitment of 21% entails that emissions must be reduced from an amount corresponding to 69.6 million tonnes of CO_2 equivalents in the base year 1990/95 to 55 million tonnes of CO_2 equivalents in 2008-2012.

The most recent projections from May 2005 include the period 2004-2030 and are shown in Annex E of the Fourth National Communication. Computations for 2013-2030 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. Therefore the projection must not be confused with the most likely development, since effects of new political initiatives, which will most likely be implemented as part of the continued follow-up to the Climate Strategy, have not been taken into account.

Since the Climate Strategy of 2003 and the associated baseline projection without additional measures, a baseline projection has been prepared and the previous emission inventories have been up-dated as a result of new knowledge, including new figures for the base year. Therefore the climate deficit has changed in comparison to the inventory in the Climate Strategy. The deficit is what Denmark lacks to fulfill the target for reduction of greenhouse gas emissions under the Kyoto Protocol and EU burden sharing.

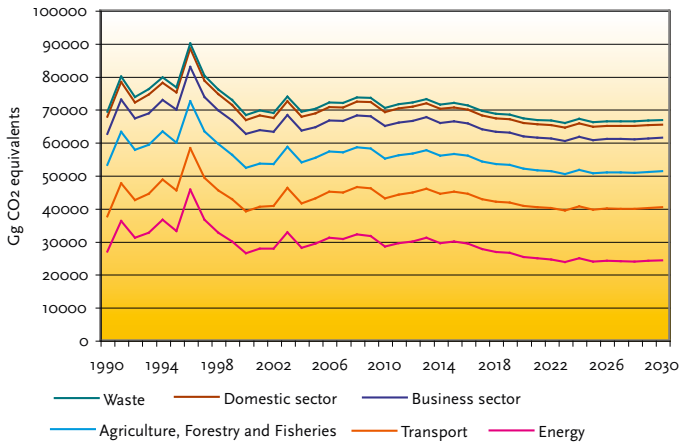
In the new baseline projection, Denmark's expected annual net greenhouse gas emissions under the Kyoto Protocol for the period 2008-2012 correspond to 72.3 million tonnes of CO_2 equivalents, as shown in Table 3.2. The emissions in the new baseline projection are 7.8 million tonnes of CO_2 equivalents lower than in the previous baseline projection without additional measures, on which the Climate Strategy was based. The new baseline projection for the entire period 2004-2030 is shown in Figure 3.7, altogether and aggregated into the economic sectors described in chapter 4 of the Fourth National Communication.

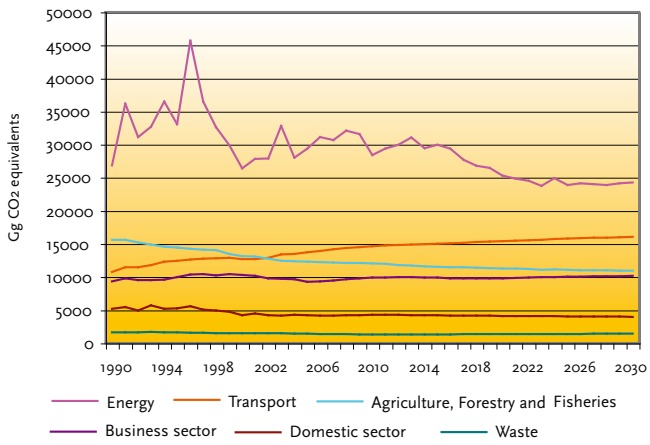
The projection for the period 2008-2012 is 7.8 million tonnes of CO_2 equivalents less than the previous projection. This is primarily due to the reduction in exports of electricity, e.g. as a result of price effects of new electricity production capacity in Finland and Sweden and of the introduction of the EU allowance regulation. The reduction in exports of electricity corresponds to almost 5.5 million tonnes of CO_2 (from 9.9 to 4.4 million tonnes of CO_2). To this can be added a reduction corresponding to approx. 2 million tonnes of CO_2 equivalents in the energy sector due to the continued shift towards more natural gas and renewable energy, which is in reality even bigger, since the figure also includes expectations adjusted upward to emissions corresponding to approx. 1.3 million tonnes of CO_2 equivalents from extraction in the North Sea.

In the business sector, the change in the new projection corresponds to the effect of Kemira's termination of nitric acid production in Denmark, since the reduction in the industry's

FIGURE 3.7 DENMARK'S EXPECTED NET GREENHOUSE GAS EMISSIONS UNDER THE KYOTO PROTOCOL FOR 2004-2030 IN THE NEW BASE PROJECTION, WHICH IS A PROJECTION "WITH MEASURES", I.E., A PROJECTION THAT ONLY INCLUDES EXPECTED EFFECTS OF EXISTING AND ADOPTED MEASURES

Source: 1990-2003: The National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2005.
2004-2030: Projection of greenhouse gas emissions, Memorandum to the Danish EPA, NERI, May 2005.





energy consumption, corresponding to approx. 0.5 million tonnes of CO_2 equivalents has largely been compensated for by a similar increase in process emissions, where the increase from cement production contributes the most (almost 0.4 million tonnes of CO_2 equivalents).

The increase in the domestic sector follows the upward-adjusted projection of energy consumption.

Of the increase of 0.4 million tonnes of CO_2 equivalents from waste, almost 0.3 million tonnes are due to the new inclusion of methane and nitrous oxide from wastewater. Since this source has also been included in the base year 1990 and it is almost unchanged, up-dating emission inventories and projections to include this source does not alter the deficit. But the deficit is influenced slightly by the up-dated projection of 0.1 million tonnes of CO_2 equivalents of methane from landfills.

To these expected effects of new measures and changes on the total result due to the new projection of emissions should be added expected effects of funds allocated for projects reducing greenhouse gas emissions in other countries – that is the JI and CDM projects, cf. articles 6 and 12 in the Kyoto Protocol. Since the Climate Strategy for the period 2003-2008 was agreed, Denmark has allocated DKK 1,130 million to such projects, corresponding to 4.5 million tonnes of CO_2 equivalents annually in 2008-2012 with an average cost of DKK 50 per tone.

As shown in Table 3.2, the Danish deficit is estimated on this background to be approx. 13 million tonnes of CO_2 equivalents annually, based on Denmark's legal commitment under the EU Burden Sharing Agreement. This is based on a situation where no corrections has been made for the particularly large imports of electricity in 1990.

If this correction is made as assumed by Denmark, the deficit is reduced to approx. 8 million tonnes of CO_2 equivalents annually in 2008-2012, as shown in Table 3.2.

Compared to the deficit of 20-25 million tonnes of CO_2 equivalents annually in 2008-2012, inventoried on the basis of the projection which was presented together with the Government's *Proposal for a Climate Strategy for Denmark* in February 2003 to show the expected development without implementation of additional measures, there is a reduction of approx. 12 million tonnes of CO_2 equivalents annually in 2008-2012.

Using this method, the deficit expresses the need for buying allowances abroad or for implementing additional measures outside sectors subject to allowances. As a result of the introduction of the CO_2 allowance scheme, the deficit is not in principle directly comparable to the deficit in the Government's Climate Strategy, since the cost effects of the allowances have been taken into account, whereas it is ultimately only the allocation of allowances that

decides the climatic effects of the scheme.

Note that the projection, and therefore also the deficit, is based on model predictions, which are subject to uncertainty. This applies, not least, to expected developments in energy prices, prices of CO_2 allowances, and the developments in the Nordic electricity market, which have a direct influence on the size of exports of electricity. This is illustrated in more detail through sensitivity analyses, cf. section 5.2.4. The implementation of the EU allowance scheme has, however, created a basis for greater certainty regarding the fulfilment of Denmark's climate commitments under the Kyoto Protocol and the EU Burden Sharing Agreement.

The "with measures" projection presented in this report is the most recent projection. It was finalised in May 2005 and it is in general based on expected effects of policies and measures implemented or adopted until the end of 2004. Due to the adoption of additional energy-savings initiatives in 2005, up-dated projections in the off-shore sector and new IEA projections of energy prices, an update of the May 2005 "with measures" projection has been initiated. However, results from this update will not be available until the beginning of 2006. Preliminary results suggests that the action plan on

TABLE 3.2 DENMARK'S EXPECTED GREENHOUSE GAS EMISSIONS AND THE EXPECTED DEFICIT COMPARED TO THE EU BURDEN SHARING OF THE EU REDUCTION TARGET UNDER THE KYOTO PROTOCOL.

Source: 1990-2003: The National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2005.
2004-2030: Projection of greenhouse gas emissions, Memorandum to the Danish EPA, NERI, May 2005.

Million tonnes of CO2 equivalents	Base year[1] 1990/95	2003	"2010"[2]	"2015"[3],	2020	2025	2030
CO_2[4]	52.9	**59.2**	59.0	58.8	55.2	54.2	54.9
Methane, CH_4	5.7	5.9	5.6	5.3	5.2	5.2	5.2
Nitrous oxide, N_2O	10.7	8.1	6.9	6.8	6.6	6.5	6.5
Industrial gases HFCs, PFCs and SF_6	0.3	0.7	0.8	0.5	0.2	0.2	0.2
Total emissions	**69.6**	**73.9**	**72.3**	**71.4**	**67.2**	**66.1**	**66.8**
Of which exports of electricity: (- means imports)	-6.3	6.9	4.4	2.3	1.4	0.9	2.7
Kyoto target: -21%			55.0				
Reductions in other countries from funds allocated to JI and CDM projects			4.5				
Deficit incl. JI and CDM			7.8/12.8[5]				

[1] Base year for CO_2, methane, and nitrous oxide is 1990. In accordance with the Kyoto Protocol, 1995 is chosen as the base year for industrial gases.

[2] "2010" stands for mean emissions in 2008-2012.

[3] "2015" stands for mean emissions in 2013-2017

[4] Here net emission of CO_2 inventoried under the Kyoto Protocol, because removal of CO_2 in new forests planted since 1990 is included cf. Protocol article 3.3.

[5] The deficit has been calculated both on the basis of the assumption of taking imports of electricity in 1990 into account, cf. the political statement of the Council and the Commission and on the basis of Denmark's legal commitment under the EU Burden Sharing Agreement.

additional energy-savings initiatives could lead to a 2 mill. tonnes further reduction in annual CO_2 emissions 2008-2012.

3.2.2 Carbon dioxide, CO_2

Table 3.3 shows the expected development in CO_2 emissions. The largest source of CO_2 emissions in Denmark is the burning of fossil fuels, including for the production of electricity, heating and transport.

Since 1990, the transport sector has shown the greatest increase in CO_2 emissions, and this increase is expected to continue throughout the projection period. CO_2 emissions from the transport sector were 10,441 Gg of CO_2 in 1990 and had risen to 12,785 Gg of CO_2 in 2003, whereas the projection for 2008-2012 is 13,890 Gg of CO_2 annually. Emissions from energy production, including conversion and distribution have varied in 1990-2003 due to great variations in exports/imports of electricity. Emissions from the production of energy were 26,173 Gg of CO_2 in 1990 and 31,402 Gg of CO_2 in 2003, whereas the projection for 2008-2012 is 29,021 Gg of CO_2 annually, of which 4,400 Gg of CO_2 are due to electricity exports.

Total CO_2 emissions, excluding land-use changes and forestry (LUCF[19]) were 52,887 Gg of CO_2 in 1990 and 59,329 Gg of CO_2 in 2003, whereas the projection for 2008-2012 is 59,233 Gg of CO_2 annually.

3.2.3 Methane, CH_4

Most of the methane emissions come from the digestive tracts of domestic animals. The projections are shown in Table 3.4. The reduction in emissions from agriculture from 1990 to 2001 and the continued reductions in the projection period are primarily due to reductions in cattle stocks. The next largest source of methane is landfills, from which emissions were also reduced from 1990 to 2001. 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 5,684 Gg of CO_2 equivalents in 1990 to 5,873 Gg of CO_2 equivalents in 2003, whereas the projection for 2008-2012 is lower, i.e. 5,573 Gg of CO_2 equivalents annually.

3.2.4 Nitrous oxide, N_2O

Agriculture constitutes the most important source of nitrous oxide emissions, since soil bacteria can create this gas on the basis of fertilizer and manure spread on fields. The projections are shown in Table 3.5. The decrease in total emissions from 10,713 Gg of CO_2 equivalents in 1990 to 8,060 Gg of CO_2 equivalents in 2003 is primarily due to a combination of the Action Plan for the Aquatic Environment I and II and the Action Plan for Sustainable Agriculture. The projection for 2008-12 is 6,942 Gg of CO_2 equivalents annually. This substantial reduction is not least due to the fact that Denmark ceased to produce

Table 3.3 Projections of Denmark's CO_2 emissions in 2004 – 2030 and emissions observed in 1990, 1995, 2000, and 2003.

Source: 1990-2003: The National Inventory Report (NIR), NERI, April 2005.

2004-2030: Projections of greenhouse gas emissions, Memorandum to the Danish EPA, NERI, May 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2003	2005	2008-12	2013-17	2020	2025	2030
	(Gg CO2)									
1. Energy	**51502**	**58992**	**51290**	**57635**	**54762**	**57180**	**57176**	**53685**	**52840**	**53629**
A Fuel Combustion Activities (Sectoral Approach)	51239	58627	50696	57085	54252	56670	56685	53345	52499	53288
1 Energy Industries	26173	31934	25114	31402	28188	29021	28351	24385	22964	23390
2 Manufacturing Industries and Construction	5376	5890	5786	5404	5389	5915	6173	6439	6688	6814
3 Transport	10441	11823	12118	12785	13057	13890	14291	14673	15006	15288
4 Other Sectors	9129	8728	7567	7402	7496	7722	7748	7726	7718	7674
5 Other (Military mobile combustion of fuels)	119	252	111	92	122	122	122	122	122	122
B Fugitive Emissions from Fuels	263	365	594	550	510	510	491	341	341	341
1 Solid Fuels	0	0	0	0	0	0	0	0	0	0
2 Oil and Natural Gas	263	365	594	550	510	510	491	341	341	341
2. Industrial Processes	**1068**	**1375**	**1574**	**1488**	**1764**	**1841**	**1841**	**1841**	**1841**	**1841**
3. Solvent and Other Product Use	**317**	**242**	**212**	**206**	**212**	**212**	**212**	**212**	**212**	**212**
4. Agriculture	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
5. Land-Use Change and Forestry (LUCF)	**158**	**-234**	**1782**	**-1204**	**-953**	**-1195**	**-1472**	**-1781**	**-1963**	**-2315**
6. Waste	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
7. Other	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Denmark's Total Emissions/Removals with LUCF	**53045**	**60375**	**54858**	**58124**	**55785**	**58038**	**57756**	**53957**	**52929**	**53367**
Denmark's Total Emissions without LUCF	**52887**	**60609**	**53076**	**59329**	**56738**	**59233**	**59229**	**55738**	**54892**	**55682**
Trend under the Climate Convention (1990=100), with LUCF	***100***	***114***	***103***	***110***	***105***	***109***	***109***	***102***	***100***	***101***
Trend under the Climate Convention (1990=100), without LUCF	***100***	***115***	***100***	***112***	***107***	***112***	***112***	***105***	***104***	***105***
CO2 emissions related to net electricity import (negative means net electricity export for the year)	***6300***	***-690***	***659***	***-6869***	***-4403***	***-4375***	***-2276***	***-1379***	***-859***	***-2868***
CO2 emissions related to the years temperature deviation from a normal year (based on degree days)	***1879***	***235***	***1323***	***723***	***0***	***0***	***0***	***0***	***0***	***0***
Trend under the Climate Convention (1990=100), with LUCF, when adjusted for inter-annual variations in electricity import/export and temperature	***100***	***98***	***93***	***85***	***84***	***88***	***91***	***86***	***85***	***82***
Trend under the Climate Convention (1990=100), without LUCF, when adjusted for inter-annual variations in electricity import/export and temperature	***100***	***99***	***90***	***87***	***86***	***90***	***93***	***89***	***88***	***86***
CO2 removals from afforestation since 1990, cf. Article 3.3 in the Kyoto Protocol	***0***	***-10***	***-59***	***-108***	***-141***	***-262***	***-401***	***-555***	***-646***	***-822***
Trend under the Kyoto Protocol (1990/95=100), with removals cf. Article 3.3	***100***	***115***	***100***	***112***	***107***	***112***	***111***	***104***	***103***	***104***
Trend under the Kyoto Protocol (1990/95=100), with removals cf. Article 3.3, when adjusted for inter-annual variations in electricity import/export and temperature	***100***	***98***	***90***	***87***	***85***	***89***	***93***	***88***	***87***	***85***
Memo Items (not included above):										
International Bunkers	**4823**	**6928**	**6629**	**5318**	**5393**	**5581**	**5794**	**6027**	**6220**	**6425**
Aviation	1736	1867	2350	2188	2254	2443	2656	2889	3082	3287
Marine	3087	5061	4279	3130	3138	3138	3138	3138	3138	3138
Multilateral Operations	0	0	0	0	0	0	0	0	0	0
CO2 Emissions from Biomass	4641	5869	7090	9108	0	0	0	0	0	0

Table 3.4 Projections of Denmark's methane emissions in 2004 – 30 and emissions observed in 1990, 1995, 2000, and 2003.

Source: 1990-2003: The National Inventory Report (NIR), NERI), April 2005.

2004-2030: Projection of greenhouse gas emissions, Memorandum to the Danish EPA, NERI, May 2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2003	2005	2008-12	2013-17	2020	2025	2030
	(CH4 i Gg CO2-equivalents)									
Denmark's Total Emissions	**5684**	**6108**	**5941**	**5873**	**5646**	**5573**	**5322**	**5217**	**5166**	**5199**
1. Energy	**297**	**662**	**722**	**771**	**622**	**731**	**625**	**572**	**560**	**570**
A Fuel Combustion Activities (Sectoral Approach)	186	469	579	594	500	617	524	497	489	499
1 Energy Industries	23	242	312	330	211	322	237	215	204	210
2 Manufacturing Industries and Construction	16	19	34	34	41	44	45	46	47	47
3 Transport	57	78	72	65	65	51	35	26	23	23
4 Other Sectors	90	130	161	165	183	200	206	210	214	218
5 Other (Military mobile combustion of fuels)	0	0	0	0	0	0	0	0	0	0
B Fugitive Emissions from Fuels	111	193	143	177	122	114	101	75	71	71
1 Solid Fuels	72	132	64	93	0	0	0	0	0	0
2 Oil and Natural Gas	38	60	79	84	122	114	101	75	71	71
2. Industrial Processes	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3. Solvent and Other Product Use	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4. Agriculture	**3853**	**3938**	**3809**	**3706**	**3681**	**3587**	**3438**	**3356**	**3282**	**3282**
A Enteric Fermentation	3110	3079	2872	2734	2681	2582	2441	2354	2275	2275
B Manure Management	743	860	937	972	1000	1005	997	1002	1007	1007
5. Land-Use Change and Forestry (LUCF)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6. Waste	**1534**	**1507**	**1410**	**1397**	**1344**	**1255**	**1258**	**1289**	**1323**	**1347**
A Solid Waste Disposal on Land	1334	1286	1192	1153	1113	1071	1065	1080	1097	1105
B Wastewater Handling	200	222	217	244	231	183	193	210	226	242
7. Other	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Trend under the Climate Convention (1990=100) in total emission of CH4	***100***	***107***	***105***	***103***	***99***	***98***	***94***	***92***	***91***	***91***
Trend under the Climate Convention (1990=100) in total emission of CH4 from energy	***100***	***223***	***243***	***259***	***209***	***246***	***210***	***192***	***189***	***192***
Trend under the Climate Convention (1990=100) in total emission of CH4 from agriculture	***100***	***102***	***99***	***96***	***96***	***93***	***89***	***87***	***85***	***85***
Trend under the Climate Convention (1990=100) in total emission of CH4 from waste and wastewater handling	***100***	***98***	***92***	***91***	***88***	***82***	***82***	***84***	***86***	***88***

Table 3.5 Projections of Denmark's nitrous oxide emissions in 2004–30 and emissions observed in 1990, 1995, 2000, and 2003.
Source: 1990-2003: The National Inventory Report (NIR), NERI, April 2005.
2004-2030: Projection of greenhouse gas emissions, Memorandum to the Danish EPA, NERI, May 2005.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2003	2005	2008-12	2013-17	2020	2025	2030
	(N2O i Gg CO2-equivalents)									
Denmark's Total Emissions	**10713**	**9657**	**8615**	**8060**	**7102**	**6942**	**6760**	**6628**	**6530**	**6543**
1. Energy	**590**	**761**	**790**	**913**	**933**	**1025**	**1060**	**1052**	**1063**	**1076**
A Fuel Combustion Activities (Sectoral Approach)	589	759	787	910	930	1022	1058	1050	1062	1075
1 Energy Industries	276	327	255	328	306	313	314	283	273	268
2 Manufacturing Industries and Construction	54	56	57	56	58	63	66	68	71	72
3 Transport	147	270	380	430	466	540	570	590	608	624
4 Other Sectors	110	104	94	95	99	104	106	107	108	109
5 Other (Military mobile combustion of fuels)	1	3	1	1	2	2	2	2	2	2
B Fugitive Emissions from Fuels	1	2	3	3	3	3	3	2	2	2
1 Solid Fuels	0	0	0	0	0	0	0	0	0	0
2 Oil and Natural Gas	1	2	3	3	3	3	3	2	2	2
2. Industrial Processes	**1043**	**904**	**1004**	**895**	**0**	**0**	**0**	**0**	**0**	**0**
3. Solvent and Other Product Use	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4. Agriculture	**8993**	**7907**	**6756**	**6192**	**6108**	**5856**	**5639**	**5515**	**5406**	**5406**
B Manure Management	685	642	601	560	552	539	524	516	505	505
D Agricultural Soils	8308	7265	6154	5632	5556	5317	5114	4999	4900	4900
5. Land-Use Change and Forestry (LUCF)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6. Waste	**88**	**85**	**65**	**61**	**61**	**61**	**61**	**61**	**61**	**61**
B Wastewater Handling	88	85	65	61	61	61	61	61	61	61
7. Other	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Trend under the Climate Convention (1990=100) in total emission of N2O	***100***	***90***	***80***	***75***	***66***	***65***	***63***	***62***	***61***	***61***
Trend under the Climate Convention (1990=100) in total emission of N2O from energy	***100***	***129***	***134***	***155***	***158***	***174***	***180***	***178***	***180***	***182***
Trend under the Climate Convention (1990=100) in total emission of N2O from agriculture	***100***	***88***	***75***	***69***	***68***	***65***	***63***	***61***	***60***	***60***
Trend under the Climate Convention (1990=100) in total emission of N2O from wastewater handling	***100***	***97***	***75***	***69***	***70***	***70***	***70***	***70***	***70***	***70***

Table 3.6 Projections of Denmark's industrial gas emissions in 2004 – 30 and emissions observed in 1995, 2000, and 2003.

Source: 1990-2003: The National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2005. 2004-2030: Projections of greenhouse gas emissions, Memorandum to the Danish Environmental Protection Agency (EPA), NERI, May 2005.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1995	2000	2003	2005	2008-12	2013-17	2020	2025	2030
	(HFCs, PFCs and SF6 in Gg CO_2 equivalents)								
Total emissions of HFCs, PFCs and SF6	**326**	**682**	**746**	**819**	**768**	**523**	**179**	**179**	**179**
2. Industrial Processes	**326**	**682**	**746**	**819**	**768**	**523**	**179**	**179**	**179**
C Metal Production	**36**	**21**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1 Iron and Steel Production	0	0	0	0	0	0	0	0	0
2 Ferroalloys Production	0	0	0	0	0	0	0	0	0
3 Aluminium Production	0	0	0	0	0	0	0	0	0
4 SF6 Used in Aluminium and Magnesium Foundries	36	21	0	0	0	0	0	0	0
SF6 Used in Aluminium Foundries	0	0	0	0	0	0	0	0	0
SF6 Used in Magnesium Foundries	36	21	0	0	0	0	0	0	0
5 Other	0	0	0	0	0	0	0	0	0
F Consumption of Halocarbons and Sulphur Hexafluoride	**290**	**660**	**746**	**819**	**768**	**523**	**179**	**179**	**179**
1 Refrigeration and Air Conditioning Equipment	36	436	575	-	-	-	-	-	-
2 Foam Blowing	183	168	129	-	-	-	-	-	-
3 Fire Extinguishers	0	0	0	-	-	-	-	-	-
4. Aerosols/ Metered Dose Inhalers	0	17	10	-	-	-	-	-	-
5 Solvents	0	0	0	-	-	-	-	-	-
6. Semiconductor Manufacture	0	0	0	-	-	-	-	-	-
7. Electrical Equipment (SF6)	4	11	10	-	-	-	-	-	-
8 Other (please specify)	68	29	23	-	-	-	-	-	-
C_3F_8 (PFC used as detergent)	0	2	2	-	-	-	-	-	-
SF6 (Window plate production, Research laboratories and Running shoes)	68	27	22	-	-	-	-	-	-
Total emissions of HFCs	**218**	**605**	**695**	**773**	**703**	**407**	**118**	**118**	**118**
Total emissions of PFCs	**1**	**18**	**19**	**14**	**10**	**8**	**6**	**6**	**6**
Total emissions of SF6	**107**	**59**	**31**	**32**	**55**	**108**	**55**	**55**	**55**
Trend under the Kyoto Protocol (1995=100) in total emissions of F-gases	***100***	***209***	***229***	***251***	***236***	***161***	***55***	***55***	***55***
Trend under the Kyoto Protocol (1995=100) in total emissions of HFCs	***100***	***278***	***319***	***355***	***323***	***187***	***54***	***54***	***54***
Trend under the Kyoto Protocol (1995=100) in total emissions of PFCs	***100***	***3562***	***3851***	***2791***	***1904***	***1494***	***1141***	***1141***	***1141***
Trend under the Kyoto Protocol (1995=100) in total emissions of SF6	***100***	***55***	***29***	***30***	***51***	***101***	***51***	***51***	***51***

Table 3.7 Projections of Denmark's total greenhouse gas emissions and removals in 2004–2030 and emissions observed in 1990, 1995, 2000, and 2003.

Source: 1990-2003: National Inventory Report (NIR), NERI, April 2005.

2004-2030: Projection of greenhouse gas emissions, Memorandum to the Danish EPA, NERI, May 2005.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1995	2000	2003	2005	2008-12	2013-17	2020	2025	2030
	(Gg CO_2-equivalents)									
1. Energy	**52390**	**60415**	**52802**	**59319**	**56317**	**58936**	**58862**	**55309**	**54463**	**55276**
A Fuel Combustion Activities (Sectoral Approach)	52014	59855	52062	58589	55683	58309	58266	54891	54049	54862
1 Energy Industries	26472	32503	25680	32059	28705	29656	28902	24882	23441	23868
2 Manufacturing Industries and Construction	5447	5965	5877	5494	5489	6022	6283	6553	6806	6933
3 Transport	10645	12171	12570	13280	13587	14481	14897	15289	15637	15935
4 Other Sectors	9329	8961	7822	7662	7778	8026	8060	8043	8041	8001
5 Other (Military mobile combustion of fuels)	120	256	112	94	124	124	124	124	124	124
B Fugitive Emissions from Fuels	376	560	740	729	635	627	595	418	414	414
1 Solid Fuels	72	132	64	93	0	0	0	0	0	0
2 Oil and Natural Gas	303	428	676	636	635	627	595	418	414	414
2. Industrial Processes	**2155**	**2604**	**3259**	**3129**	**2583**	**2609**	**2364**	**2020**	**2020**	**2020**
3. Solvent and Other Product Use	**317**	**242**	**212**	**206**	**212**	**212**	**212**	**212**	**212**	**212**
4. Agriculture	**12845**	**11845**	**10565**	**9898**	**9788**	**9444**	**9077**	**8870**	**8688**	**8688**
5. Land-Use Change and Forestry (LUCF)	**158**	**-234**	**1782**	**-1204**	**-953**	**-1195**	**-1472**	**-1781**	**-1963**	**-2315**
6. Waste	**1622**	**1593**	**1475**	**1457**	**1405**	**1316**	**1319**	**1350**	**1385**	**1409**
7. Other	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Denmark's Total Emissions/Removals with LUCF	**69487**	**76466**	**70095**	**72804**	**69352**	**71321**	**70361**	**65980**	**64803**	**65288**
Denmark's Total Emissions without LUCF	**69328**	**76700**	**68314**	**74009**	**70305**	**72516**	**71833**	**67761**	**66767**	**67603**
Trend under the Climate Convention (1990=100), with LUCF	***100***	***110***	***101***	***105***	***100***	***103***	***101***	***95***	***93***	***94***
Trend under the Climate Convention (1990=100), without LUCF	***100***	***111***	***99***	***107***	***101***	***105***	***104***	***98***	***96***	***98***
CO_2 emissions related to net electricity import (negative means net electricity export for the year)	***6300***	***-690***	***659***	***-6869***	***-4403***	***-4375***	***-2276***	***-1379***	***-859***	***-2868***
CO_2 emissions related to the years temperature deviation from a normal year (based on degree days)	***1879***	***235***	***1323***	***723***	***0***	***0***	***0***	***0***	***0***	***0***
Trend under the Climate Convention (1990=100), with LUCF, when adjusted for inter-annual variations in electricity import/export and temperature	***100***	***98***	***93***	***86***	***84***	***86***	***88***	***83***	***82***	***80***
Trend under the Climate Convention (1990=100), without LUCF, when adjusted for inter-annual variations in electricity import/export and temperature	***100***	***98***	***91***	***88***	***85***	***88***	***90***	***86***	***85***	***84***
CO_2 removals from afforestation since 1990, cf. Article 3.3 in the Kyoto Protocol	***0***	***-10***	***-59***	***-108***	***-141***	***-262***	***-401***	***-555***	***-646***	***-822***
Trend under the Kyoto Protocol (1990/95=100), with removals cf. Article 3.3	***100***	***111***	***98***	***107***	***101***	***104***	***103***	***97***	***95***	***96***
Trend under the Kyoto Protocol (1990/95=100), with removals cf. Article 3.3, when adjusted for inter-annual variations in electricity import/export and temperature	***100***	***98***	***91***	***87***	***85***	***88***	***89***	***85***	***84***	***82***
Memo Items (not included above):										
International Bunkers	**4904**	**7050**	**6741**	**5405**	**5481**	**5671**	**5887**	**6122**	**6317**	**6525**
Aviation	1755	1888	2376	2212	2280	2470	2686	2921	3116	3324
Marine	3149	5162	4365	3193	3201	3201	3201	3201	3201	3201
Multilateral Operations	0	0	0	0	0	0	0	0	0	0
CO_2 Emissions from Biomass	4641	5869	7090	9108	0	0	0	0	0	0

nitrous acid in 2004, as shown under industrial processes in Table 3.5. Contributions from the transport and energy sectors are expected to increase, whereas contributions from agriculture are expected to be somewhat less than in 2001.

3.2.5 Industrial gases, HFCs, PFCs, and SF_6

In accordance with provisions of the Kyoto Protocol, Denmark chose 1995 as its base year for emissions of the industrial gases HFCs, PFCs, and SF_6. Total emissions of these gases corresponded to 326 Gg of 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 of CO_2 equivalents.

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 768 Gg of CO_2 equivalents annually are projected, after which a major reduction in emissions of HFCs, the major contributors, is expected and will result in a considerable reduction in emissions of industrial gases following the first period of commitment.

3.2.6 Denmark's total greenhouse gas emissions and removals

Table 3.7 shows the base year and projections of Denmark's total greenhouse gas emissions and removals.

3.3 The projection without measures

According to the guidelines for national communications, projections without expected effects of measures implemented after a certain point in time may also be reported in national communications.

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, cf. section 4.1.

3.4 Projected trends in greenhouse gas emissions and removals in a scenario including additional measures

The Government's Climate Strategy from 2003 contains a number of expected effects of supplemental policies and measures that are planned but still not implemented.

The Strategy does not, however, present a projection with additional measures included in a traditional manner.

With the allowance regulation, it is left to the individual businesses to decide whether market conditions make the buying of extra allowances or the implementation of emission-reducing measures – e.g. saving energy - most favourable.

With the entering into force of the Kyoto Protocol, demands have shift-

ed from traditional projections of greenhouse gas emissions to more appropriate target-fulfilment projections, which is expressed by e.g. the inclusion of expected effects of funds already allocated to JI and CDM projects as in Table 3.2.

If additional, specific cost-effective measures that should be included in future planning of reduction efforts are found in connection with the *Policies and measures Project* (section 2.2.4.2), then up-dated projections can be made where expected effects of these additional measures are included.

4 Analysis of the contribution of domestic measures and use of the Kyoto mechanisms

4.1 Evaluation of projected progress in emissions reduction by measure

The result of the latest baseline projection of Denmark's greenhouse gas emissions and removals – "with (existing) measures" projection – is shown in section 3.2 of this report. The conditions and assumptions underlying this baseline projection include estimates of the effects of existing measures on greenhouse gas emissions. The result of the baseline projection is thus the result of combined quantitative estimates of the effects of existing policies and measures on greenhouse gas emissions.

Prior to this analysis, quantitative estimates of the effects of individual measures on greenhouse gas emissions were often limited to ex-ante estimates prior to adoption of the measures. 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, since many areas (sectors/sources) are affected by several measures at the same time.

Despite these difficulties, Denmark has in 2005 completed an analysis of the impact of selected initiated measures on greenhouse gas emissions as a result of Denmark's efforts between 1990-2001. The analysis was published in the report "*Danmarks udledning af CO_2 – indsatsen i perioden 1990-2001 og omkostningerne herved*" (Denmark's CO_2 emissions – the effort in the period 1990-2001 and the associated costs) from the Danish EPA, no. 2, April 2005[20]. In this analysis (hereafter referred to as the *Effort Analysis*), the effects of a number of measures have been estimated – both for 2001 and the period 2008-2012. The latter case, is a so-called "without measures" projection without the effect of measures since 1990 – i.e. estimates of what the volume of average annual greenhouse gas emissions would have been in 2008-2012, if the measures initiated prior to 2001 had not been initiated.

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's Climate Strategy.

The *Effort Analysis* also includes estimates of the costs of some of the individual measures. The analysis is described in more detail in the next section.

4.1.1 The Effort Analysis

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* 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[21].

One of the additional requirements of the Kyoto Protocol is that the use of flexible mechanisms has to 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

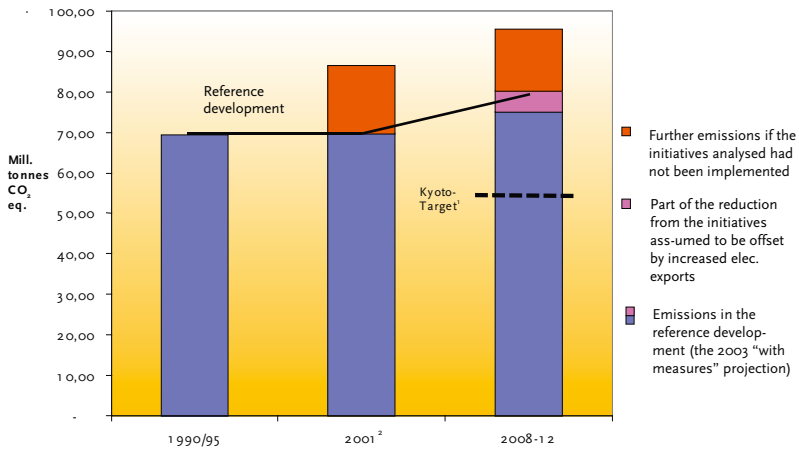
The *Effort Analysis* evaluates the effects of measures implemented in the period 1990-2001 in relation to the actual emissions in 2001, and in relation to the expected average annual emissions in 2008-2012, as laid down in the baseline projection used as a basis for the Danish Climate Strategy from 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 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 4.1 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.

As the Figure 4.1 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

FIGURE 4.1: 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 CO2 reductions that domestic actions have led to in other countries.

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, "*Energipolitiske tiltag i 1990'erne - Omkostninger og CO2-effekt* (Energy policy initiatives in the 1990's: Costs and CO_2 effects) from the Danish Energy Authority, 2005[22]).

The *Effort Analysis'* 'without measures' calculation of CO_2 emissions per sector is shown in Table 4.1 (below). In Denmark's Fourth National Communication on Climate Change, the estimated effects of all of individual measures analysed, can be found.

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 under consideration had not been implemented.

TABLE 4.1: *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.

In summary, the effect in 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. One can therefore conclude 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.

Please note that 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, i.a. 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 CO_2 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 quota scheme from 2005 changes the framework conditions for large parts of the energy sector and energy-intensive industry. Therefore, the calculation method cannot be used to assess future measures within these areas where quotas have been imposed. The introduction of the quota scheme means that CO_2 emissions from the sectors subject to quotas, including electricity production, will be unequivocally determined by the total quota

measured in accordance with Kyoto accounting. The calculations of the shadow values for the areas subject to quotas, 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 1990's 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 baseline projection.

Please note that the CO_2 allowance system 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 4.2 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 associ-

Table 4.2: 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 CO2 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 CO2), Heat pumps (DKK 650/tonne CO2) and Biomass (DKK 600/tonne CO2).

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 CO2 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.

ated 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 1990's: 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

Table 4.3: 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.

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 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 1990's: Costs and CO_2 effects*" .

4.2 Achievement of targets under the Kyoto Protocol in terms of overall greenhouse gas "with measures" projections

As shown in section 3.2.1 the base projection of Denmark's greenhouse emissions and removals in 2004-2030 was up-dated in May 2005. This up-date ("with (existing) measures" projection) builds on, e.g. an updated energy projection, which now includes expected effects of the implementation of the EU allowance directive (cost effects alone of the implementation of the directive– i.e. excluding the effect of the allowance itself, which for the period 2008-2012 will not be decided before 2006). The expected effects of the Action Plan for the Aquatic Environment III are also included in the base projection.

The outcome of this projection of emissions is shown in Table 3.2, together with expected effects of the allocation of funds to JI and CDM projects in 2003-2008.

As shown in Table 3.2, the Danish deficit is estimated on this background to be at approx. 13 million tonnes of CO_2 equivalents annually, based on Denmark's legal commitment according to the EU Burden Sharing Agreement. This is based on a situation where no correction has been made for the particularly large imports of electricity in 1990.

If this correction is made as assumed by Denmark, the deficit is reduced to approx. 8 mill. tonnes of CO_2 equivalents annually in 2008-2012, as shown in Table 3.2. The deficit of 20-25 million tonnes of CO_2 equivalents annually in 2008-2012 is based on a projection showing the expected development without implementation of the additional measures, which were presented together with the Government's *Proposal for a Climate Strategy for Denmark* in February of 2003. The new projection from May of 2005 of the mean annual deficit in 2008-2012 is approx. 12 million tonnes of CO_2 equivalents lower than the previous one.

With the choice of method, the deficit expresses the need to purchase allowances from abroad or to implement new measures outside the sectors subject to allowances. So, as

a result of the introduction of the CO_2 allowance scheme, the deficit is in principle not directly comparable to the deficit in the government's Climate Strategy, since the cost effects of the allowances are included, whereas ultimately the allocation of allowances decides the climatic effects of the scheme.

Note that the projection, and therefore also the deficit, is based on model predictions, which are subject to uncertainty. This applies, not least, to expected developments in energy prises, prises of CO_2 allowances, and the developments in the Nordic electricity market, which have a direct influence on the size of exports of electricity. The implementation of the EU allowance scheme has, however, created a basis for greater certainty regarding the fulfilment of Denmark's climate commitments under the Kyoto Protocol and EU burden sharing.

The main instrument for fulfilling Denmark's climate commitments is secured with the allowance scheme.

Other measures will be implemented, if they can contribute cost-effectively. Additional cost-effective measures identified by the *Measures Project* and further allocation of funds for JI and CDM projects are expected to eliminate the deficit entirely.

Sector policy measures that can have climate relevance in the short or long term, including the long-term energy strategy towards 2025 and the action plan for increased energy saving, will also be implemented.

The "with measures" projection presented in this report is the most recent projection. It was finalised in May 2005 and it is in general based on expected effects of policies and measures implemented or adopted until the end of 2004. Due to the adoption of additional energy-savings initiatives in 2005, up-dated projections in the off-shore sector and new IEA projections of energy prices, an update of the May 2005 "with measures" projection has been initiated. However, results from this update will not be available until the beginning of 2006. Preliminary results suggests that the action plan on additional energy-savings initiatives could lead to a 2 mill. tonnes further reduction in annual CO_2 emissions 2008-2012.

5 Progress concerning the other commitments under articles 10 and 11 of the Kyoto Protocol

In accordance with the Climate Convention and articles 10 and 11 of the Kyoto Protocol, Denmark is continuously:

- improving the emission inventories etc.: the national system for making emission inventories under the Kyoto Protocol is being established,

- preparing to adapt to climate changes: a national strategy is being prepared,

- ensuring the introduction, dissemination, and transfer of climate-friendly technology: the Danish Government is giving high priority to scientific research and development, including green technology, which is included in the Government platform. In the EU, heads of state and government have encouraged Member States to prepare "roadmaps" for efforts to be made concerning environmental technology, including relevant measures and timetables. The Government will – as also encouraged to by the Danish Parliament, *Folketinget* - continue its focused efforts to promote development and use of environmentally efficient technologies and prepare a Danish action plan for environmental technology and a report to *Folketinget*,

- promoting co-operation in scientific and technological research: Danish universities and businesses are co-operating in developing climate-friendly technology, in part with the support of a number of research programmes, including the Energy Research Programme, which is mentioned in Denmark's Fourth National Communication,

- supporting capacity-building concerning climate, especially in developing countries: Denmark has a long tradition of giving assistance to and supporting capacity building in developing countries, also concerning climate, as shown in e.g. Denmark's Fourth National Communication, and

- giving assistance to implement the Climate Convention in developing countries: Danish assistance to developing countries, not least the poorest countries, also includes assistance to implement the Climate Convention.

Additional information on these activities is available in Denmark's Fourth National Communication on Climate Change.

Notes

1 (Decision 22/CP.7 and Decision 25/CP.8)

2 The "with measures" baseline projection presented in this report is the most recent projection. It was finalised in May 2005 and it is in general based on expected effects of policies and measures implemented or adopted until the end of 2004. Due to the adoption of additional energy-savings initiatives in 2005, up-dated projections in the off-shore sector and new IEA projections of energy prices, an update of the May 2005 "with measures" projection has been initiated. However, results from this update will not be available until the beginning of 2006. Preliminary results suggest that the action plan on additional energy-savings initiatives could lead to a 2 mill. tonnes further reduction in annual CO_2 emissions 2008-2012.

3 It should be noted that Greenland is not included in the European Union.

4 For Faroe Islands, which is also a part of the Realm, territorial reservation was taken in connection with the Kingdom of Denmark's ratification of the Kyoto Protocol. And the Faroe Islands are not included in the European Union.

5 http://www.retsinfo.dk/

6 Denmark's Greenhouse Gas Projection up to 2012, an up-date including preliminary projection up to 2017, December 2002, Jørgen Fenham, UNEP-centre.

7 Difference between 20 and 25 million 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.

8 "Danmarks udledning af CO_2 – indsatsen i perioden 1990-2001 og omkostningerne herved" (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)

9 http://www.ens.dk/graphics/CO2_kvoter/Kvoteomfattede_Produktionsenheder_2005-01-13b.xls (in English: http://www.mst.dk/transportuk/pdf/NAPeng.xls)

10 http://www.mst.dk/transport/01100000.htm

11 Under the Kyoto Protocol, Denmark's base year is 1990 for CO_2, methane and nitrous oxide, whereas 1995 will be chosen as base year for the industrial gases (HFCs, PFCs, and SF6) cf. Article 3.8 of the protocol.

12 Under the Kyoto Protocol, the LULUCF category is dealt with separately under articles 3.3 and 3.4. Since effects of afforestation must be included as a contribution to fulfilling the reduction target, according to article 3.3, these are also included here. Since it is optional to include effects of activities under article 3.4 and Denmark has not yet made a decision on this, these effects are excluded here.

13 See http://ens.dk/graphics/Publikationer/Energipolitik_UK/Energy_Strategy_2025/index.htm

14 See http://ens.dk/graphics/Publikationer/Energipolitik/TRM_handlingsplan_web.pdf

15 Olesen et al., 2004

16 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. (Agriculture and climate change - interaction with action plans for the aquatic environment) DJF report Markbrug no. 109.

17 Olesen, 2005: Olesen, J.E. (2005). Muligheder for reduktion af drivhusgasemissioner i jordbruget. (Possible ways of reducing greenhouse gas emissions from agriculture) In: Olesen, J.E. (red). Drivhusgasser fra jordbruget - reduktionsmuligheder. (Greenhouse gases from agriculture – reduction possibilities) DJF report Markbrug no. 113, pp. 12-32.

18 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. (Quantification of three measures for reducing greenhouse gas emissions from agriculture) DJF report Markbrug 48.

19 "LUCF" stands for "Land-Use Change and Forestry". This is a source category in the UN guidelines for making inventories on greenhouse gas emissions and removals under the Climate Convention, under which CO_2 emissions and removals in connection with land-use changes feature. According to articles 3.3 and 3.4 of the protocol, only certain parts of this can be included. So, persuant to the reporting commitments under the Climate Convention, net CO_2 emissions and total greenhouse gas emissions are to be reported both with and without inclusion of this source category.

20 http://www.mst.dk/transport/01041000.htm

21 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.

22 http://www.ens.dk/graphics/Publikationer/Energipolitik/energipol_tiltag_CO2effekt.pdf.

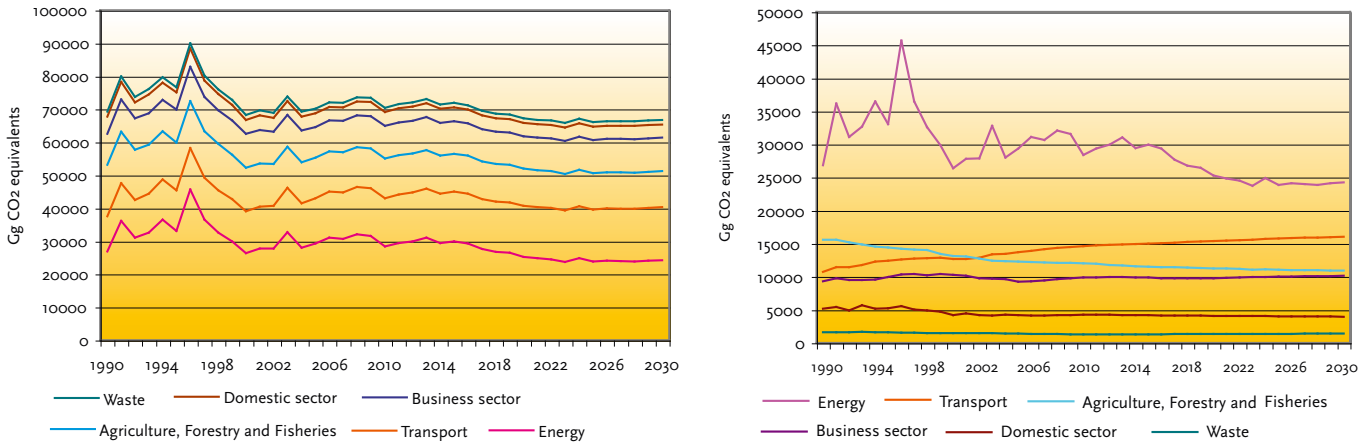
Annex Selected indicators

1. Greenhouse gas inventories and projections

Figure 5.1 Denmark's expected net greenhouse gas emissions under the Kyoto Protocol for 2004-2030 in the new baseline projection, which is a projection "with measures", i.e. a projection that only includes expected effects of existing and adopted measures. Both accumulated and non-accumulated trends are shown.

Source: 1990-2003: The National Inventory Report (NIR), the National Environmental Research Institute (NERI), April 2005.

2004-2030: Projection of greenhouse gas emissions, Memorandum to the Danish EPA, NERI, May 2005.

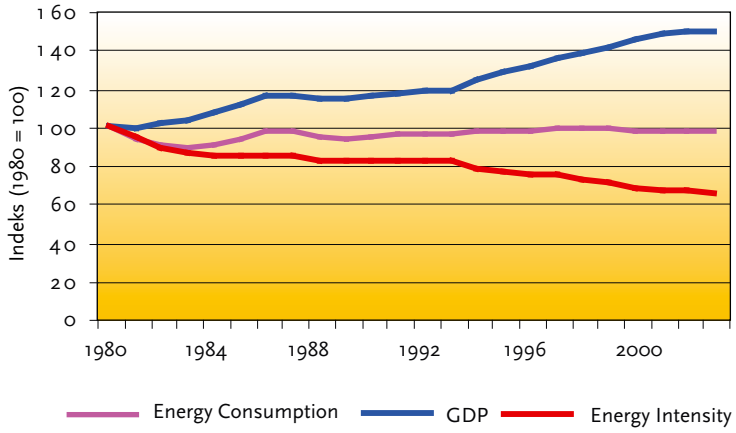


This Figure shows the actual trends 1990-2003 and projected trends 2004-2030 in Denmark's total greenhouse gas emissions by economic sector both accumulated (to the left) and non-accumulated (to the right). Projected trends are from Denmark's latest baseline projection (the so-called "with measures" projection) from May 2005. Further information on the projections and policies and measures in the economic sectors is available in text of this report and in Denmark's Fourth National Communication.

2. Gross Domestic Product (GDP), CO_2 emissions and energy consumption

Figure 1.1 Trend in final energy consumption, GDP and energy intensity

Source: Danish Energy Authority

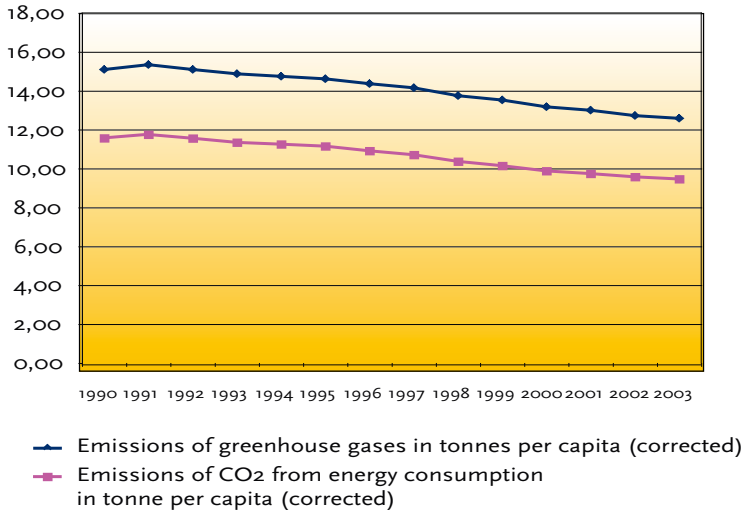


This Figure shows GDP developments, corrected CO_2 emissions and gross energy consumption from 1975 to 2003.

Corrected means that variations due to climate and net exports of electricity are compensated for. Denmark's corrected gross energy consumption and CO_2 emissions in 2003 were almost the same as in 2002. Since 1990, GDP has increased 30%, whereas the corrected energy consumption has only increased app. 1%. During the same period, corrected CO_2 emissions decreased app. 15%, due, in particular, to increased use of renewable energy and use of natural gas at the power plants. Natural gas produces less CO_2 per unit of energy than, e.g. oil and coal.

3. Emissions of greenhouse gases and CO_2 per capita

Source: National Environmental Research Institute and Statistics Denmark

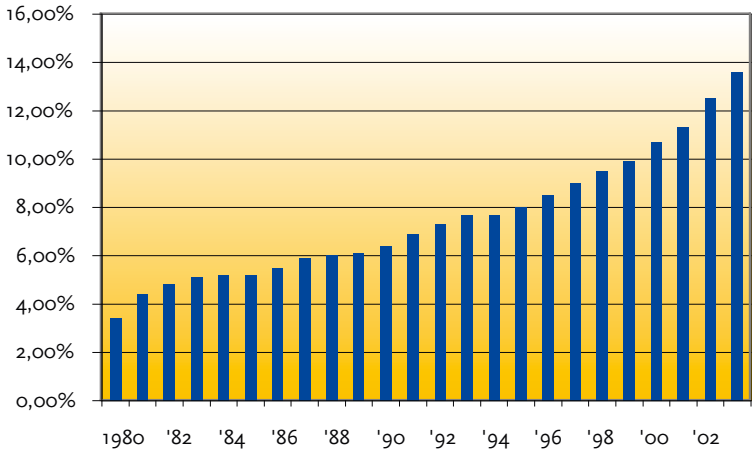


This Figure shows Denmark's corrected total greenhouse gas emissions and CO_2 emissions per capita from the base year under Kyoto Protocol to 2003. Corrected means that variations due to climate and net exports of electricity are compensated for in order to better reflect Denmark's efforts and progress with national measures aiming at reducing emissions from energy consumption by the Danish population. Denmark's corrected total greenhouse gas emissions and CO_2 emissions per capita both decreased about 17% in the period.

4. Renewable energy

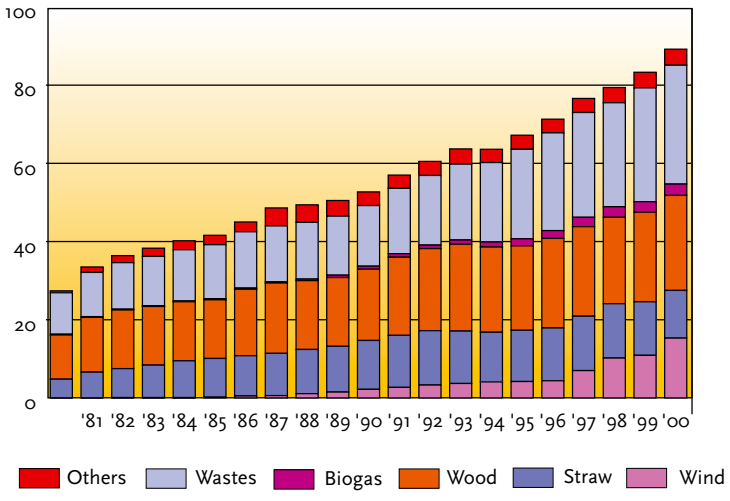
Source: Danish Energy Authority

4a. Production of Renewable Energy etc. – Share of Gross Energy Consumption



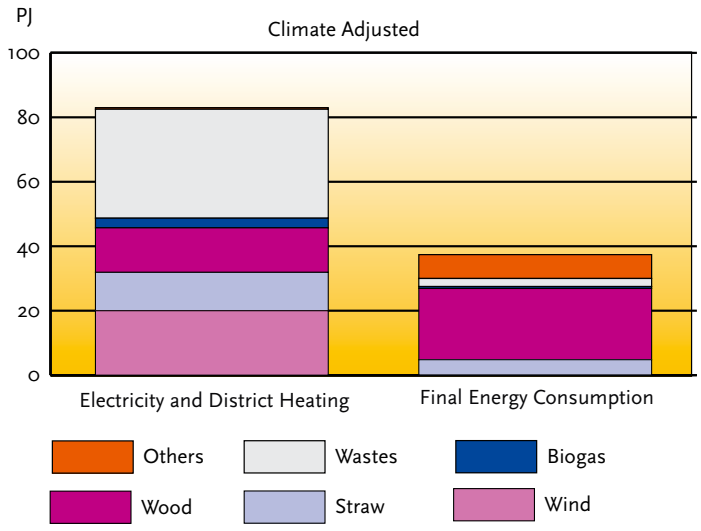
Renewable energy etc. includes solar energy, wind energy, hydropower, geothermal energy, biomass, biodiesel, biogas, wastes and heat pumps. Year by year, renewable energy etc. is accounting for a greater share of total energy consumption. In 2003, the production of renewable energy etc. covered 13.6 per cent of the climate-adjusted gross energy consumption as opposed to 6.4 per cent in 1990 and 3.4 per cent in 1980. Since 1995, the proportion has increased on average by between half and one percentage point annually. The increased use of renewable energy etc. makes a significant contribution to reducing Danish CO_2 emissions.

4b. Renewable Energy etc. by Energy Product



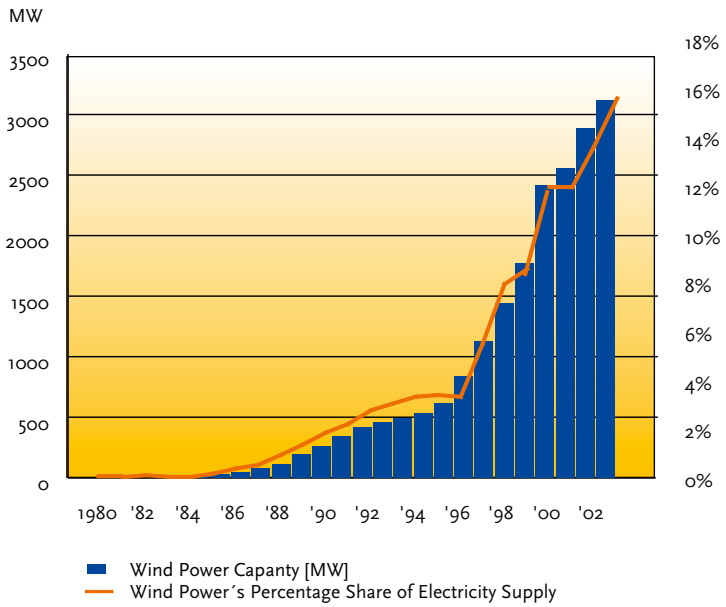
Production of renewable energy etc. increased in 2003 to 112.3 PJ, which is 10.4 PJ or almost 10 per cent more than the previous year. Production of biomass energy (wood and straw) increased by 3.6 PJ to 46.3 PJ and thus was the largest contributor to the increase. Wind energy increased by 2.5 PJ to 20.0 PJ, while energy from wastes increased in 2003 by 1.3 PJ to 36.2 PJ. Biomass represented 41 per cent of the renewable energy etc. produced in 2003. Wastes and wind power accounted for 32 per cent and 18 per cent respectively. Consumption of renewable energy, etc. is greater than production. In 2003, 6.4 PJ wood pellets and wood chips were imported, while 1.7 PJ biodiesel was exported.

4C. Uses of Renewable Energy etc. in 2003



Total consumption of renewable energy, etc. in 2003 (production plus net imports) was 117.0 PJ, of which 82.9 PJ was used in the production of electricity and district heating. Wastes energy was clearly dominant followed by biomass and wind power. The development of offshore wind parks means wind power is expected to play a more prominent role in the years to come. 34.1 PJ renewable energy etc. was included in the final energy consumption, i.e. in processing and heating in the agriculture and industry sector and the trade and service sector, as well as heating in households. In final energy consumption, biomass, particularly wood, is most prominent. Additionally, a small amount of biogas was used by the energy sector.

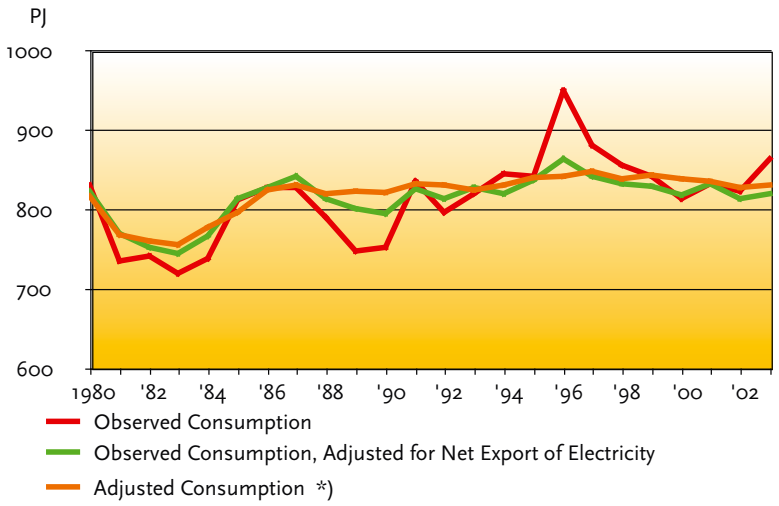
4D. Wind Power Capacity and Percentage Share of Electricity Supply



Wind power constitutes an ever larger proportion of the Danish electricity supply. 15.8 per cent of electricity was supplied by wind power in 2003, as opposed to 13.8 per cent in the previous year. The increases in wind power capacity and production do not always correspond exactly, as annual wind power production is highly dependent on wind conditions, which can be quite variable in Denmark. 2001 was a relatively poor wind year, while 2002 and 2003 were close to a normal wind year. Wind power capacity in 2003 was 3115 MW, which is 7.9 per cent more than the year before.

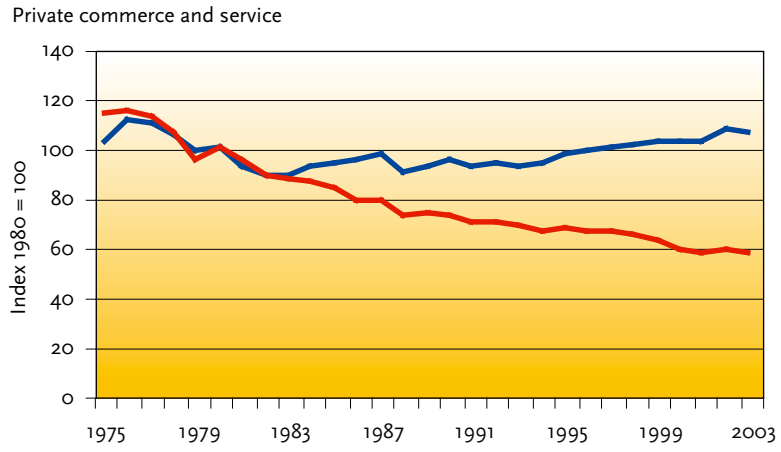
5. Gross energy consumption and energy intensity

Source: Danish Energy Authority

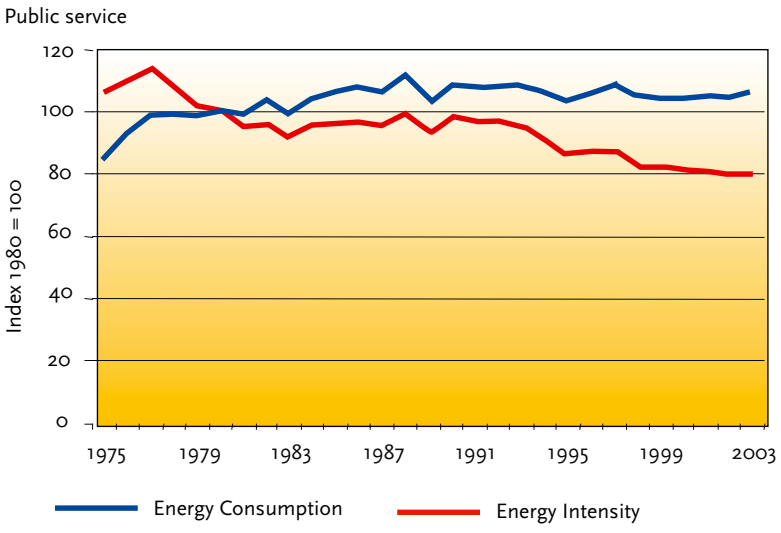


5a. Gross Energy Consumption – Observed and Adjusted

Observed energy consumption shows the registered amount of energy consumed in a calendar year. Gross energy consumption is derived by adjusting observed energy consumption by the fuel consumed to produce electricity for foreign trade. Additionally, the adjusted gross energy consumption is adjusted for climate variations with respect to a normal weather year. The purpose of this consumption figure is to provide a clearer picture of trends in domestic energy consumption. Adjusted gross energy consumption in 2003 was 829 PJ as opposed to 827 PJ in 2002 and 820 PJ in 1990. Observed energy consumption in 2003 was 863 PJ, which is 5.0 per cent higher than for 2002. It is 14.7 per cent higher than in 1990, which should be regarded in the context of considerable net imports of electricity in 1990 as opposed to even larger net exports in 2003.



5b. Energy Intensity in Private Commerce and Service and Public Sector



As can be seen from this Figure, over the past 15 years there has been a steady increase in energy consumption by the private commerce and services sector. Primarily

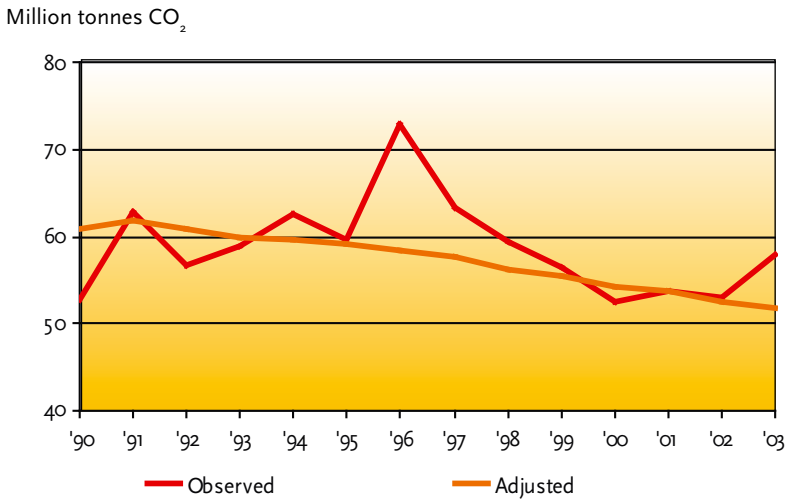
electricity consumption has been rising. The growth in energy consumption by the service sector is due to high growth in this sector and reflects a development where services are becoming increasingly important in the economy. As the Figure shows, there has been a constant drop in intensity of on average 2.3% per year from 1975-2003. Since 1990 the drop has been on average 1.6% per year.

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

6. CO2 FROM ENERGY CONSUMPTION

Source: Danish Energy Authority

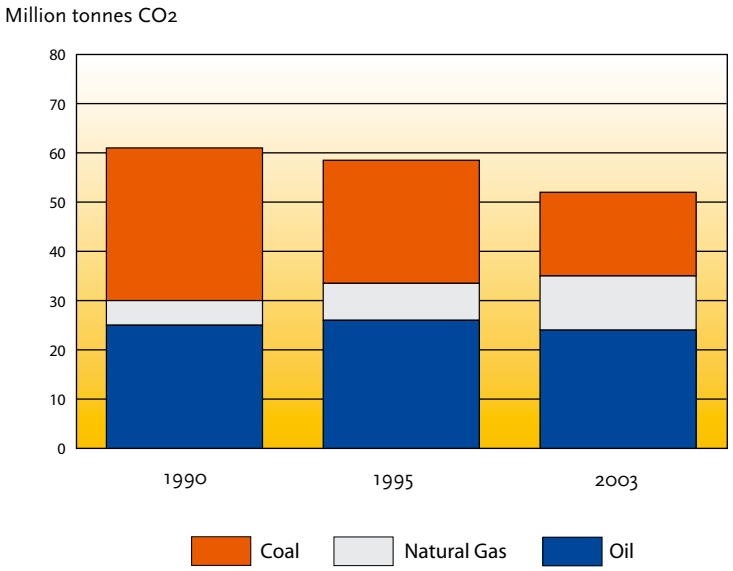
6A. CO2 EMISSIONS, OBSERVED AND ADJUSTED



The Danish Energy Authority calculates both observed CO_2 emissions and adjusted CO_2 emissions, taking into consideration annual temperature variations and foreign trade in electricity. The aim of the adjusted statement is to obtain a better picture of the underlying trends in the development. In 2003, observed CO_2 emissions went up by 9.3 per cent in relation to 2002. Compared with 1990, observed CO_2 emissions were 9.9 per cent higher. This trend should be seen in the context of a significant increase in net electricity exports from 2002 to 2003. Moreover, the weather was colder in 2003 than in 2002. In 1990, Denmark had large net imports of electricity. In 2003, the adjusted CO_2 emissions were 1.2 per cent lower than the year before. Compared with 1990, there has been a fall of 14.9 per cent.

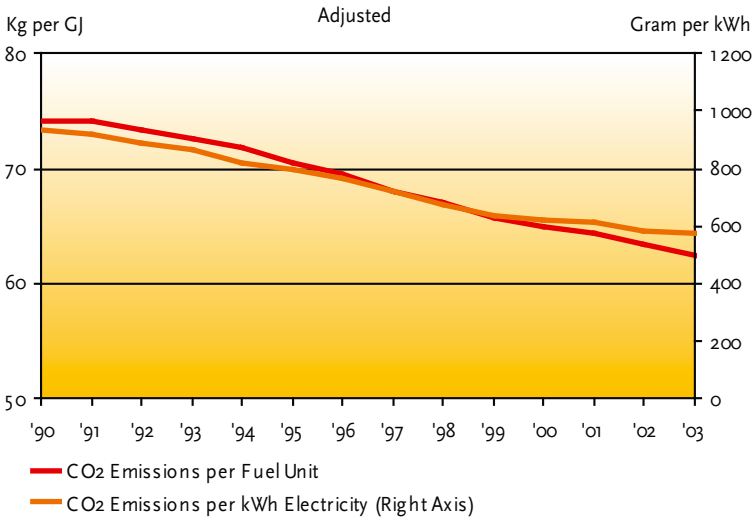
6B. CO_2 Emissions by Fuels

Since 1990, there has been a marked shift in the breakdown of energy consumption by fuel. Consumption of natural gas and renewable energy etc. has increased at the expense of coal consumption. The change in fuel types has led to a decline in CO_2 emissions despite an increase in gross energy consumption of 1.0 per cent since 1990, as coal burning generates greater CO_2 emissions than the burning of natural gas.

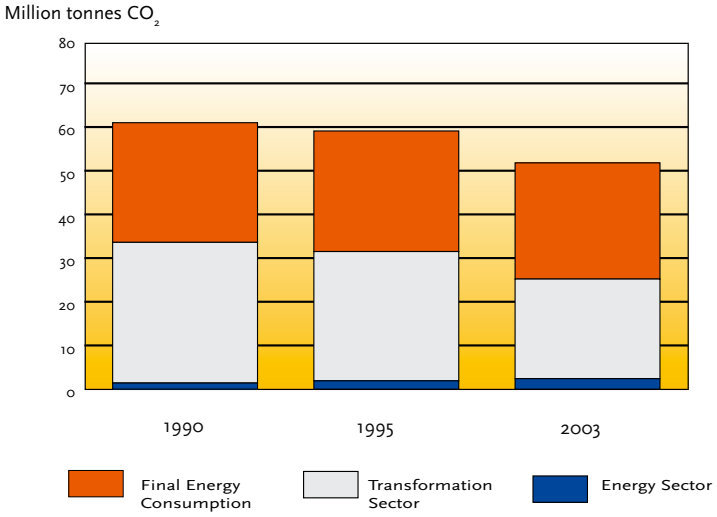


6C. CO_2 Emissions per Fuel Unit and per kWh of Electricity

Gross energy consumption has been more or less constant over the last 10 years; however, the fuels used have changed considerably. The shift from coal to natural gas and renewable energy etc. has meant that, year by year, less CO_2 is linked to each unit of fuel consumed. Thus, in 2003 each GJ of adjusted gross energy consumption was linked to 62.5 kg CO_2, against 74.2 kg in 1990. In 2003, fuel consumption in electricity generation adjusted for electricity exports and climate variations resulted in emissions of 572 g CO_2 per kWh electricity. In 1990, 937 g CO_2 were emitted per kWh electricity.



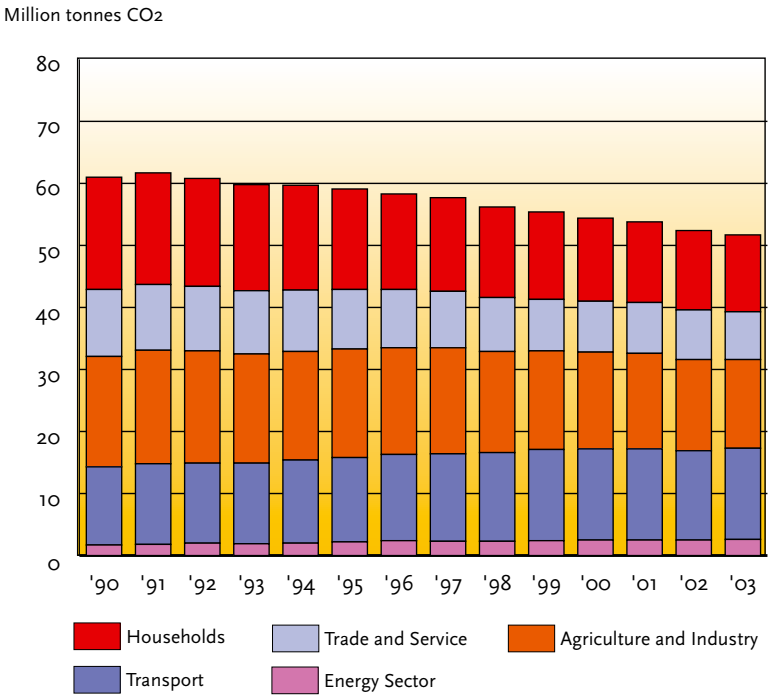
6D. CO2 Emissions by Sector



The energy system is divided into three sectors: *energy sector* (extraction and refining), *transformation sector* (production of electricity, district heating and town gas) and *final consumption* (transport and consumption in households and agriculture and industry, excluding energy and transformation sectors). Most of the CO_2 reduction since 1990 has been in the transformation sector, when net exports of electricity are disregarded. CO_2 emissions in the transformation sector were at 22.8 million tonnes in 2003 compared to 32.2 million tonnes in 1990, corresponding to a decrease of 29.1 per cent. Today, the largest contribution to Danish CO_2 emissions comes from final consumption. In 2003, CO_2 emissions were at 26.6 million tonnes, as opposed to 27.4 million tonnes in 1990. This corresponds to a reduction of 2.7 per cent.

6E. CO2 Emissions in Final Energy Consumption incl. Energy Sector

A distribution of CO_2 emissions caused by electricity generation and production of district heating and town gas amongst end consumers illustrates how total emissions of CO_2 can be attributed to the energy sector, transport, agriculture and industry and households. In 2003, the agriculture and industry sector and transport were responsible for the largest shares of total CO_2 emissions, with 28.5 per cent and 27.8 per cent respectively. Households and the trade and service sector accounted for 24.0 per cent and 15.0 per cent respectively, while the energy sector accounted for 5.0 per cent of CO_2 emissions. In relation to 1990, CO_2 emissions from transport increased by 16.9 per cent. However, for agriculture and industry and households there have been significant decreases. In the agriculture and industry sector and the trade and service sector, CO_2 emissions fell by 19.7 per cent and 28.2 per cent respectively, while for households the fall was 31.3 per cent.



Data Sheet

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Abstract:
"Denmark's Climate Policy Objectives and Achievements" is Denmark's report on demonstrable progress in 2005 under the Kyoto Protocol in accordance with decisions taken under the United Nations Framework Convention on Climate Change. The report presents progress made in Denmark in the endeavours to fulfil its international climate commitments.

Supplementary notes:
The report has been prepared to be forwarded to the UN secretariat for the Climate Convention and to the European Commission. Except for minor updates it was published in Danish in June 2005.

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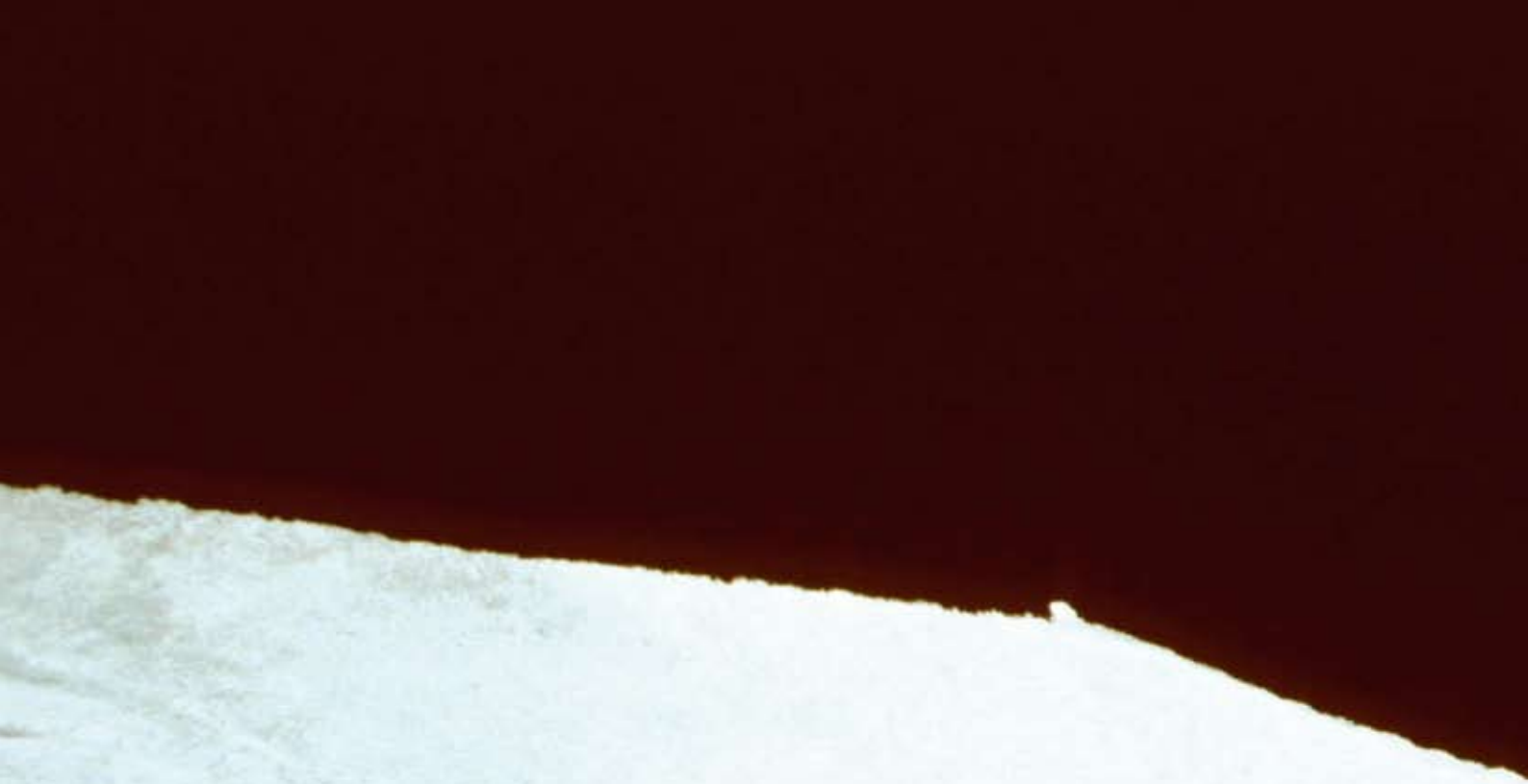

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