Denmark

Sources of information

The following communications have been made available for this study.

- Follow-up on Energy 21 — Status of energy planning, Danish Energy Agency, June 1999.
- Projections of emissions of greenhouse gases, ozone precursors and sulphur dioxide from Danish sources until 2012, prepared by Risoe National Laboratory, Danish Energy Agency, December 1999.
- Proposal for regulating the potent industrial greenhouse gases, HFCs, PFCs and SF6, January 2000.
- Note on new projections of emissions of HFCs, PFCs and SF6, January 2000.
- Climate 2012 — Status and Perspectives for Denmark's Climate Policy, The Ministry of the Environment and Energy, March 2000.
- Energy Policy Review 2001, Statement by the Minister for Environment and Energy pursuant to the Act on Energy Policy Measures, April 2001.
- Proposal for Parliamentary Resolution on ratification of the Kyoto Protocol to the UNFCCC, unofficial translation, Danish Energy Agency, April 2001.
- Denmark's GHG Projections until 2012, prepared by Risoe National Laboratory, Danish Energy Agency, April 2001.
- Denmark's GHG Inventories and Projections 1990–2012, Danish Energy Agency, June 2001.
- Preliminary data from the Danish database on initiatives/PAMs, Danish Energy Agency, June 2001.
- Workshop on Energy-related National and EU-wide Projections of GHG emissions, 27–28 February 2002.
- Denmark's National Greenhouse Gas Inventory 1990–2000, National Environmental Research Institute, March 2002.
- Proposal for Parliamentary Resolution on ratification of the Kyoto Protocol to the UNFCCC, unofficial translation, Danish Environmental Protection Agency, April 2002.
- Statutory Order Regulating Certain Industrial Greenhouse Gases, unofficial translation, Danish Environmental Protection Agency, July 2002.

In addition, a meeting was held between AEAT and the Danish Energy Agency during April 2000 at which the projection procedures and contents of Climate 2012 were discussed.

Quality and transparency of reporting

Table 1: Information provided on policies and measures

Information provided	Level provided	Comments
Policy names	Yes	
Objectives of policies	Yes	These are covered in the narrative.
Which greenhouse gases?	CO_2, CH_4, N_2O + F-gases	
Status of implementation	++	Mainly associated with existing historic measures
Implementation body specified	++	Activities in some areas are well advanced
Quantitative assessment of implementation	+++	Quantitative assessments made of Energy 21 programme implementation in June 1999
Interaction with other P&Ms discussed	—	Not examined

+, ++, +++ level of information available increases as the number of + signs increases

The national forecasts are based on econometric modelling techniques and have been described in the Second National Communication, although updates to the methodology are now in place. There are no English translations of the model updates.

Table 2: Information provided on projections

Category of information	Level of information provided	Comments
Scenarios considered	Not discussed in latest communication	Information is given on P&Ms included in the with measures scenario.
Expressed relative to inventory for previous years	Yes	
Starting year	Yes	
Split of projections	+	Shown for all gases
Presentation of results	+++	Good. Results are presented in CRF
Description of model (level of detail, approach and assumptions)	++	Discussion with DEA indicates different models for different sectors. Description and level of detail good.
Discussion of uncertainty	—	
Details of parameters and assumptions	++	Discussion of parameters and assumptions provided

+, ++, +++ level of information available increases as the number of + signs increases

Assessment of policies and measures

Table 3: Summary of the effect of policies and measures included in the projections ($MtCO_2$)

	With measures	With additional measures
Cross sector		1
Energy		
Transport		0.9
Agriculture		
Trade and industry		
Households		
Waste		
Total		1.9

A 'without measures' reference scenario has not been provided and thus the effect of policies and measures under the 'with measures' scenario' cannot be calculated. Some disaggregation of savings are

provided though this is not adequate to give the effect of policies and measures on a sector by sector basis.

Existing policies and measures have been expanded to cover the likely gap between the current forecast and the commitment of –21 %. The following table summarises both existing and additional measures.

Table 4: Detailed information on polices and measures[1]

Sector	Name	Objective	GHG affected	Type of instrument	Status	Implementing entity	Estimate of savings ($MtCO_2$)		CCPM
							2010	2020	
Policies and measure in the with measures projection									
Sector	Name	Objective	GHG affected	Type of instrument	Status	Implementing entity	Estimate of savings ($MtCO_2$ equiv)		CCPM
							2010	2020	
Energy supply	Existing biogas action plan	Expansion of wind power and biomas	Mainly CO_2	Fiscal (R & D subsidy)	Given	Given	3	Not given	y
Energy supply	Wave energy programme	To develop wave energy	CO_2	Fiscal (R & D subsidy)	Implemented	Government	Not given	Not given	y
Cross sector	Target to stabilise emissions in 2005 at 1998 level.	Not given	Not given	Not given	Not given				n
Transport	Energy labelling of new cars	To reduce demand	CO_2	Information/regulatory	Implemented	Government	Included in transport initiative	Not given	y
Energy supply	Power generation — existing measures plus quotas	Lower level of electricity generation	Mainly CO_2	Economic, regulation		Given	13	Not given	n
Energy supply	Benchmarking in heat supply sector	Ensure on-going cost effectiveness of heat supply	CO_2	Information/other	Planned	Government	Not given	Not given	n

[1] The policies and measures listed relate to the April 2001 GHG projection. Due to the change of government in Denmark's this list is under revision and new 'with measures' and 'with additional measures' projections is expected to be finalised by the end of 2002 and mid 2003 respectively.

Sector	Name	Objective	GHG affected	Type of instrument	Status	Implementing entity	Estimate of savings ($MtCO_2$)		CCPM
							2010	2020	
Agriculture	Agriculture — existing measures	Non-CO_2 reduction	CH_4 and N_2O	Fiscal (subsidy) and regulation	Given	Water environment plan II	A 20 % emissions reduction in agricul-ture	Not given	n
Domestic	Domestic sector economic instruments	Additional demand reduction	Mainly CO_2	Fiscal (tax and subsidy), information, regulation	Not given — Parliamentary debate	Given	0.4 gas deregn. 1.6 green tax subsidy schemes	Not given	n
Commercial/ residential	Energy management in large buildings	Reduction of energy consumption	CO_2	Regulatory (labelling)	Implemented	Government	Not given	Not given	y
Commercial/ residential/ public sector	Electrical appliances	Develop-ment and use of more energy efficient appliances	CO_2	Agreement and information	Implemented	Energy Saving Trust	Not given	Not given	n
Commercial/ residential/ public sector	Subsidies for conversion of electrically heated dwellings	Reduction of energy consumption	CO_2	Fiscal (Subsidy)	Implemented	Danish electricity saving trust	Not given	Not given	n
Commercial/ residential/ public sector	Subsidies for condensing boilers	Reduction of energy consumption	CO_2	Fiscal (Subsidy)	Implemented	DEA	Not given	Not given	n
Public sector	Energy supply in public sector	Reduction of demand in public sector	CO_2	Information	Implemented	DEA	Not given	Not given	n

Sector	Name	Objective	GHG affected	Type of instrument	Status	Implementing entity	Estimate of savings ($MtCO_2$)		CCPM
							2010	2020	
Domestic	Energy labelling	Labelling of domestic appliances	CO_2	Regulation, information	Implemented	Government	Not given	Not given	y
Industry	Industry efficiency improvements	Additional demand reduction	Mainly CO_2 also F-gases	Voluntary agreement, fiscal (tax), regulation	Not given — Parliamentary debate F-gases: Both tax and regulation implemented[2]	Government	0.6 green tax package 0.7–0.8 limiting industrial gases		n
Waste	Waste incineration	Use in CHP and district heating	Mainly CO_2	Fiscal (waste levy and subsidy)	Not given	Given	0.6	Not given	y
Policies and measures in the with additional measures projection									
Cross sector	Energy saving measures	To reduce demand	CO_2		Agreed	DEA and Government	1	Not given	n
Transport	Transport initiatives	Demand reduction	Mainly CO_2	Information, Fiscal (tax)	Existing meas. assessed. New priority initiatives to be assessed 2001	Given	0.9	Not given	y

[2]. The expected effect of taxes, which entered into force in marts 2001, was included in the April 2001 projection. The regulation has recently been adopted in July 2002. The combined effect will together with a change in methodology be included in new 'with measures' projections to be finalised by the end of 2002.

Evaluation of projections

The latest projections (April 2001) show total greenhouse gases reductions of 18.1 % (excluding sinks) between 1990 and 2010 when the latest emission inventories (March 2002) are used for the base year. This compares to Denmark's' commitment under the EU burden sharing agreement of –21 %. The saving from additional measures[3] brings the 2008–2012 projection to –20.1 % without removals from sinks and –20.6 % if sinks are included.

Table 5: Summary of projections by gas in 2010 ($MtCO_2$)

	Base year[1]	With measures[2]	With additional measures[2]
CO_2 with removals by sinks since 1990	58.9	47.8	45.9
CO_2 without removals by sinks since 1990	58.9	48.2	46.3
CH_4	5.8	4.9	4.9
N_2O	10.8	8.6	8.6
Fluorinated gases[3]	0.3	0.9	0.9
Total with removals by sinks since 1990	76.0	62.2	60.3
Total without removals by sinks since 1990	76.0	62.6	60,7
% change relative to base year with sink		–18.1 %	–20.6 %
% change relative to base year without sink		–17.6 %	–20.1 %

1) Base year emissions increased to even out effect of electricity import in 1990.
2) Including a continuation of the CO_2 quota scheme with quotas set to reflect domestic consumption 2008–2012.
3) Fluorinated gases base year 1995 (all other gases have 1990 base year).

In the latest projection, the energy sector is projected to have the largest decrease in GHG emissions relative to 1990, followed by waste and agriculture. A significant increase in transport emissions is predicted, even with the existing measures and additional measures planned.

Table 6: Summary of projections by sector in 2010 ($MtCO_2$)[a]

	Base year	With measures	% change relative to 1990	with additional measures	% change relative 1990 (additional measures)
Energy	33.3	21.2	–36 %		
Transport	10.7	13.8	29 %		
Agriculture	16.8	12.5	–26 %		
Trade and industry	8.6	9.6	12 %		
Households	5.3	4.2	–21 %		
Waste	1.30	0.9	–29 %		
Total (with sinks)	76.0	62.2	–18 %		

a) The sector projections are for all GHGs (CO_2, CH_4, N_2O, F-gases)

Denmark GHG emissions are predicted to almost reach the Kyoto commitment of –21 % if all existing and additional measures are implemented and effective. The additional measures almost close the gap of 3.4 % to the target.

[3] The former Danish government planned these additional measures. Due to the change of government in Denmark the list of existing and additional policies and measures is under revision.

Table 7: Assessment of the target

	$MtCO_2$ equiv.	% of 1990 level (six gas basket)
Base year (from projections)[1,3]	76.0	
Commitment	60.0	–21 %
With existing P&Ms[1,2,3]	62.6	–18.1 %
Gap (-ve means no gap)	2.6	3.4 %
Effect of additional P&Ms	1.9	2.5 %

1) Base year emissions increased to even out effect of electricity import in 1990.
2) Including a continuation of the CO_2 quota scheme with quotas set to reflect domestic consumption 2008–2012.
3) The emission projections and base year exclude carbon sinks
4) The former Danish government planned these additional measures. Due to the change of government in Denmark the list of existing and additional policies and measures is under revision.

Description of modelling approach

Energy demand forecasts are based on econometric regression techniques, although in the case of households a more bottom- up approach is used based on housing changes and electrical appliance demands. Industrial projections are made using EMMA, a top-down econometric model, where fuel consumption is based on economic activity, efficiency and relative energy prices. Transport is modelled separately by the Ministry of Transport based on ad hoc bottom-up calculations.

The Risoe National Laboratory combined activity data projections and emission factors and calculated future GHG emissions in a spreadsheet model. They also modelled non-energy sources. Agriculture, which is responsible for around 22 % of GHG emissions, relies on estimates of animal numbers and farming practices.

A technical model was used to forecast electricity and heating activity, based on future household demand. Over the period 2000–2012 the final energy consumption of households was predicted to decrease by 0.4 %.

Energy production forecasting uses detailed bottom-up simulation modelling (Ramses) relying on knowledge of individual power stations and heat producing plants. Modelling of future production is shown in the Climate 2012 summary document indicating variable year-on-year savings from the energy sector. Electricity export peaked in 1996 and then reduces and will decline further to 2000 because of the new quota system (see previous discussion in Table 4). After 2000, export is forecast to rise even with penalties under the quota system. At 2002, a new CCGT plant is expected to come on stream, but because of a gradual growth in electricity prices export will increase again until the commitment period, where significant CO_2 reductions will need to be made or permits purchased. It is forecast that compared to 1990, greenhouse gas emissions from the energy sector will be 36 % lower.

Modelling parameters used in the projections are given below.

Modelling parameters

Parameter	2000	2010	Unit
Population	5.34	5.44	Millions
GDP	2.4	1.5	% Growth/year
Oil (international price, IEA)	28.4	21	USD (2000)/bbl
Coal (international price, IEA)	32.8	46.5	USD (2000)/tonne
Transport passenger growth	79366	87169	Passenger km – Millions
Freight growth	14300	16524	Tonnes km – Millions

Source: Questionnaire

Country conclusions

Since 1990 Denmark has had in place a climate change strategy (the Energy 2000 plan) which was updated in 1996 (the Energy 21 plan) with the national CO_2 target confirmed. The national target for reducing CO_2 emissions set in 1990 is still 20 % by 2005 compared with 1988 levels. The additional target for the transport sector (CO_2 emissions at 2005 would be the same as at 1988 which implied that other CO_2 emissions must reduce by 25 % by 2005 compared to 1988) was revised in April 2001. According to the new transport action plan the new initiatives will contribute 'with additional measures' reductions in the range of 0.8–1.0 Mt CO_2-equiv, in comparison with the 'with measures' projection. The latest projections of CO_2 emissions carried out in connection with Climate 2012 shows that, compared with the burden sharing target, the total GHG emissions gap will be 3.4 % (excluding removals from sinks). New measures were identified by the former government to almost close this gap and proposals have been brought forward by this government in 2001, including proposals within the transport sector mentioned above.

The information provided on policy objectives and quantification of the effect is good, but cost data are not available. The information on projections is also good, giving details of emission factors and activity used in the projections. The projections are also presented in the IPCC/CRF format making it compatible with the inventories. In general, the reporting is clear and comprehensive.

Due to the change of government in Denmark's this list of climate change policies and measures is under revision. It is expected that new 'with measures' and 'with additional measures' projections will be finalised by the end of 2002 and mid 2003 respectively.