No. 827 Denmark's National Inventory report 2011 - Emission inventories 1990-2009

Executive summary

ES.1. Background information on greenhouse gas inventories and climate change

Reporting

This report is Denmark's National Inventory Report (NIR) 2011 for submission to the United Nations Framework Convention on Climate change and the Kyoto Protocol, due April 15, 2011. The report contains detailed information about Denmark's inventories for all years from 1990 to 2009. The structure of the report is in accordance with the UNFCCC guidelines on reporting and review. The main difference between Denmark's NIR 2011 report to the European Commission, due March 15, 2011, and this report to UNFCCC is reporting of territories. The NIR 2011 to the EU Commission was for Denmark, while this NIR 2011 to UNFCCC is for Denmark, Greenland and the Faroe Islands. The suggested outline provided by the UNFCCC secretariat has been followed to include the necessary information under the Kyoto Protocol. The report includes detailed and complete information on the inventories for all years from year 1990 to the year 2009, in order to ensure transparency.

The annual emission inventories for the years from 1990 to 2009 are reported in the Common Reporting Format (CRF). Within this submission separate CRF's are available for Denmark (EU), Greenland, the Faroe Islands, for Denmark and Greenland (KP) as well as for Denmark, Greenland and the Faroe Islands (UNFCCC). The CRF spreadsheets contain data on emissions, activity data and implied emission factors for each year. Emission trends are given for each greenhouse gas and for total greenhouse gas emissions in CO_2 equivalents.

The issues addressed in this report are: Trends in greenhouse gas emissions, description of each emission category of the CRF, uncertainty estimates, explanations on recalculations, planned improvements and procedure for quality assurance and control.

This report itself does not contain the full set of CRF tables. Only the trend tables, Tables 10.1-5 of the CRF format for Denmark, are included, refer to Annex 8. The full set of CRF tables is available at the EIONET, Central Data Repository, kept by the European Environmental Agency:
http://cdr.eionet.europa.eu/dk/Air_Emission_Inventories

Please note that figures in Annex 8 are in the Danish notation, which is "," (comma) for decimal sign and "." (full stop) to divide thousands. In the report (except where tables are taken from the CRF as "pictures" as in Annex 8) English notation is used: "." (full stop) for decimal sign and mostly space for division of thousands. The English notation for division of thousand as "," (comma) is mostly not used due to the risk of being misinterpreted by Danish readers.

Institutions responsible

On behalf of the Ministry of the Environment and the Ministry of Climate and Energy the National Environmental Research Institute (NERI), Aarhus University, is responsible for the calculation and reporting of the Danish national emission inventory to EU and the UNFCCC (United Nations Framework Convention on Climate Change) and UNECE CLRTAP (Convention on Long Range Transboundary Air Pollution) conventions. Hence, NERI prepares and publishes the annual submission for Denmark to the EU and UNFCCC of the National Inventory Report and the greenhouse gas (GHG) inventories in the Common Reporting Format, in accordance with the UNFCCC guidelines. Further, NERI is responsible for reporting the national inventory for the Kingdom of Denmark to the UNFCCC. NERI is also the body designated with overall responsibility for the national inventory under the Kyoto Protocol for Greenland and Denmark. Furthermore, NERI participates when reporting issues are discussed in the regime of UNFCCC and EU (Monitoring Mechanism).

The work concerning the annual greenhouse gas emission inventory is carried out in cooperation with Danish ministries, research institutes, organisations and companies. The Government of Greenland is responsible for finalising and transferring the inventory for Greenland to NERI. The Faroe Islands Environmental Agency is responsible for finalising and transferring the inventory for the Faroe Islands to NERI.

Greenhouse gases

The greenhouse gases reported are those under the UN Climate Convention:

- Carbon dioxide CO_2
- Methane CH_4
- Nitrous Oxide N_2O
- Hydrofluorocarbons HFCs
- Perfluorocarbons PFCs
- Sulphur hexafluoride SF_6

The global warming potential (GWP) for various greenhouse gases has been defined as the warming effect over a given time of a given weight of a specific substance relative to the same weight of CO_2. The purpose of this measure is to be able to compare and integrate the effects of the individual greenhouse gases on the global climate. Typical lifetimes in the atmosphere of greenhouse gases are very different, e.g. approximately 12 and 120 years for CH_4 and N_2O, respectively. So the time perspective clearly plays a decisive role. The lifetime chosen is typically 100 years. The effect of the various greenhouse gases can then be converted into the equivalent quantity of CO_2, i.e. the quantity of CO_2 giving the same effect in absorbing solar radiation. According to the IPCC and their Second Assessment Report, which UNFCCC has decided to use as reference, the global warming potentials for a 100-year time horizon are:

- CO_2: 1
- Methane (CH_4): 21
- Nitrous oxide (N_2O): 310

Based on weight and a 100-year period, CH_4 is thus 21 times more powerful a greenhouse gas than CO_2 and N_2O is 310 times more powerful than CO_2. Some of the other greenhouse gases (hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) have considerably higher global warming potentials. For

example, sulphur hexafluoride has a global warming potential of 23 900. The values for global warming potential used in this report are those prescribed by UNFCCC. The indirect greenhouse gases reported are Nitrogenoxide (NO_x), Carbonmonooxide (CO), Non-Methane Volatile Organic Compound (NMVOC) and Sulphurdioxid (SO_2). Since no GWP is assigned these gases they do not contribute to GHG emissions in CO_2-equivalents.

ES.2. Summary of national emission and removal trends

Summary ES.1-4 is the inventory for Denmark only. The inventories for Greenland, Denmark and Greenland and the Faroe islands are described in Chapter 16 and 17 and Annex 9, respectively.

ES.2.1 Greenhouse gas emissions inventory

The greenhouse gas emissions are estimated according to the IPCC guidelines and guidance and are aggregated into seven main sectors. According to decisions made under the UNFCCC and the Kyoto Protocol the greenhouse gas emissions are estimated according to the IPCC 1996 guidelines and the IPCC 2000 good practice guidance. The greenhouse gases include CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. Figure ES.1 shows the estimated total greenhouse gas emissions in CO_2 equivalents from 1990 to 2009. The emissions are not corrected for electricity trade or temperature variations. CO_2 is the most important greenhouse gas contributing in 2009 to the national total emission in CO_2 equiv. excluding LULUCF (Land Use and Land Use Change and Forestry) with 78.8 %, followed by N_2O with 10.1 %, CH_4 with 9.7 % and F-gases (HFCs, PFCs and SF_6) with 1.4 %. Seen over the time span from 1990 to 2009 these contributions (in percentages) have been increasing for CO_2 and F-gases, almost constant for CH_4 and decreasing for N_2O. Stationary combustion plants, transport and agriculture represent the largest emission categories, followed by Industrial processes, Waste and Solvents, see Figure ES.1. The net CO_2 uptake for the LULUCF sector in 2009 is 1.8 % of the total emission in CO_2 equivalents (excluding LULUCF). The national total greenhouse gas emission in CO_2 equivalents excluding LULUCF has decreased by 10.3 % from 1990 to 2009 and decreased 15.9 % including LULUCF. Comments on the overall trends on the individual greenhouse gases etc. seen in Figure ES.1 are given in the sections below.

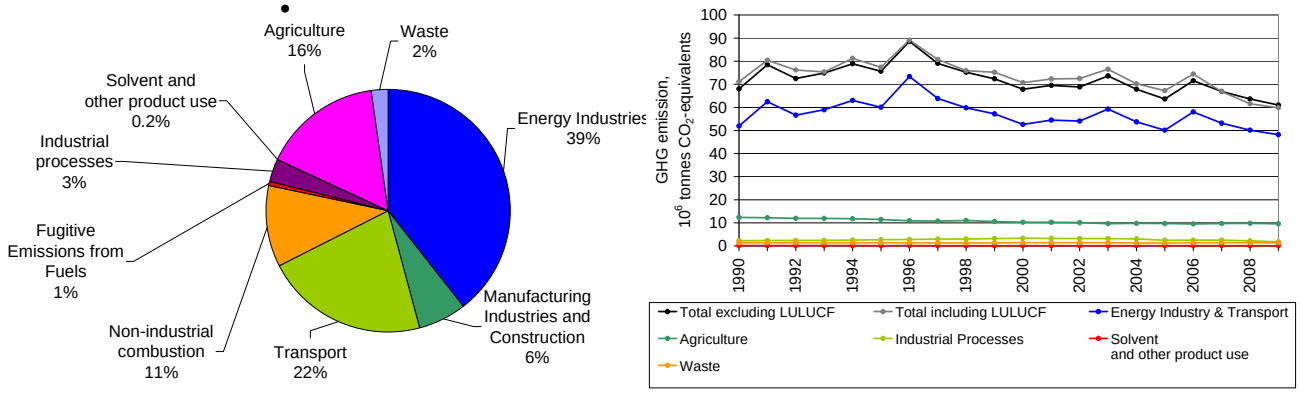

Figure ES.1 Greenhouse gas emissions in CO_2 equivalents distributed on main sectors (excl. LULUCF) for 2009 and time-series for 1990 to 2009, where data for CO_2 excludes LULUCF.

ES.2.2 KP-LULUCF activities

Net removals from Afforestation Reforestation Deforestation (ARD) activities in 2009 were 111.8 Gg CO_2 eqv., hereof 0.4 Gg CO_2 eqv. owe to N_2O emissions from disturbance of soils. Net emissions from FM activity were 2 591.1 Gg CO_2 eqv. (Table ES.1) hereof 12.0 Gg CO_2 eqv. owe to N_2O emissions from drainage of soils.

For Cropland Management (CM) the net emissions in 2009 were 1369.3 Gg CO_2 eqv. compared to a net emission in 1990 of 3 188.6 Gg CO_2 eqv.

For Grassland Management (GM) the net emissions in 2009 were 185.6 Gg CO_2 eqv. compared to a net emission in 1990 of 313.6 Gg CO_2 eqv.

Table ES.1 Emissions and removals in 2008 for activities relating to Article 3.3 and Article 3.4.

	Net CO_2 emissions/ removals	CH_4	N_2O	Net CO_2 equivalent emissions/ removals
			(Gg)	
A. Article 3.3 activities				-111.83
A.1. Afforestation and Reforestation	-145.31	NO	IE,NA,NO	-145.31
A.1.1. Units of land not harvested since the beginning of the commitment period	-145.31	NO	IE,NA,NO	-145.31
A.1.2. Units of land harvested since the beginning of the commitment period	IE,NO	NO	IE,NO	IE,NO
A.2. Deforestation	33.07	NO	0.00	33.48
B. Article 3.4 activities				-1 024.17
B.1. Forest Management	-2 591.13	NO	0.04	-2 579.10
B.2. Cropland Management	1 369.28	NO	IE,NA,NO	1 369.28
B.3. Grazing Land Management	185.64	NO	NO	185.64
B.4. Revegetation	NA	NA	NA	NA

ES.3. Overview of source and sink category emission estimates and trends

ES.3.1 Greenhouse gas emissions inventory

Energy

The largest source of the emission of CO_2 is the energy sector, which includes the combustion of fossil fuels such as oil, coal and natural gas. Energy excluding transport contributes in 2009 with 49 % of the national total CO_2 emissions (excl. LULUCF). The transport sector accounts for approximately 27 %. The CO_2 emission from the energy sector including transport decreased by approximately 9 % from 2008 to 2009. The relatively large fluctuations in the emission time-series from 1990 to 2009 are due to inter-country electricity trade. Thus, high emissions in 1991, 1994, 1996, 2003 and 2006 reflect electricity export and the low emissions in 1990 and 2005 were due to import of electricity in these years. The low emission in 2009 is due to a decrease in the energy demand due to the economic recession. The minor increasing emission of CH_4 is due to increasing use of gas engines in the decentralised cogeneration plants. The deregulation of

the electricity market has made production of electricity in gas engines less favourable, therefore the fuel consumption has decreased and hence the CH_4 emission has decreased. The CO_2 emission from the transport sector has increased by 23 % since 1990, mainly due to increasing road traffic.

Industrial processes

The emissions from industrial processes, i.e. emissions from processes other than fuel combustion, amount to 2.9 % of total emissions in CO_2-equivalents (excl. LULUCF) in 2009. The main categories are cement production, refrigeration, foam blowing and calcination of limestone. The CO_2 emission from cement production – which is the largest source contributing in 2009 with 1.3 % of the national total – increased by 13 % from 1990 to 2009. The second largest source has been N_2O from the production of nitric acid. However, the production of nitric acid/fertiliser ceased in 2004 and therefore the emission of N_2O also ceased.

The emission of HFCs, PFCs and SF_6 has increased by 161 % from 1995 until 2009, largely due to the increasing emission of HFCs. The use of HFCs, and especially HFC-134a, has increased several fold and thus HFCs have become the dominant F-gases, contributing 67 % to the F-gas total in 1995, rising to 94 % in 2009. HFC-134a is mainly used as a refrigerant. However, the use of HFC-134a is now stabilising. This is due to Danish legislation, which in 2007, banned new HFC-based refrigerant stationary systems. However, in contrast to this trend is the increasing use of air conditioning systems in mobile systems.

Solvents

The use of solvents in industries and households contribute 0.1 % of the total greenhouse gas emissions in CO_2-equivalents. There is a 48 % decrease in CO_2 emissions from 1990 to 2009. In 2009 N_2O comprises 36 % of the total CO_2-equivalent emissions for solvent use.

Agriculture

The agricultural sector contributes in 2009 with 15.8 % of the total greenhouse gas emission in CO_2-equivalents (excl. LULUCF) and is one of the most important sectors regarding the emissions of N_2O and CH_4. In 2009 the contributions to the total emissions of N_2O and CH_4 were 91 % and 70 %, respectively. The main reason for the decrease of 32 % in the emission of N_2O from 1990 to 2009 is a legislative demand for an improved utilisation of nitrogen in manure. This results in less nitrogen excreted pr livestock unit produced and a considerable reduction in the use of fertilisers. From 1990 to 2009, the emission of CH_4 from enteric fermentation has decreased due to decreasing numbers of cattle. However, the emission from manure management has increased due to changes in stable management systems towards an increase in slurry-based systems. Altogether, the emission of CH_4 for the agricultural sector has decreased by 3 % from 1990 to 2009.

Land Use and Land Use Change and Forestry (LULUCF)

The LULUCF sector alters between being a net sink and a net source of GHG. In 2009 LULUCF was a net sink with 1.8 % of the total GHG emission excluding LULUCF. In 2008 LULUCF was a net sink equivalent to 3.3 % of the total GHG emission (excluding LULUCF). In 2009 Forest Land was a large sink of 2 724 CO_2-eqv., while Cropland, Grassland, Wetlands and Settlements was net sources contributing with 1 347 Gg CO_2-eqv., 199 Gg CO_2-eqv., 5 Gg CO_2-eqv. and 54 Gg CO_2-eqv., respectively. The emission from Croplands is mainly due to emissions from organic soils. Since 1990 there has been a decrease in the total C-stock in soil. Despite the global warming it seems that this decrease has stabilized so that it is possible to maintain the current C-stock level in soil.

Waste

The waste sector contributes in 2009 with 2.2 % of the national total. The trend of emission from 1990 to 2009 is decreasing by 0.4 %. The sector is dominated by CH_4 emission from solid waste disposal contributing with 87.0 % to the sector total in 2009. This emission has decreased by 6.4 % from 1990 to 2009. The decrease is due to the increasing incineration of waste for power and heat production. Since all incinerated waste is used for power and heat production, the emissions are included in the 1A IPCC category.

The CH_4 and N_2O emissions from wastewater handling contribute to the sectoral total with 6.2 and 66 %, respectively. For the wastewater handling the CH_4 emissions has an increasing trend while N_2O are at the same level as in 1990. Waste incineration without energy recovery contributes to the sectoral total of CH_4 and N_2O emissions in 2009 with 7 % and 34 %, respectively; the trends of these emissions are increasing from 1990 to 2009.

ES.3.2 KP-LULUCF activities

In 2009 the activities under Article 3.3 was a net sink of 112 Gg CO_2-eqv. and the activities under Article 3.4 was a net sink of 1 024 Gg CO_2-eqv. A short overview of KP-LULUCF is given in Chapter ES.2.2 and a more detailed description is given in Chapter 11.

ES.4. Other information

ES.4.1 Quality assurance and quality control

A plan for Quality Assurance (QA) and Quality Control (QC) in greenhouse gas emission inventories is included in the report. The plan is in accordance with the guidelines provided by the UNFCCC (Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and Guidelines for National Systems). ISO 9000 standards are also used as an important input for the plan.

The plan comprises a framework for documenting and reporting emissions in a way that emphasize transparency, consistency, comparability, completeness and accuracy. To fulfil these high criteria, the data structure describes the pathway, from the collection of raw data to data compilation and modelling and finally reporting.

As part of the Quality Assurance (QA) activities, emission inventory sector reports are being prepared and sent for review to national experts, not involved in the inventory development. To date, the reviews have been completed for the stationary combustion plants sector, the fugitive emissions from fuels sector, the transport sector, the solvents and other product use sector and the agricultural sector. In order to evaluate the Danish emission inventories, a project where emission levels and emission factors are compared with those in other countries has been conducted.

ES.4.2. Completeness

The Danish greenhouse gas emission inventories include all sources identified by the revised IPPC guidelines.

Please see Annex 5 for more information.

ES.4.3. Recalculations and improvements

The main improvements of the inventories are:

Energy

Stationary Combustion

For stationary combustion plants, the emission estimates for the years 1990-2008 have been updated according to the latest energy statistics published by the Danish Energy Agency. The update included both end use and transformation sectors as well as a source category update.

The petroleum coke purchased abroad and combusted in Danish residential plants is no longer included in the inventory. The border trade have been increasing since 1990 and was 628 TJ in 2008.

The CO_2 emission factors for coal have been recalculated for 1990-2008. The recalculation has resulted in an improved time-series consistency. Due to the considerable consumption of coal, this recalculation is considerable for the years 1990-2005 before plant specific data (EU ETS) became available. The recalculation resulted in lower estimates for CO_2: -1.9 Gg in 2009 and -245 Gg in 1990.

The CO_2 emission factors for residual oil have also been recalculated based on the EU ETS data and an improved time-series has been implemented.

The CO_2 emission factors for LPG and kerosene have been changed and both emission factors now refer to the IPCC Guidelines (1996).

Emission factors for CH_4 and N_2O that are not country specific have been updated and now all refer to the IPCC Guidelines (1996).

Mobile sources

Road transport

The total mileage per vehicle category from 2005-2008 have been updated based on new data prepared by DTU Transport (Department of Transport, Technical University of Denmark). More accurate fleet and mileage figures are provided by the latter institution, split into the different vehicle layers of the emission model. An important change is the categorisation of fleet data for heavy duty trucks and buses into the numerous weight classes covered by the COPERT IV model.

The minimum and maximum percentage difference and year of numeric maximum differences (min. %, max. %, year of max. %) for the different emission components are: CO_2 (-0.081%, 0.082 %, 1993), CH_4 (-1.3 %, -17.9 %, 2008) and N_2O (-4.6 %, 3.7 %, 1991).

National sea transport

Fuel consumption by vessels sailing between Denmark and Greenland/Faroe Islands, and between Denmark and the North Sea off shore installations has been added to this category. Previously this fuel consumption was reported under international sea transport. The corresponding minimum and maximum percentage difference and year of numeric maximum differences (min. %, max. %, year of max. %) for the different emission components are: CO_2 (9.2 %, 30.8 %, 2008), CH_4 (4.6 %, 10.7 %, 2008) and N_2O (9.6 %, 34.0 %, 2008).

Fisheries

Due to the changes made in national sea transport and the fuel transferral between national sea transport and fisheries made as an integral part of the Danish inventories, significant fuel consumption and emission changes have been made for the fishery sector accordingly, for 2001 onwards. The corresponding minimum and maximum percentage difference and year of numeric maximum differences (min. %, max. %, year of max. %) are (27 %, 39 %, 2006), for all emission components.

Agriculture

The stock of harvesters have been updated for the years 2001-2008, based on discussions with the Danish Knowledge Centre for Agriculture. For gasoline fuelled ATV's the stock has been updated for 2007 and 2008. The changes in fuel consumption and emissions are between 0 and 2 % for CO_2 and N_2O, whereas for CH_4 the emission changes are 12 % and 21 %, in 2007 and 2008, respectively.

Agriculture/forestry/fisheries

The total consequences for agriculture/forestry/fisheries, expressed as minimum and maximum percentage difference and year of numeric maximum differences (min. %, max. %, year of max. %) for the different emission components are: CO_2 (9.6 %, 12.1 %, 2006), CH_4 (4.0 %, 21.7 %, 2008) and N_2O (12.4 %, 15.5 %, 2008).

Military

Emission factors derived from the new road transport simulations have caused some emission changes from 1985-2008. The minimum and maximum emission differences (min. %, max. %) for the different emission components are: CH_4 (-1 %, -16 %) and N_2O (-4 %, 1 %).

Residential

A split in activity codes has been made. In this way the majority of the fuel consumption and emissions previously reported under residential (SNAP code 0809; NFR code 1A4b) are now reported under commercial/institutional (SNAP code 0811; NFR code 1A4a ii).

No changes have been made in the estimated fuel consumption and emissions for Residential and Commercial/institutional as a sum.

Commercial/institutional

A split in activity codes has been made. The majority of the fuel consumption and emissions previously reported under residential (SNAP code 0809; NFR code 1A4b) are now reported under commercial/institutional (SNAP code 0811; NFR code 1A4a ii).

No changes have been made in the estimated fuel consumption and emissions for Residential and Commercial/institutional as a sum.

Industrial non road machinery

The annual working hours for fork lifts in 2008 have been adjusted with a factor of 0.95 due to the decrease in activities caused by the global financial crisis. The total fuel consumption and emission changes in 2008 for industrial non road machinery are approximately -1 %.

Railways

No changes have been made.

Aviation

Very small emission changes between -2 % and 1 % occur for the years 2001-2008, due to inclusion of new aircraft types assigned to the representative aircraft types.

Fugitive emissions

Service stations

The amounts of gasoline sales used for calculation of fugitive emissions from service stations (SNAP 050503) have been updated according to the Energy Statistics for 2009 1990-2008. The NMVOC emission in 2008 has thereby increased by 6 Mg corresponding to 0.5 %.

Extraction of oil and gas

Fugitive emissions from extraction are calculated from the standard formula in the EMEP/EEA Guidebook (EMEP/EEA, 2009) based on the number of platforms. In 2009 the number of platforms has been corrected for 2007 and 2008. In 2008 the NMVOC emission decreased by 20 Mg according to this correction corresponding to 1 %.

Gas distribution

Distribution amounts have been updated for one of three natural gas distribution companies for the years 2006-2008 due to new data availability. The NMVOC emission has thus decreased by 4 Mg in 2008 due to this, corresponding to 10 %. Emissions from venting in gas storage have previously been included in gas transmission, but are now included in the venting and flaring category (1B2c). The emissions have not been changed for the time-series during the IPCC category shift.

Flaring in oil and gas extraction

The NMVOC emission in 2008 from flaring in the gas treatment plant has been updated according to the environmental report leading to an increase of 2 Mg NMVOC. The increase corresponds to 12 % of the NMVOC emission from flaring in oil and gas extraction including offshore flaring. Emissions from venting in gas storage have previously been included in gas transmission, but are now included in the venting and flaring category (1B2c). The emissions have not been changed for the time-series during the IPCC category shift.

Industry

Emission of NMVOC from 2D2 Food and Drink has been improved by using better emission factors for production of bread and cookies, and breweries.

For F-gases there has been a change in the methodology for mobile air condition. Information on actual amounts of f-gas used for refilling is available from 2009 and has been used as an estimate on f-gas emitted during use of the air condition.

Solvents

Further improvement of the source allocation model, which combines information on Use Categories and NACE Industrial Use Categories from SPIN and use amounts from Statistics DK.

Implementation of correct 2008 import amounts for xylene, which has been verified by Statistics Denmark.

Emissions from use of fireworks have been included under Other Product Use.

Agriculture

Some changes for emissions from the agricultural sector have taken place. These changes reflect decreased emissions in the years 1990-2008 up to 7 % compared to the total CO_2-equivalent emission from the agricultural sector. The decrease is due to an increase in the emissions of CH_4 but a higher decrease in the emission of N_2O.

As recommended by ERT during the in-country review in September 2010, the MCF factor for housing systems with deep litter stored > 1 month is changed from 1 to 10 %. The change in MCF factors influence emissions from cattle, sheep and goats. The total CH_4 emission increased up to 4 % in CO_2-equivalents for the years 1990-2008 with an increasing trend.

The decrease in N_2O emissions is mainly due to a change in the calculation of emission form N-leaching. Because of new data it is now possible to separate the calculation of emissions from leaching in emissions from groundwater and surface drainage, rivers and estuaries.

Two changes have been made which have an increasing effect on the N_2O emission. The implied emission factor for histosols is changed from 2-3 kg N_2O-N per hectare to an IPCC default value at 8 kg N_2O-N per hectare, as recommended by ERT during the in-country review in September 2010. Furthermore, an error for N excreted from sows has been corrected. The total N_2O emissions decreased up to 12 % in CO_2-equivalents for the years 1990-2008.

LULUCF

As a consequence of the Danish election of 3.4 for forest management, cropland management and grassland management is a thoroughly investigation of the LULUCF undertaken. Some results from this investigation are included in this submission, whereas other data will be included in the final 2011 submission. This investigation includes a wall-to-wall mapping of the Danish area through remote sensing (RS) for 1989/90 and 2005, a new soil map for organic soils, Danish emission factors for organic soils, monitoring of hedgerows etc. This submission includes results from the RS, which change several data. The use of RS has made it possible to estimate land use conversion to a much higher degree than previous. The changes in the land area/activity data from the remote sensing affect more or less all subsequent emission estimates.

Forestry

Based on the mapped forest area in 1990 and 2005 a calculation of carbon stored in both the old forests (forest established pre-1990 - under the Kyoto Protocol Article 3.4) and in new forests (afforestation since 1990 - under the Kyoto Protocol Article 3.3) has been performed. The afforestation since 1990 has been mapped to be larger than previously estimated.

The calculation of carbon stock in 1990 and 2000 is based on the age distribution as reported in census 1990 and Forest in 2000 as an expression of the total forest land allocation to species and ages. Based on the actual measurements of carbon storage in different species and age classes, the total standing carbon stock has been recalculated. For each of the years 1990 - 2000 carbon pools are calculated as a moving average, corrected for the deforestation that was detected.

Since the National Forest Inventory (NFI) was initiated in 2002, it is representative from 2005. Calculation of carbon stock in the period 2000-2004 is based on NFI in 2005 and carbon stock as calculated for 2000. For

2005-2009 carbon stock is calculated solely on the basis of the NFI - with additional information about the total forest area from satellite image mapping.

The recalculations have caused Forestry to go from a source of 133 Gg CO_2 in 2008 to be a net sink of -233 Gg CO_2. N_2O is only slightly affected.

Cropland, grassland, wetlands and settlements

For cropland, grassland, wetlands and settlements there has been changes in soil carbon stock from land use changes. There have been minor changes in how the agricultural land area is estimated due to the remote sensing. As new data are arriving from our research programme many new national data has been implemented. The major change comes from our study on the area with organic soils where preliminary data has shown that the area is more likely only 50 000 hectares and not 80 000 hectares as previous reported. This has reduced the overall emission from cropland in 2008 from 2 687 Gg CO_2 to 2 267 Gg CO_2. Final data will be submitted on March 15, 2011. Further more there are changes in grassland, wetlands and settlements but with lesser impact.

Waste

For Solid Waste Disposal no recalculations were made.

For Waste Water handling recalculations was made for 1990 to 2008 for CH_4 and N_2O emissions.

The methane emission Waste Water handling have this year been specified according to contributions from 1) the sewer system, 2) in primary settling tanks 3) during biological N and P removal and 4) from anaerobic treatment processes in closed systems with biogas extraction and combustion for energy production. In this years inventory an estimation of methane emissions from the septic system has been included. Furthermore, a yearly emission factor for the anaerobic processes has been implemented as reported in Chapter 8.3.

Updated quality assured data on the N content in the effluent wastewater for 2005-2009, have resulted in changes of indirect N_2O emission.

Correction of an error in the EF algorithm for direct N_2O emissions has resulted in an increase of 13.7% of the direct N_2O emission.

Emissions from waste incineration have decreased as the calculated emissions from accidental building and vehicle fires have been moved from this section to the waste other section. There are no longer non-biogenic CO_2 emissions from this category.

For the category Waste Other; in addition to the increase in emission due to the moving of accidental fires, are the emissions of methane and nitrous oxide from compost production, which are new in this year's inventory.

The sectoral total increased between 6.1 % (1990) and 12.6 % (2007). For 2008 the increase was 11.3 %.

KP-LULUCF

Almost all sectors in the KP-LULUCF have been recalculated.

This is due to:

- small changes in Land Use Matrix, which affect the land use conversions,
- updated data from the Danish NFI for C-stock changes in above-, belowground, dead wood and litter,
- a new soil map for organic soils,
- a new R:S factor for vegetation in grassland,
- new emission factors for organic soils,
- new data on C-stock in mineral soils from our research (0-100 cm dept compared to 0-50 cm/0-30 cm in the previous submission to be used when land use change takes place ,
- correction of errors in the previous reporting.

The major changes in afforestation/reforestation are corrections of errors in the previous submission and changed methodology for estimation of C accumulation in litter as recommended by the previous ERT.

For deforestation the main reason is a small change in living biomass and updated values on C-stock in mineral soils.

For forest management the major change is due to updated values from the NFI on C-stocks in living biomass.

For cropland management and grazing land management the changes are primarily due to the new soil map for organic soils and the new emission factors for organic soils. The analysis has shown that a large part of the area should be classified as grazing land and not as cropland. Consequently has there been a reduction of 150-200 Gg CO_2-eqvivalents in the emissions from CM and a similar increase in the emission from GM.

For more information on KP-LULUCF recalculations please refer to Chapter 10 and 11.