DENMARK'S NATIONAL INVENTORY REPORT 2009

Emission Inventories 1990-2007 – Submitted under the United Nations Framework Convention on Climate Change

NERI Technical Report no. 724 2009

NATIONAL ENVIRONMENTAL RESEARCH INSTITUTE
AARHUS UNIVERSITY

DENMARK'S NATIONAL INVENTORY REPORT 2009

Emission Inventories 1990-2007 – Submitted under the United Nations Framework Convention on Climate Change

NERI Technical Report no. 724 2009

Ole-Kenneth Nielsen[1]
Erik Lyck[1]
Mette Hjorth Mikkelsen[1]
Leif Hoffmann[1]
Steen Gyldenkærne[1]
Morten Winther[1]
Malene Nielsen[1]
Patrik Fauser[1]
Marianne Thomsen[1]
Marlene S. Plejdrup[1]
Rikke Albrektsen[1]
Katja Hjelgaard[1]
Lars Vesterdal[2]
Inge Stupak Møller[2]
Lene Baunbæk[3]
[1]National Environmental Research Institute, Aarhus University
[2]Faculty of Life Sciences, University of Copenhagen
[3]Statistics Greenland

NATIONAL ENVIRONMENTAL RESEARCH INSTITUTE
AARHUS UNIVERSITY

[Blank page]

Data sheet

Series title and no.: NERI Technical Report No. 724

Title: Denmark's National Inventory Report 2009
Subtitle: Emission Inventories 1990-2007 - Submitted under the United Nations Framework Convention on Climate Change

Authors: Ole-Kenneth Nielsen[1], Erik Lyck[1], Mette Hjorth Mikkelsen[1], Leif Hoffmann[1], Steen Gyldenkærne[1], Morten Winther[1], Malene Nielsen[1], Patrik Fauser[1], Marianne Thomsen[1], Marlene S. Plejdrup[1], Rikke Albrektsen[1], Katja Hjelgaard[1], Lars Vesterdal[2], Inge Stupak Møller[2] and Lene Baunbæk[3]
Departments: [1)] Department of Policy Analysis, National Environmental Research Institute, Aarhus University
[2)] Department of Forestry and Landscape, Faculty of Life Sciences, University of Copenhagen
[3)] Statistics Greenland

Publisher: National Environmental Research Institute ©
Aarhus University - Denmark
URL: http://www.neri.dk

Year of publication: April 2009
Editing completed: April 2009

Referee: Henning Høgh Jensen, NERI

Financial support: No external financial support

Please cite as: Nielsen, O.-K., Lyck, E., Mikkelsen, M.H., Hoffmann, L., Gyldenkærne, S., Winther, M., Nielsen, M., Fauser, P., Thomsen, M., Plejdrup, M.S., Albrektsen, R., Hjelgaard, K., Vesterdal, L., Møller, I.S. & Baunbæk, L. 2009: Denmark's National Inventory Report 2009. Emission Inventories 1990-2007 - Submitted under the United Nations Framework Convention on Climate Change. National Environmental Research Institute, Aarhus University. 826 pp. – NERI Technical Report No 724. http://www.dmu.dk/Pub/FR724.pdf

Abstract: This report is Denmark's National Inventory Report 2009. The report contains information on Denmark's emission inventories for all years' from 1990 to 2007 for CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, NO_x, CO, NMVOC, SO_2.

Keywords: Emission Inventory; UNFCCC; IPCC; CO_2; CH_4; N_2O; HFCs; PFCs; SF_6.

Layout: Ann-Katrine Holme Christoffersen
Front page photo: Ann-Katrine Holme Christoffersen

ISBN: 978-87-7073-106-5
ISSN (electronic): 1600-0048

Number of pages: 826

Internet version: The report is available in electronic format (pdf) at NERI's website
http://www.dmu.dk/Pub/FR724.pdf

Contents

Executive summary

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

Reporting

This report is Denmark's National Inventory Report (NIR) 2009 for submission to the United Nations Framework Convention on Climate change, due April 15, 2009. The report contains detailed information about Denmark's inventories for all years from 1990 to 2007. The structure of the report is in accordance with the UNFCCC guidelines on reporting and review. The difference between Denmark's NIR 2008 report to the European Commission, due March 15, 2009, and this report to UNFCCC is reporting of territories. The NIR 2009 to the EU Commission was for Denmark, while this NIR 2009 to UNFCCC is for Denmark, Greenland and the Faroe Islands. The annual emission inventory report for Denmark for the years from 1990 to 2007 is unchanged compared with the NIR 2009 to the EU Commission. Since the inventories for Greenland and Faroe Islands are included and described in this report in Annex 6 only, the sector chapters and the summary below are also basically unchanged since the EU reporting, March 15, 2009.

The annual emission inventory for Denmark for the years from 1990 to 2007 is reported in the Common Reporting Format (CRF). 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, are included, refer to Annex 9. 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 the CRF tables (and Annex 9) 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 9) 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

The National Environmental Research Institute (NERI), University of Aarhus, is responsible for the annual preparation and submission for Denmark to the EU and UNFCCC of the National Inventory Report and the GHG inventories in the Common Reporting Format, in accordance with the UNFCCC guidelines. Thus 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 Greenland Home Rule Government 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 for CH_4 and N_2O, 12 and 120 years 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:

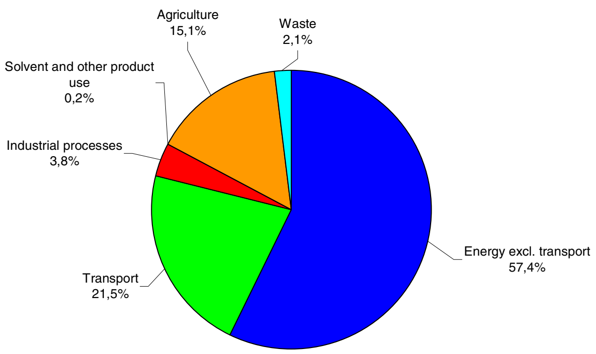
- CO_2: 1
- Methane (CH_4): 21
- Nitrous oxide (N_2O): 310

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

Greenhouse Gas Emissions

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 IPCC 1996 guidelines and 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 2007. The emissions are not corrected for electricity trade or temperature variations. CO_2 is the most important greenhouse gas contributing in 2007 to national total emission in CO_2 equiv. excluding LULUCF (Land Use and Land Use Change and Forestry with 80.3 %, followed by N_2O with 9.7 %, CH_4 8.7 % and F-gases (HFCs, PFCs and SF_6) with 1.3 %. Seen over the time span from 1990 to 2007 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 removal by forestry and soil is in 2007 1.7 % of the total emission in CO_2 equivalents in 2007. The National total greenhouse gas emission in CO_2 equivalents excluding LULUCF has decreased by 3.5 % from 1990 to 2007 and decreased 5.9 % including LULUCF. Comments on the overall trends on the individual greenhouse gases etc. seen in Figure ES.1 are given in the sections below.



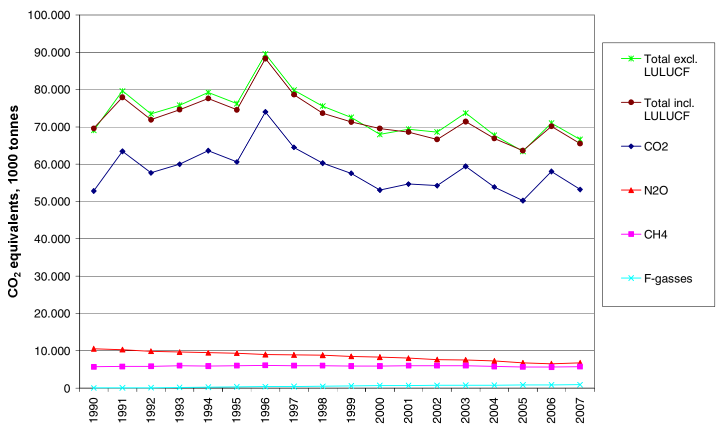


Figure ES.1 Greenhouse gas emissions in CO_2 equivalents distributed on main sectors (excl. LULUCF) for 2007 and time-series for 1990 to 2007, when data for CO_2 excludes LULUCF.

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

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 contribute in 2007 with 57 % of the national total CO_2 emissions (excl. LULUCF). The transport sector accounts for approximately 22 %. The CO_2 emission from the energy sector decreased by approximately 9 % from 2006 to 2007. The relatively large fluctuations in the emission time-series from 1990 to 2007 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 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 33 % 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 3.8 % of total emissions in CO_2-equivalents. 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 with about 2.1 % of the national total – increased by 59 % from 1990 to 2007. 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 172 % from 1995 until 2007, largely due to the increasing emission of HFCs. The use of HFCs, and especially HFC-134a, has increased several fold so HFCs have become the dominant F-gases, contributing 67 % to the F-gas total in 1995, rising to 95 % in 2007. 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, bans 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 0.2 % of the total greenhouse gas emissions in CO_2-equivalents. There is a 51 % decrease in CO_2 emissions from 1990 to 2007. N_2O comprises in 2007 30 % of the total CO_2-equivalent emissions for solvent use.

Agriculture

The agricultural sector contributes with 15.1 % 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 2007 the contributions to the total emissions of N_2O and CH_4 were 92 % and 67 %, respectively. The main reason for the decrease of approximately 31 % in the emission of N_2O from 1990 to 2007 is a legislative demand for an improved utilisation of nitrogen in manure. This result in less nitrogen excreted pr livestock unit produced and a considerable reduction in the use of fertilisers. From 1990 to 2007, 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 4 % from 1990 to 2007.

Land Use and Land Use Change and Forestry (LULUCF)

The LULUCF sector is generally a net sink. In 2007 it has been estimated to be a net sink equivalent to 1.7 % of the total emission. This is slightly higher compared with 2006 due to stormfelling in the forests in 2005 reducing the net sink in forests from normally 3 000-3 500 Gg CO_2 pr yr to 2 977 Gg CO_2 pr yr. In cropland a net emission has been estimated to 1 779 Gg CO_2 with the organic soils as source and the mineral cropland as net sink. The emission estimate from cropland is calculated with a dynamic model taking into account harvest yields and actual temperatures and may therefore fluctuate between years. The year 2007 was the warmest year ever registred in Denmark, however the agricultural soils maintained the C-stock in the soil as it was in 2006. In Denmark there are small areas with permanent grassland so emission/removal from these areas has only a limited influence on the overall emission trend.

Waste

The waste sector contributes in 2007 with 2.1 % of the national total. The trend of emission from 1990 to 2007 is decreasing by 12 %. The sector is dominated by CH_4 emission from solid waste disposal contributing 78 % to the sector total in 2007. This emission has decreased by 20 % from 1990 to 2007. This 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 19 and 3 %, respectively. For the wastewater handling the CH_4 emissions has an increasing trend while N_2O decreases.

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 emphasis 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 transport 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 except the following:

Agriculture: The CH_4 conversion factor in relation to the enteric fermentation for poultry and fur farming is not estimated. There is no default value recommended by the IPCC. However, this emission is seen as non-significant compared with the total emission from enteric fermentation.

ES.4.3. Recalculations and improvements

The main improvements of the inventories are:

Energy

Stationary Combustion

Update of fuel rates according to the latest energy statistics. The update included the years 1980-2006. The most changes were for the years 2005 and 2006.

Data from the ETS has been utilised for the second time in the 2009 inventory submission. It was mainly coal and residual oil fuelled power plants where detailed information was available. One of the reports for 2007 was judged by NERI to be incorrect and therefore not incorporated in the 2007 inventory. Following this, the 2006 report for the same plant, which was also an outlier, was removed from the inventory.

Based on the centralised review in September 2008 several improvements have been made to the NIR:

- An improved documentation for the use of town gas has been included in the NIR.
- An improved documentation concerning emissions from non-energy use of fuels has been incorporated, see annex 3A.
- The documentation for the use of EU ETS data has been improved, see annex 3A.
- Improved documentation for QA/QC of plant specific emission factors. (In connection with EU ETS data)

Mobile sources

For heavy duty vehicles new information from the Danish Car Importers Association has enabled a more precise distribution of vehicles into Euro levels. Also, a more realistic development from 2005 to 2006 in the total mileage for passenger cars has been introduced in the calculations. For 2005 and 2006, the Danish Energy Agency (DEA) has made small changes in a downward direction for the annual diesel fuel consumption statistics.

Fuel consumption and emission factors directly measured for the ferries used by the company Mols Linien have now been implemented in the inventory calculations, and small activity changes have been made for two smaller Danish ferry companies.

Due to the change in fuel consumption for national sea transport, fuel adjustments are made for gas oil used by fishing vessels, and the emissions for this sector are also affected. Also, an error in the energy statistics for the year 2006 has been corrected by the DEA, thus reducing the gas oil fuel consumption for fisheries by 0.4 PJ.

Fugitive emissions

Emissions from oil refining has in earlier years been reported under 1B2a vi "Other". In 2007 "Oil refined" has been relocated to 1B2a iv "Refining/Storage". This was a result of a suggestion made during the internal EU review.

Recalculation has been made for flaring and processing of petroleum products in refineries for the years 2005-2006 according to availability of new data from the Danish oil refineries.

For flaring in natural gas storage plants the data have been relocated from CRF 1B2b iv to 1B2b iii for the year 2000 to make the time-series consistent.

Industry

The emission of CO_2 from production of cement has been revised for the years 1998-2005 based on new information from the company. For yellow bricks and expanded clay products the CO_2 emission has been adopted from the company reports to EU-ETS as the emission factors calculated previously and used until 2005 were found not to be in line with the actual emission.

In the group 2F9 *Other* production of fibre optics has been included from 2005 with emissions of HFC-23.

The sector *Other* (2G), consumption of lubricant oil is included in the inventory for the first time.

Solvents

The following chemicals and groups have been removed, compared to the 2008 submission, due to vapour pressures below 0.01kPa: aminooxygen groups, glycerol, toluendiisocyanate, dioctylphthalate, diethylenglycol.

NMVOC emission factors (EFs) have been adjusted for all chemicals, with most predominant effect for the following chemicals: ethanol, formaldehyde, turpentine, xylene, toluene and ethylenglycol.

A differentiation of EFs in four different categories has been implemented: 1) chemical industry (lowest EF), 2) other industry, 3) non-industrial activities, 4) domestic and other diffuse use (highest EF). In previous inventories there was only a differentiation in two categories.

More detailed and reliable information on used amounts and emission factors has been obtained from importers and producers for the following chemicals: methanol, ethanol in windscreen washing agent, naphthalene, propane and butane.

Agriculture

N_2O emission factors for synthetic nitrogen fertilizers have been changed to the values given by EMEP/EEA (2009) and recalculations have been done for 1990-2006. This results in an increase in N_2O emission of less than 1 % for the period.

Updated data from The Danish Environmental Protection Agency (DEPA) for the use of sewage sludge as fertilizers for the years 2004-2006 have been received and therefore recalculations. This results in an increase in N_2O of 16 % for the period.

The NH_3 emission factors for crops are lowered from 5 to 2 % for crops and from 3 to 0.5 % for grass based on a literary survey. Recalculations have been done for the years 1990-2006. This results in a decrease in the NH_3 emission of 62-64 %. A further result is that the N_2O emission from atmospheric deposition decreases by 1-10 % in the period.

NH_3 emission factors for fur farming have been raised from 25 to 36 % in agreement with FAS and recalculation is done for the years 1990-2006.

Data for dairy cattle and heifer's time on pasture have been lowered with 10 % in 2007. In order to remove time-series inconsistency the data are interpolated for the years 2003-2006.

Waste

For the submission in 2009, recalculations have been carried out in relation to the submission in 2008 of inventories for the years 2004-2006. The recalculation represents updates in the energy statistics on the uptake of CH_4 by installations at SWDSs for energy production. Further, for 2004-2005 rounding of data for waste amounts was removed in the model. The recalculation implies an increase in emissions of 2.5 and 4.0 % for 2004 and 2005, respectively.

Land Use and Land Use Change and Forestry (LULUCF)

The increase in C stock of living biomass was corrected for the year 1999 (378 Gg C to 379 Gg C).

The decrease in C stock in living biomass for conifers in forests remaining forests was corrected for the years 2005 and 2006. The reason for this is an update of harvesting figures at Statistics Denmark. There is only a slight difference between previously and currently reported net removals, i.e from 1 672 Gg CO_2 to 1 640 Gg CO_2 for 2005 and from 2 574 to 2 601 Gg CO_2 for 2006.

For cropland converted to forest land, we reported forest floor C sequestration for the fist time in the NIR from 2008 for the period 1990-2006. We have moved this C sink from "Net carbon stock change in soils" to "Net carbon stock change in dead organic matter" for the years 1990-2006. This would be the correct column for reporting as we understand the term "soil" as mineral soil without the organic material accumulated in the forest floor.

As the reported emission from agricultural soils is a five-year average there has been a recalculation of the emission in 2005 and 2006. Furthermore a small error in the amount of used lime in 2006 has been corrected.

Total changes

For the *National Total CO_2 Equivalent Emissions without Land-Use, Land-Use Change and Forestry (LULUCF***)**, the general impact of the improvements and recalculations performed is small and the changes for the whole time-series are between -0.18 % (1998) and +0.81 % (2006). Therefore, the implications of the recalculations on the level and on the trend, 1990-2006, of this national total are small.

For the *National Total CO_2 Equivalent Emissions with Land-Use, Land-Use Change and Forestry (LULUCF)*, the general impact of the recalculations is also small, although the impact is somewhat larger than without LULUCF. The differences vary between –0.15 % (2004) and +1.14 % (2005).

Sammenfatning

S.1. Baggrund for opgørelse af drivhusgasemissioner og klimaændringer

Rapporteringen
Denne rapport er Danmarks årlige rapport – den såkaldte Nationale Inventory Report (NIR) for 2009. Rapporten beskriver drivhusgasopgørelsen og den blev fremsendt til FN's konvention om klimaændringer (UNFCCC) den 15. april 2009. Rapporten indeholder detaljerede informationer om Danmarks drivhusgasudslip for alle år fra 1990 til 2007. Rapportens struktur er i overensstemmelse med UNFCCC's retningslinjer for rapportering og review. Forskellen mellem Danmarks NIR 2009 som blev fremsendt til EU-Kommissionen til den 15. marts 2009, og denne rapport til UNFCCC vedrører det territorium rapporteringen omfatter. NIR 2009 til EU-Kommissionen var for Danmark, mens NIR 2009 til UNFCCC er for Danmark, Grønland og Færøerne. Opgørelserne for Danmark er uændrede siden 15. marts, 2009-rapporteringen til EU-Kommissionen. Da opgørelserne for Grønland og Færøerne alene beskrives i Annex 6 i denne rapport er sektorkapitlerne og sammenfatningen neden for også uændret siden 15. marts-rapporteringen.

Denne emissionsopgørelse for Danmark for årene 1990 til 2007, er som tidligere årlige opgørelser, rapporteret i formatet Common Reporting Format (CRF) som Klimakonventionen foreskriver anvendt. CRF-tabellerne indeholder oplysninger om emissioner, aktivitetsdata og emissionsfaktorer for hvert år, emissionsudvikling for de enkelte drivhusgasser samt den totale drivhusgasemission i CO_2-ækvivalenter.

Følgende emner er beskrevet i rapporten: Udviklingen i drivhusgasemissionerne, metoder mv. som anvendes til opgørelserne i de emissionskategorier som findes i CRF-formatet, usikkerheder, rekalkulationer, planlagte forbedringer og procedure for kvalitetssikring og – kontrol.

Denne rapport indeholder ikke det fulde sæt af CRF-tabeller. Kun trendtabellerne fra CRF, som viser udviklingen for de rapporterede direkte drivhusgasser - CO_2, CH_4 og N_2O - for 1990-2007 (tabellerne 10.1-5 fra CRF formatet) er medtaget, se Annex 9. Det fulde sæt af CRF tabeller er tilgængelige på EIONET som er det Europæiske Miljøagenturs rapporterings-internetsite:

http://cdr.eionet.europa.eu/dk/Air_Emission_Inventories

Med hensyn til gengivelsen af tal i rapporten og i CRF-formatet, gøres opmærksom på at CRF-tabellerne og Annex 9 er med dansk notation: "," (komma) for decimaladskillelse og "." (punktum) til adskillelse af tusinder. I rapporten (undtagen i de få tilfælde hvor tabeller er indsat som "billede" fra CRF, som Annex 9) er den engelske notation brugt: "." (punktum) for decimaltegn og (for det meste) mellemrum for adskillelse af tusinder. Den engelske notation for adskillelse af tusinder med "," (komma) er (for det meste) ikke brugt på grund af risikoen for fejltagelser for danske læsere.

Ansvarlige institutioner

Danmarks Miljøundersøgelser (DMU) ved Aarhus Universitet er ansvarlig for opgørelser af drivhusgasemissioner og den årlige rapportering til EU og UNFCCC for Danmark. DMU er kontaktpunktet for Danmarks nationale system til drivhusgasopgørelser under Kyoto-protokollen. Som følge heraf er DMU ansvarlig for rapportering af drivhusgasemissionsopgørelser til Klimakonventionen for Kongeriget Danmark (Færøerne, Grønland og Danmark), samt Danmarks og Grønlands samlede rapportering til Kyoto-protokollen. DMU deltager desuden i arbejdet i regi af Klimakonventionen og Kyotoprotokollen, hvor retningslinjer for rapportering diskuteres og vedtages og i EU's moniteringsmekanisme for opgørelse af drivhusgasser, hvor retningslinjer for rapportering til EU reguleres.

Arbejdet med de årlige opgørelser udføres i samarbejde med andre danske ministerier, forskningsinstitutioner, organisationer og private virksomheder. Grønlands Klima- og Infrastrukturstyrelse er ansvarlig for levering af opgørelser for Grønland til DMU. Færøernes miljømyndighed (Umhvørvisstovan) er ansvarlig for de Færøske opgørelser.

Drivhusgasser

Til Klimakonventionen rapporteres følgende drivhusgasser:

- Kuldioxid CO_2
- Metan CH_4
- Lattergas N_2O
- Hydrofluorcarboner HFC'er
- Perfluorcarboner PFC'er
- Svovlhexafluorid SF_6

Det globale opvarmningspotentiale, på engelsk Global Warming Potential (GWP), udtrykker klimapåvirkningen over en nærmere angivet tid af en vægtenhed af en given drivhusgas relativt til samme vægtenhed af CO_2. Drivhusgasser har forskellige karakteristiske levetider i atmosfæren, således for CH_4 ca. 12 år og for N_2O ca. 120 år. Derfor spiller tidshorisonten en afgørende rolle for størrelsen af GWP. Typisk vælges 100 år. Herefter kan effekten af de forskellige drivhusgasser omregnes til en ækvivalent mængde CO_2, dvs. til den mængde CO_2 der vil give samme klimapåvirkning. Til rapporteringen til Klimakonventionen er vedtaget at anvende GWP-værdier for en 100-årig tidshorisont, som ifølge IPCC's anden vurderingsrapport er:

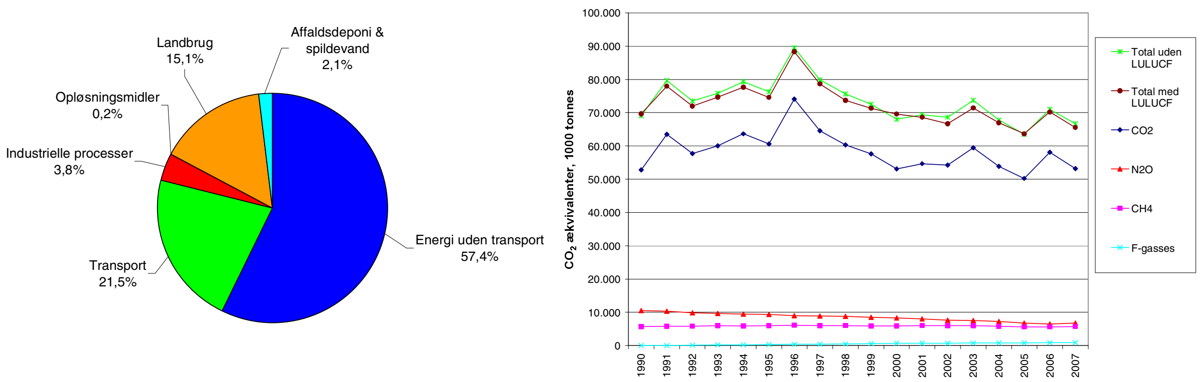
- Kuldioxid, CO_2: 1
- Metan, CH_4: 21
- Lattergas, N_2O: 310

Regnet efter vægt og over en 100-årig periode er metan således ca. 21 og lattergas ca. 310 gange så effektive drivhusgasser som kuldioxid. For andre drivhusgasser der indgår i rapporteringen, de såkaldte F-gasser (HFC, PFC, SF_6) findes væsentlig højere GWP-værdier. Under Klimakonventionen er der ligeledes vedtaget GWP-værdier for disse baseret på IPCC's anbefalinger. Således har f.eks. SF_6 en GWP-værdi på 23 900. I denne rapport anvendes de GWP-værdier, som UNFCCC har vedtaget.

Endvidere rapporteres de indirekte drivhusgasser Nitrogenoxide (NO_x), Carbonmonooxide (CO), Non-Methane Volatile Organic Compound (NMVOC) og Sulphurdioxid (SO_2). Da der ikke tilskrives disse gasser GWP-værdier, medregnes disse ikke I drivhusgasemissioner i CO_2-ækvivalenter

S.2. Udviklingen i drivhusgasemissioner og optag

De danske opgørelser af drivhusgasemissioner følger metoderne som beskrevet i IPCC's retningslinjer. I den forbindelse skal nævnes at det under Klimakonventionen og Kyotoprotokollen er vedtaget at IPCC's 1996 retningslinjer og IPCC's 2000 anvisninger skal anvendes. Opgørelserne er opdelt i seks overordnede sektorer, 1. energi, 2. industrielle processer, 3. opløsningsmidler, 4. landbrug, 5. arealanvendelse for skove og jorder (Land Use Land Use Change and Forestry: LULUCF) og 6. affald. Drivhusgasserne omfatter CO_2, CH_4, N_2O og F-gasserne: HFC'er, PFC'er og SF_6. I Figur S.1 ses de estimerede drivhusgasemissioner for Danmark i CO_2-ækvivalenter for perioden 1990 til 2007. Figuren viser Danmarks totale udslip med og uden LULUCF-sektoren (Land Use and Land Use Change and Forestry). Til venstre i S.1 ses det relative bidrag til Danmarks totale udslip (uden LULUCF) i 2007 for sektorerne 1. – 4. og 6. For sektor 1. energi er vejtrafik vist særskilt. Sektor 5. LULUCF indgår ikke i denne figur da sektoren i 2007 udgjorde et optag for drivhusgasser.



Figur S.1 Danske drivhusgasemissioner. Bidrag til total emission fra hovedsektorer for 2007 og tidsserier i CO_2-ækvivalenter for 1990-2007, hvor data for CO_2 er uden LULUCF.

I overensstemmelse med retningslinjerne for opgørelserne er emissionerne ikke korrigerede for handel med elektricitet med andre lande og temperatursvingninger fra år til år. CO_2 er den vigtigste drivhusgas og bidrager i 2007 med 80,3 % af det nationale totale udslip, efterfulgt af N_2O med 9,7 % og CH_4 med 8,7 %, mens HFC'er, PFC'er og SF_6 kun udgør 1,3 % af de totale emissioner. Set over perioden 1990-2007 så har disse procenter været stigende for CO_2 og F-gasser, nær konstant for CH_4 og faldende for N_2O. Netto-CO_2-optaget af skov og jorder (LULUCF) er i 2007 1,7 % af den nationale totale emission. Med hensyn til sektorerne (figur S.1) så bidrager energi ekskl. vejtransport (hovedsageligt stationære forbrændingsanlæg), transport og landbrug mest med i 2007 henholdsvis 57,4, 21,5 og 15,1 %. De nationale totale drivhusgasemissioner i

CO_2-ækvivalenter er faldet med 3,5 % fra 1990 til 2007, hvis nettobidraget fra skovenes og jordernes udledninger og optag af CO_2 ikke indregnes, og faldet med 5,9 % hvis de indregnes.

S.3. Oversigt over drivhusgasemissioner og optag fra sektorer

1. Energi

Sektoren bidrager i 2007 med 78,8 % af den danske totale emission (excl. LULUCF). Udledningen af CO_2 stammer altovervejende fra forbrænding af kul, olie, benzin og naturgas på kraftværker, i beboelsesejendomme, industri og vejtransport. Kraft- og fjernvarmeværker samt udvinding af olie og gas bidrager med 47 % af de totale CO_2 emissioner, omkring 26 % stammer fra transportsektoren. CO_2-emissionen fra energisektorerne faldt med omkring 9 % fra 2006 til 2007. De relative store udsving i emissionerne fra år til år skyldes handel med elektricitet med andre lande, herunder særligt de nordiske. De høje emissioner i 1991, 1994, 1996, 2003 og 2006 er et resultat af stor eksport af elektricitet, mens de lave emissioner i 1990 og 2005 skyldes import af elektricitet. Udledningen af CH_4 fra energiproduktion har været stigende på grund af øget anvendelse af gasmotorer, som har en stor CH_4-emission i forhold til andre forbrændingsteknologier. Anvendelsen af gasmotorer er dog blevet mindre siden liberaliseringen af elmarkedet, hvilket har ført til lavere CH_4-emissioner fra energisektoren. Transportsektorens CO_2-emissioner er steget med ca. 33 % siden 1990 hovedsagelig på grund af voksende vejtrafik.

2. Industrielle processer

Emissionen fra industrielle processer – hvilket vil sige andre processer end forbrændingsprocesser – udgør i 2007 3,8 % af de totale danske drivhusgasemissioner. De vigtigste kilder er cementproduktion, kølesystemer, opskumning af plast og kalcinering af kalksten. CO_2-emissionen fra cementproduktion - som er den største kilde - bidrager med ca. 2,1 % af den totale emission i 2007 og stigningen fra 1990 til 2007 er 59 %. Den anden største kilde har tidligere været N_2O fra produktion af salpetersyre. Produktionen af salpetersyre stoppede i midten af 2004, hvilket betyder, at N_2O-emissionen er nul for denne kilde fra 2005.

Emissionen af HFC'er, PFC'er og SF_6 er i perioden fra 1995 og til 2007 steget med 172 %, hovedsageligt på grund af stigende emissioner af HFC'er. Anvendelsen af HFC'er, og specielt HFC-134a, er steget kraftigt, hvilket har betydet, at andelen af HFC'er af den samlede F-gas emission steg fra 67 % i 1995 og til 95 % i 2007. HFC'er anvendes primært inden for køleindustrien. Anvendelsen er dog nu stagnerende, som et resultat af dansk lovgivning, der forbyder anvendelsen af nye HFC-baserede stationære kølesystemer fra 2007. I modsætning til denne udvikling ses et stigende brug af airconditionsystemer i køretøjer.

3. Opløsningsmidler og relaterede produkter

Forbrug af opløsningsmidler i industrier og husholdninger bidrager i 2007 med 0,2 % af totalmængden af emitterede drivhusgasser i CO_2-ækvivalenter. Der er en reduktion på 51 % i total CO_2 emissionerne i perioden 1990 til 2007. Bidraget fra N_2O-forbruget til de totale CO_2-ækvivalent emissioner for solventer er 30 %.

4. Landbrug

Landbrugssektoren bidrager i 2007 med 15,1 % til den totale drivhusgasemission i CO_2-ækvivalenter og er den vigtigste sektor hvad angår emissioner af N_2O og CH_4. I 2007 var landbrugets bidrag til de totale emissioner af N_2O og CH_4 henholdsvis 92 % og 67 %. Fra 1990 til 2007 ses et fald på 31 % i N_2O-emissionen fra landbrug. Dette skyldes mindre brug af kvælstofhandelsgødning og bedre udnyttelse af kvælstof i husdyrgødningen, hvilket resulterer i mindre emissioner pr. produceret dyreenhed. Emissioner af CH_4 fra husdyrenes fordøjelsessystem er faldet fra 1990 til 2007 grundet et faldende antal kvæg. På den anden side har en stigende andel af gyllebaserede staldsystemer bevirket at emissionerne fra husdyrgødning er steget. I alt er CH_4 emissionerne fra landbrugssektoren faldet med 4 % fra 1990 til 2007.

5. Arealanvendelse skove og jorder (LULUCF)

Arealanvendelse omfatter emissioner og optag/bindinger fra skov- og landbrugsarealet. Denne sektor binder generelt CO_2. I 2007 er sektoren estimeret til at binde ca. 1,7 % af det samlede udslip af drivhusgasser. Dette er større end i 2006, fordi stormfaldet i de danske skove i 2005 reducerede bindingen fra normalt 3000-3500 Gg CO_2 pr. år til 2977 Gg CO_2 pr. år. For landbrugsarealet er der estimeret en samlet emission på 1779 Gg CO_2 pr. år, hvor de organiske jorde afgiver CO_2, mens mineraljordene normalt binder CO_2. Bindingen i mineraljorde beregnes med en dynamisk model som tager hensyn til det aktuelle høstudbytte og aktuelle temperaturer og vil derfor variere fra år til år. Året 2007 var det varmeste år nogensinde registreret i Danmark. Landbrugsjordene bevarede C indholdet i jorden på same niveau som 2006. I Danmark findes der kun et meget lille areal med permanente græsmarker, hvorfor det kun har en lille indflydelse på den samlede udvikling i drivhusgasudledningen.

6. Affald

Affaldssektoren udgør i 2007 2,1 % af den danske total-emission. Lossepladser er den tredjestørste kilde til CH_4-emissioner og dominerer sektor-bidraget med 78 %. Emissionen er faldet med 20 % fra 1990 til 2007. Faldet skyldes faldende affaldsmængder til deponering og stigende anvendelse af affald til produktion af elektricitet og varme. Da al affaldsforbrænding bruges til produktion af elektricitet og varme, er emissionerne herfra inkluderet i IPCC-kategorien 1A.

Emissioner af CH_4 og N_2O fra spildevandsanlæg udgør i 2007 henholdsvis 19 og 3 % af sektorens bidrag. CH_4 fra spildevandsanlæg er stigende fra 1990 til 2007 på grund af en stigning i mængden af industrielt spildevand, mens N_2O er faldende i takt med teknisk opgradering af spildevandsanlæg.

S.4. Andre informationer

S.4.1 Kvalitetssikring og - kontrol

Rapporten indeholder en plan for kvalitetssikring og -kontrol af emissionsopgørelserne. Kvalitetsplanen bygger på IPCC's retningslinjer og ISO 9000 standarderne. Planen skaber rammer for dokumentation og rapportering af emissionerne, så opgørelserne er gennemskuelige, konsistente, sammenlignelige, komplette og nøjagtige. For at opfylde disse kriterier, understøtter datastrukturen arbejdsgangen fra indsamling af data til sammenstilling, modellering og til sidst rapportering af data.

Som en del af kvalitetssikringen, udarbejdes der for emissionskilderne rapporter, der detaljeret beskriver og dokumenterer anvendte data og beregningsmetoder. Disse rapporter evalueres af personer uden for DMU, der har høj faglig ekspertise indenfor det pågældende område, men som ikke direkte er involveret i arbejdet med opgørelserne. Indtil nu er rapporter for stationære forbrændingsanlæg, transport og landbrug blevet evalueret. Desuden er der gennemført et projekt, hvor de danske opgørelsesmetoder, emissionsfaktorer og usikkerheder sammenlignes med andre landes, for yderligere at verificere rigtigheden af opgørelserne.

S. 4.2. Fuldstændighed i forhold til IPCCs retningslinjer for kilder og gasser

De danske opgørelser af drivhusgasemissioner indeholder alle de kilder der er beskrevet i IPCC's retningsliner undtagen:

Landbrug: Metankonverteringsfaktoren for emissioner fra kyllingers og pelsdyrs fordøjelsessystemer er ikke bestemt, og der findes ingen IPCC standardemissionsfaktor. Emissionerne fra disse dyrs fordøjelsessystemer anses dog for at være forsvindende i forhold til de totale emissioner fra fordøjelsessystemer.

S. 4.3. Rekalkulationer og forbedringer

De vigtigste forbedringer af opgørelserne er:

Energi

Stationær forbrænding

For stationær forbrænding er emissionsopgørelserne blevet opdateret i henhold til den seneste officielle energistatistik publiceret af Energistyrelsen. Opdateringen omfatter årene 1990-2006. De fleste ændringer berører årene 2005 og 2006.

Data fra CO_2-kvote-indberetninger er for anden gang inkluderet i emissionsopgørelsen for 2007. Det er hovedsageligt fra centrale kraftværker, der benytter kul og fuelolie, hvor detaljerede oplysninger er til rådighed. En af rapporterne for 2007 blev af DMU vurderet til at være forkert, derfor indgår oplysninger fra dette værk ikke i opgørelsen. Efterfølgende blev rapporten fra samme værk for 2006 revurderet og det blev besluttet at fjerne indberetningen for 2006 fra opgørelsen. Denne ændring medførte en stigning i CO_2 emissionen, da dette værk havde haft en meget lav resulterende emissionsfaktor sammenlignet med standard emissionsfaktoren.

Baseret på den gennemgang af drivhusgasopgørelserne, som blev foretaget i september 2008 af et hold af eksperter fra FN, er der foretaget en række forbedringer vedrørende data samt form og indhold i rapporteringen:

- Bedre dokumentation for bygas er inkluderet.

- Forbedret dokumentation for emissioner fra brændsler anvendt til ikke-energi formål.
- Dokumentationen af data fra CO_2 kvote indberetningerne er blevet forbedret.
- Forbedret dokumentation af QA/QC for anlægsspecifikke emissionsfaktorer (I forbindelse med CO_2 kvote indberetninger)

Mobile kilder

For tunge køretøjer har nye oplysninger fra bilimportørernes forening muliggjort en mere præcis fordeling af køretøjer på EURO normer. En mere realistisk udvikling fra 2005 til 2006 i antallet af kørte kilometre for passagerbiler er inkluderet i beregningerne. For 2005 og 2006 har Energistyrelsen nedjusteret forbruget af diesel i energistatistikken.

Brændselsforbrug og emissionsfaktorer baseret på målinger fra Mols Liniens færger er blevet implementeret i opgørelserne. Derudover har der været genberegninger for to mindre færgeselskaber.

På grund af ændringerne i brændselsforbrug til national søfart er forbruget af dieselolie i fiskeriet blevet justeret, dette har indflydelse på emissionerne. Derudover er en fejl i energistatistikken for 2006 blevet rettet af Energistyrelsen. Dette har reduceret diesel forbruget i fiskeriet med 0,4 PJ.

Flygtige emissioner

Emissioner fra raffinering af olie har tidligere været rapporteret under CRF kategori 1B2a vi. I denne aflevering er emissionen blevet reallokeret til CRF sektor 1B2a iv. Denne ændring var et resultat af EU's interne review.

For årene 2005 og 2006 er emissionerne fra flaring i raffinaderier blevet genberegnet baseret på nye data fra de to danske raffinaderier.

Emissionen fra flaring i danske naturgaslagre er for år 2000 blevet reallokeret fra CRF sektor 1B2b iv til 1B2b iii. Dette er gjort for at sikre konsistens i tidsserien.

Industri

CO_2 emissionen fra produktion af cement er blevet revideret for årene 1998 til 2005 baseret på nye oplysninger fra Danmarks eneste cementfabrik. For produktion af mursten og ekspanderede lerprodukter er CO_2 emissionen baseret på oplysninger fra virksomhedernes grønne regnskaber og EU ETS (EU Emission Trading Scheme), da emissionsfaktorerne der tidligere har været beregnet og anvendt indtil 2005 ikke var i overensstemmelse med de faktiske emissioner.

HFC-23 emission fra produktion af optiske fibre siden 2005, er blevet inkluderet i CRF sektor 2F9.

CO_2 emission fra anvendelse af smøreolie er inkluderet i opgørelsen for første gang. Emissionen er rapporteret under CRF kategori 2G.

Opløsningsmidler

Aminooxygen grupper, glycerol, toluendiisocyanat, dioctylphtalat og diethylenglycol er fjernet fra opgørelsen, da nærmere undersøgelser har vist at damptrykket af disse stoffer er under 0,01 kPa, hvilket gør, at de ikke er omfattet af NMVOC definitionen.

NMVOC emissionsfaktorer er blevet justeret for alle kemikalier baseret på erfaringer fra såvel et nordisk projekt, som et projekt udført for Miljøstyrelsen; dette har haft størst effekt på emissionerne fra stofferne: ethanol, formaldehyd, terpentin, xylen, toluen og ethylenglycol.

Der er indført en differentiering af emissionsfaktorerne mellem fire forskellige anvendelsesområder: 1) kemisk industri (lavest emissionsfaktor), 2) anden industri, 3) ikke-industriel anvendelse, 4) anvendelse i husholdninger (højeste emissionsfaktor). I de tidligere opgørelser blev der kun skelnet mellem to områder.

Mere detaljerede og pålidelige oplysninger om benyttede mængder og emissionsfaktorer er tilvejebragt gennem importører og producenter for følgende kemikalier: methanol, ethanol i sprinklervæske, naphtalen, propan og butan.

Landbrug

N_2O-emissionsfaktorer for handelsgødning er blevet ændret i henhold til nye værdier i EMEP/EEA Guidebooken.

Opdaterede data for 2004 til 2006 fra Miljøstyrelsen for anvendelsen af spildevandsslam som gødning er blevet indarbejdet i opgørelsen.

NH_3 emissionsfaktoren for afgrøder er blevet reduceret for både afgrøder og græs baseret på et litteraturstudie. Dette medfører et fald i N_2O emissionen fra atmosfærisk deposition.

For pelsdyr er NH_3-emissionsfaktoren ændret fra 25 til 36 % efter aftale med DJF.

Antallet af græsningsdage for malkekvæg og kvier er nedsat med 10 % i 2007. For at undgå inkonsistens i tidsserien er antallet af græsningsdage interpoleret for årene 2003-2006.

Affald

I forbindelse med 2009 afleveringen er der udført genberegninger for årene 2004-2006. Genberegningen skyldes opdaterede data fra energistatistikken omkring opsamlingen af CH_4 fra affaldsdeponier til energi produktion. For 2004 og 2005 er der blevet ændret i afrundingen af input data til modellen. Denne genberegning betyder en stigning i emissionen på 2,5 og 4 % for henholdsvis 2004 og 2005.

Arealanvendelse (LULUCF)

Skov, landbrugsareal, græsområder og vådområder

Stigningen i C bundet i levende biomasse er rettet for 1999 fra 378 Gg C til 379 Gg C.

Faldet i C bundet i levende biomasse for nåletræer i den bestående skov er rettet for årene 2005 og 2006. Årsagen er en opdatering af data for skovfælding fra Danmarks Statistik. Forskellen til de tidligere rapporterede værdier er dog ikke stor, for 2005 1672 Gg CO_2 til 1640 Gg CO_2 og for 2006 2574 Gg CO_2 til 2601 Gg CO_2.

For landbrugsjord konverteret til skov er C bindingen i skovbunden blevet flyttet fra kategorien "Net carbon stock change in soils" til "Net carbon stock change in dead organic matter".

Da emissionen rapporteret fra landbrugsjorde baseres på 5 års gennemsnit har der været genberegninger for årene 2005 og 2006. En lille fejl i mængden af kalk anvendt i 2006 er blevet rettet.

Totale ændringer

Ændringer i de danske totale drivhusgasemissioner (i CO_2-ækvivalenter), uden medtagning af emissioner og optag fra jorde og skov, som følge af forbedringer og rekalkulationer, er små i forhold til sidste års rapportering. Ændringerne for hele tidsserien 1990 til 2006 ligger mellem -0,18 % (1998) og +0,81 % (2006).

Ændringer i de danske totale drivhusgasemissioner (i CO_2-ækvivalenter) er noget større, når emissioner og optag fra jorde og skov medtages. Ændringerne i forhold til sidste rapportering er dog stadig forholdsvis små og ligger for hele tidsserien 1990 til 2006 mellem –0,15 % (2004) og +1,14 % (2005).

1 Introduction

1.1 Background information on greenhouse gas inventories and climate change

Annual report

This report is Denmark's National Inventory Report (NIR) 2009, for submission to the United Nations Framework Convention on Climate change, due April 15, 2009. The report contains detailed information on Denmark's inventories for all years from 1990 to 2007. The structure of the report is in accordance with the UNFCCC guidelines on reporting and review (UNFCCC, 2002). The report includes detailed and complete information on the inventories for all years from year 1990 to the year 2007, in order to ensure transparency.

The issues addressed in this report are trends in greenhouse gas emissions, a description of each IPCC category, uncertainty estimates, recalculations, planned improvements and procedures for quality assurance and control.

The annual emission inventories for Denmark, for the years from 1990 to 2007, are reported in the Common Reporting Format (CRF) as requested in the reporting guidelines. 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 the total greenhouse gas emissions in CO_2 equivalents.

According to the instrument of ratification, the Danish government has ratified the UNFCCC on behalf of Denmark, Greenland and the Faroe Islands. Annex 6.1 of this report includes total emissions for Denmark, Greenland and the Faroe Islands for 1990 to 2007. Further, in Annex 6.2, information on the Greenland and the Faroe Islands inventories is given. Apart from Annexes 6.1 and 6.2, the information in this report relates to Denmark only.

This report is available to the public on the National Environmental Research Institutes homepage.
http://www.dmu.dk/International/Publications/ (search for "National Inventory Report 2009")

This report itself does not contain the full set of CRF Tables. Only the trend tables, Tables 10.1-5 of the CRF format, are included, refer Annex 9. 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/Submission_UNFCCC/

Greenhouse gases

The greenhouse gases reported under the Climate Convention are:

- Carbon dioxide CO_2

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

The main greenhouse gas responsible for the anthropogenic influence on the heat balance is CO_2. The atmospheric concentration of CO_2 has increased from a pre-industrial value of about 280 ppm to 379 ppm in 2005 (an increase of about 35 %), and exceeds now the natural range of 180-300 ppm over the last 650 000 years as determined by ice cores (IPCC, Fourth Assessment Report, 2007). The main cause for the increase in CO_2 is the use of fossil fuels, but changing land use, including forest clearance, has also been a significant factor. The greenhouse gases CH_4 and N_2O are very much linked to agricultural production; CH_4 has increased from a pre-industrial atmospheric concentration of about 715 ppb to 1774 ppb in 2005 (an increase of about 140 %) and N_2O has increased from a pre-industrial atmospheric concentration of about 270 ppb to 319 ppb in 2005 (an increase of about 18 %) (IPCC, Fourth Assessment Report, 2007). Changes in the concentrations of greenhouse gases are not related in simple terms to the effect on the heat balance, however. The various gases absorb radiation at different wavelengths and with different efficiency. This must be considered in assessing the effects of changes in the concentrations of various gases. Furthermore, the lifetime of the gases in the atmosphere needs to be taken into account – the longer they remain in the atmosphere, the greater the overall effect. The global warming potential (GWP) for various 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 individual substances on the global climate. Typical lifetimes in the atmosphere of substances are very different, e.g. approximately for CH_4 and N_2O, 12 and 120 years 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 for reporting for inventory years throughout the commitment period 2008-2012, 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, methane is thus 21 times more powerful a greenhouse gas than CO_2, and N_2O is 310 times more powerful. Some of the other greenhouse gases (hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) have considerably higher global warming potential values. For example, sulphur hexafluoride has a global warming potential of 23 900.

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.

The Climate Convention and the Kyoto Protocol

At the United Nations Conference on Environment and Development in Rio de Janeiro in June 1992, more than 150 countries signed the UNFCCC (the Climate Convention). On the 21st of December 1993, the Climate Convention was ratified by a sufficient number of countries, including Denmark, for it to enter into force on the 21st of March 1994. One of the provisions of the treaty was to stabilise the greenhouse gas emissions from the industrialised nations by the end of 2000. At the first conference under the UN Climate Convention in March 1995, it was decided that the stabilisation goal was inadequate. At the third conference in December 1997 in Kyoto in Japan, a legally binding agreement was reached committing the industrialised countries to reduce the six greenhouse gases by 5.2 % by 2008-2012 compared with the base year and 1990 levels. For the 1990 levels and the base year and the F-gases, the nations can choose freely between 1990 and 1995 as the base year. On May 16, 2002, the Danish parliament voted for the Danish ratification of the Kyoto Protocol. Denmark is, thus, under a legal commitment to meet the requirements of the Kyoto Protocol, when it came into force on the 16th of February 2005. The European Union must reduce emissions of greenhouse gases by 8 %. However, within the EU, Member States have made a political agreement – the Burden Sharing Agreement – on the contributions to be made by each state to the overall EU reduction level of 8 %.

Under the Burden Sharing Agreement, Denmark (excluding Greenland and the Faroe Islands) must reduce emissions by an average of 21 % in the period 2008-2012 compared with the base year emission level.

In accordance with the Kyoto Protocol, Denmark's base year emissions include the emissions of CO_2, CH_4 and N_2O in 1990 in CO_2-equivalents and Denmark has chosen the emissions of HFCs, PFCs and SF_6 in 1995 in CO_2-equivalents for the base year.

The role of the European Union

The European Union (EU) is a party to the UNFCCC and the Kyoto Protocol. Therefore, the EU has to submit similar datasets and reports for the collective 15 EU Member States under the burden sharing. The EU imposes some additional guidelines and obligations to these EU Member States through Decision No. 280/2004/EC concerning a mechanism for monitoring community greenhouse gas emissions and for implementing the the Kyoto Protocol (EU monitoring mechanism).

1.2 A description of the institutional arrangement for inventory preparation

The National Environmental Research Institute (NERI), University of Aarhus, is responsible for the annual preparation and submission for Denmark to the EU and UNFCCC of the National Inventory Report and the GHG inventories in the Common Reporting Format, in accordance with the UNFCCC guidelines. Thus 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 Greenland Home Rule Government 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.

NERI has been and is engaged in work in connection to the meetings of the Conference of Parties (COP) to the UNFCCC and the meetings of the parties (COP/MOP) to the Kyoto protocol and its subsidiary bodies, where the reporting rules are negotiated and settled. Furthermore, NERI participates in the EU Monitoring Mechanism, Working Group 1 (WG1), where the guidelines, methodologies etc. on inventories to be prepared by the EU Member States are regulated.

The main experts responsible for the sectorial inventories and the key category analysis and the corresponding chapters and annexes in this report are:

Project leader		Ole-Kenneth Nielsen (okn@dmu.dk)
Sector	Sub-sector	Expert name
Energy	Stationary combustion:	Malene Nielsen, Ole-Kenneth Nielsen
	Transport and other mobile sources	Morten Winther
	Fugitive emissions:	Marlene Plejdrup
Industrial processes		Leif Hoffmann, Erik Lyck
Solvent and other product use		Patrik Fauser
Agriculture		Mette Hjorth Mikkelsen, Rikke Albrektsen & Steen Gyldenkærne
LULUCF		Lars Vesterdal & Steen Gyldenkærne
Waste	Solid waste disposal	Erik Lyck
	Waste water handling	Marianne Thomsen
Key category analysis		Erik Lyck

The work concerning the annual greenhouse emission inventory is carried out in co-operation with other Danish ministries, research institutes, organisations and companies:

Danish Energy Authority, the Ministry of Climate and Energy. Annual energy statistics in a format suitable for the emission inventory work and fuel-use data for the large combustion plants.

Danish Environmental Protection Agency, The Ministry of the Environment. Database on waste and emissions of the F-gases.

Statistics Denmark, The Ministry of Economic and Business Affairs. Statistical yearbook, sales statistics for manufacturing industries and agricultural statistics.

Faculty of Agricultural Sciences, Aarhus University. Data on use of mineral fertiliser, feeding stuff consumption and nitrogen turnover in animals.

The Road Directorate, the Ministry of Transport and Energy. Number of vehicles grouped in categories corresponding to the EU classification, mileage (urban, rural, highway), trip speed (urban, rural, highway).

Danish Centre for Forest, Landscape and Planning, University of Copenhagen. Background data for Forestry and CO_2 uptake by forest.

Civil Aviation Agency of Denmark, the Ministry of Transport and Energy. City-pair flight data (aircraft type and origin and destination airports) for all flights leaving major Danish airports.

Danish Railways, the Ministry of Transport and Energy. Fuel-related emission factors for diesel locomotives.

Danish companies. Audited green accounts and direct information gathered from producers and agency enterprises.

Formerly, the provision of data was on a voluntary basis, but more formal agreements are now prepared.

1.3 Brief description of the process of inventory preparation. Data collection and processing, data storage and archiving

The background data (activity data and emission factors) for estimation of the Danish emission inventories is collected and stored in central databases located at NERI. The databases are in Access format and handled with software developed by the European Environmental Agency and NERI. As input to the databases, various sub-models are used to estimate and aggregate the background data in order to fit the format and level in the central databases. The methodologies and data sources used for the different sectors are described in Chapter 1.4 and Chapters 3 to 9. As part of the QA/QC plan (Chapter 1.6), the data structure for data processing support the pathway from collection of raw data to data compilation, modelling and final reporting.

For each submission, databases and additional tools and submodels are frozen together with the resulting CRF-reporting format. This material is placed on central institutional servers, which are subject to routine backup services. Material which has been backed up is archived safely. A further documentation and archiving system is the official journal for NERI. In this journal system, correspondence, both in-going and out-going, is registered, which in this case involves the registration of submissions and communication on inventories with the UNFCCC Secretariat, the European Commission, review teams, etc.

Figure 1.1 shows a schematic overview of the process of inventory preparation. The figure illustrates the process of inventory preparation from the first step of collecting external data to the last step, where the reporting schemes are generated for the UNFCCC and EU (in the CRF format (Common Reporting Format)) and to the United Nations Economic Commission for Europe/Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (UNECE/EMEP) (in the NFR format (Nomenclature For Reporting)). For data handling, the software tool is CollectER (Pulles et al., 1999) and for reporting the software tool is the new CRF reporter tool developed by the UNFCCC Secretariat together with additional tools developed by NERI. Data files and programme files used in the inventory preparation process are listed in Table 1.1.

Table 1.1 List of current data structure; data files and programme files in use

QA/QC Level	Name	Application type	Path	Type	Input sources
4 store	CFR Submissions (UNFCCC and EU)	External report	I:\ROSPROJ\LUFT_EMI\Inventory\AllYears\8_All Sectors\Level_4a_Storage\	MS Excel, xml	CRF Reporter
3 process	CRF Reporter	Management tool	Working path: local machine Archive path: I:\ROSPROJ\LUFT_EMI\Inventory\AllYears\8_All Sectors\Level_3b_Processes	(exe + mdb)	manual input and Importer2CRF
3 process	Importer2CRF	Help tool	I:\ROSPROJ\LUFT_EMI\Inventory\AllYears\8_All Sectors\Level_3b_Processes	MS Access	CRF Reporter, CollectEr2CRFand excel files
3 process	CollectER2CRF	Help tool	I:\ROSPROJ\LUFT_EMI\Inventory\AllYears\8_All Sectors\Level_3b_Processes	MS Access	NERIRep
2 process 3 store	NERIRep	Help tool	Working path: I:\ROSPROJ\LUFT_EMI\DMURep	MS Access	CollectER databases; dk1972.mdb..dkxxxx.mdb
2 process	CollectER	Management tool	Working path: local machine Archive path: I:\ROSPROJ\LUFT_EMI\Inventory\AllYears\8_All Sectors\Level_2b_Processes	(exe +mdb)	manual input
2 store	dk1972.mdb.dkxxxx .mdb	Datastore	I:\ROSPROJ\LUFT_EMI\Inventory\AllYears\8_All Sectors\Level_2a_Storage	MS Access	CollectER

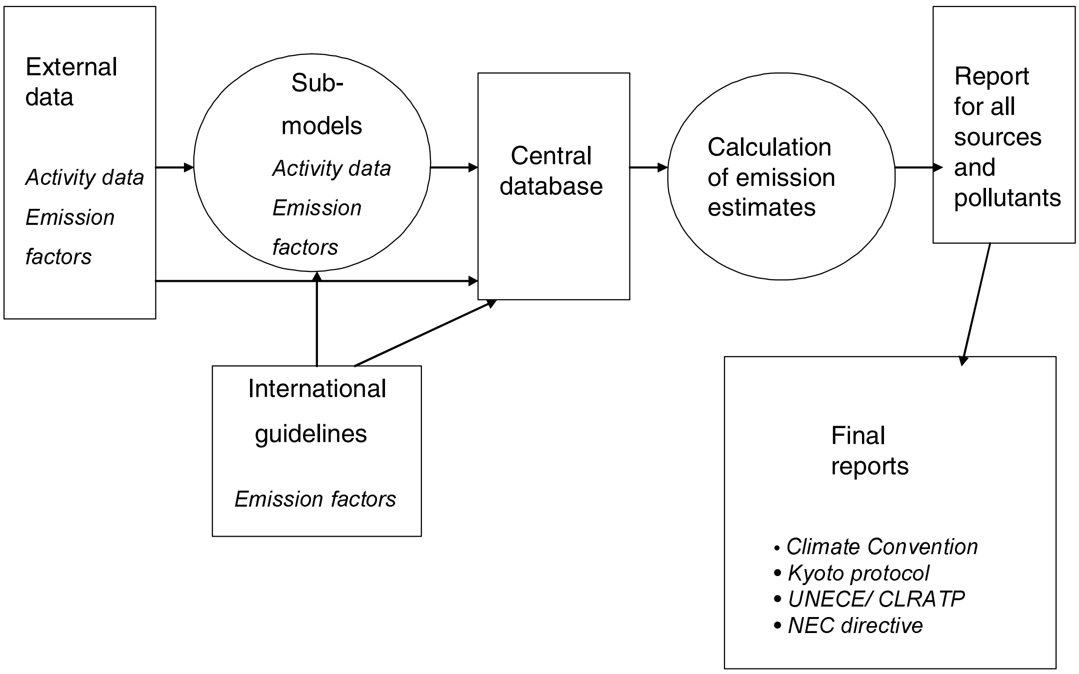


Figure 1.1 Schematic diagram of the process of inventory preparation.

1.4 Brief general description of methodologies and data sources used

Denmark's air emission inventories are based on the Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories

(IPCC, 2000) and the CORINAIR methodology. CORINAIR (COoRdination of INformation on AIR emissions) is a European air emission inventory programme for national sector-wise emission estimations, harmonised with the IPCC guidelines. To ensure estimates are as timely, consistent, transparent, accurate and comparable as possible, the inventory programme has developed calculation methodologies for most subsectors and software for storage and further data processing (EMEP-/CORINAIR, 2004).

A thorough description of the CORINAIR inventory programme used for Danish emission estimations is given in Illerup et al. (2000). The CORINAIR calculation principle is to calculate the emissions as activities multiplied by emission factors. Activities are numbers referring to a specific process generating emissions, while an emission factor is the mass of emissions pr unit activity. Information on activities to carry out the CORINAIR inventory is largely based on official statistics. The most consistent emission factors have been used, either as national values or default factors proposed by international guidelines.

A list of all subsectors at the most detailed level is given in Illerup et al. (2000) together with a translation between CORINAIR and IPCC codes for sector classifications.

1.4.1 Stationary Combustion Plants

Stationary combustion plants are part of the CRF emission sources *1A1 Energy Industries*, *1A2 Manufacturing Industries* and *1A4 Other sectors*.

The Danish emission inventory for stationary combustion plants is based on the CORINAIR system described in the Emission Inventory Guidebook (EMEP/CORINAIR, 2004). The inventory is based on activity rates from the Danish energy statistics and on emission factors for different fuels, plants and sectors.

The Danish Energy Authority aggregates fuel consumption rates in the official Danish energy statistics to SNAP categories.

For each of the fuel and SNAP categories (sector and e.g. type of plant), a set of general emission factors has been determined. Some emission factors refer to the EMEP/CORINAIR guidebook and some are country-specific and refer to Danish legislation, Danish research reports or calculations based on emission data from a considerable number of plants.

Some of the large plants, such as e.g. power plants and municipal waste incineration plants are registered individually as large point sources and emission data from the actual plants are used. This enables use of plant specific emission factors that refer to emission measurements stated in annual environmental reports, etc. At present, the emission factors for CH_4 and N_2O are, however, not plant-specific, whereas emission factors for SO_2 and NO_X often are. For CO_2 it was for the first time possible to use data reported under the EU-ETS in the emission inventory for 2006. Therefore it was possible to derive some plant specific CO_2 emission factors for coal and residual oil fired power plants.

The CO_2 from incineration of the plastic part of municipal waste is included in the Danish inventory.

In addition to the detailed emission calculation in the national approach, CO_2 emission from fuel combustion is aggregated using the reference approach. In 2007, the CO_2 emission inventory based on the reference approach and the national approach, respectively, differ by -0.004 %.

Please refer to Chapter 3 and Annex 3A for further information on the emission inventory for stationary combustion plants.

The specific methodologies regarding Fugitive Emissions from Fuels

Fugitive emissions from oil (CRF Table 1.B.2. a)

Off-shore activities:

Emissions from offshore activities are estimated using the methodology described in the Emission Inventory Guidebook (EMEP/CORINAIR, 2004). The sources include emissions from the extraction of oil and gas, on-shore oil tanks, and onshore and offshore loading of ships. The emission factors are based on the figures given in the guidebook, except for the onshore oil tanks where national values are used.

Oil Refineries – Petroleum products processing:

The VOC emissions from petroleum refinery processes cover non-combustion emissions from feedstock handling/storage, petroleum products processing, product storage/handling and flaring. SO_2 is also emitted from the non-combustion processes and includes emissions from processing the products and from sulphur recovery plants. The emission calculations are based on information from the Danish refineries and the energy statistics.

Please refer to Chapter 3 for further information on fugitive emissions from fuels.

Fugitive emissions from natural gas (CRF Table 1.B.2.b)

Natural gas transmission and distribution:

Inventories of the CH_4 emission from gas transmission and distribution is based on annual environmental reports from the Danish gas transmission company, Energinet.dk (former Gastra) and on a Danish inventory for the years 1999-2007, reported by the Danish gas sector (transmission and distribution companies).

1.4.2 Transport

The emissions from transport, referring to SNAP category 07 (road transport) and the sub-categories in 08 (other mobile sources), are made up in the IPCC categories: 1A3b (road transport), 1A2f (Industry-other), 1A3a (Civil aviation), 1A3c (Railways), 1A3d (Navigation), 1A4c (Agriculture/forestry/fisheries), 1A4b (Residential) and 1A5 (Other).

An internal NERI model with a structure similar to the European COPERT III emission model (Ntziachristos, 2000) is used to calculate the Danish annual emissions for road traffic. For most vehicle categories, updated fuel use and emission data from the new COPERT IV version is incorporated in the NERI model. The emissions are calculated for operationally hot engines, during cold start and fuel evaporation. The model also includes the emission effect of catalyst wear. Input data for vehicle stock and mileage is obtained from the Danish Road Directorate, and is grouped according to average fuel consumption and emission behaviour. For each group the emissions are estimated by combining vehicle and annual mileage numbers with hot emission factors, cold:hot ratios and evaporation factors (Tier 2 approach).

For air traffic, the 2001-2007 estimates are made on a city-pair level, using flight data from the Danish Civil Aviation Agency (CAA-DK) and LTO and distance-related emission factors from the CORINAIR guidelines (Tier 2 approach). For previous years the background data consists of LTO/aircraft type statistics from Copenhagen Airport and total LTO numbers from CAA-DK. With appropriate assumptions, consistent time-series of emissions are produced back to 1990, which also include the findings from a Danish city-pair emission inventory in 1998.

Off-road working machines and equipment are grouped in the following sectors: inland waterways, agriculture, forestry, industry, and household and gardening. In general, the emissions are calculated by combining information on the number of different machine types and their respective load factors, engine sizes, annual working hours and emission factors (Tier 2 approach).

For the most important ferry routes in Denmark (a sub-part of Navigation (1A3d)) detailed calculations are made by combining annual number of return trips, sailing time, engine size, load factor and emission factors (Tier 2 approach).

The most thorough recalculations have changed the fuel consumption input data for road transport, national sea transport, fisheries, agriculture, residential and military. CH_4 and N_2O emission factor changes are made for road transport and military. The recalculations influence the emission estimates of CO_2, CH_4 and N_2O for the sectors Road transport (1A3b), Agriculture/forestry/fisheries (1A4c), Navigation (1A3d), Residential (1A4b) and Military (Other: 1A5).

Please refer to Chapter 3 and Annex 3B for further information on emissions from transport.

1.4.3 Industrial Processes

Energy consumption associated with industrial processes and the emissions thereof are included in the Energy sector of the inventory. This is due to the overall use of energy balance statistics for the inventory.

Mineral Products: Cement. CRF Table 2(I).A-G Sectoral Background Data for Industrial Processes. A.1.

There is only one producer of cement in Denmark, Aalborg Portland Ltd. The activity data for the production of cement and the emission factor are obtained from the company as accounted for and published in the "Green Accounts" (In Danish: "Grønne regnskaber") worked out by the company according to obligations under Danish law. These accounts are subject to audit. The emission factor is produced as a result of a weight-ing of the emission factors from the production of low alkali cement, rapid cement, basis cement and white cement.

Mineral Products: Lime. CRF Table 2(I).A-G Sectoral Background Data for Industrial Processes. A.2.

The reference for the activity data for production of lime, hydrated lime, expanded clay products and bricks are the production statistics from the manufacturing industries, published by Statistics Denmark.

Mineral Products: Limestone and dolomite use. CRF Table 2(I). A-G Sectoral Background Data for Industrial Processes. A.3.

Limestone is used for the refining of sugar as well as for wet flue gas cleaning at power plants and waste incineration plants. The reference for the activity data is Statistics Denmark for sugar, Energinet.dk for gypsum from power plants combined with specific information on consumption of $CaCO_3$ at specific power plants and National Waste Statistics for gypsum from waste incineration. The emission factors are based on stoichiometric relations between consumption of $CaCO_3$ and gypsum generation as well as consumption of lime for sugar refining and precipitation with CO_2.

Mineral Products: Asphalt roofing. CRF Table 2(I). A-G Sectoral Background Data for Industrial Processes. A.5.

The reference for the activity data is Statistics Denmark for consumption of roofing materials, combined with technical specifications for roofing materials produced in Denmark. The emission factors are default factors.

Mineral Products: Road paving with asphalt. CRF Table 2(I). A-G Sectoral Background Data for Industrial Processes. A.6.

The reference for the activity data is Statistics Denmark for consumption of asphalt and cut-back asphalt. The emission factors are default factors for consumption of asphalt and an estimated emission factor for cut-back asphalt based on the statistics on the emission of NMVOC compiled by the industrial organisations in question.

Mineral products: Glass and glass wool. CRF Table 2(I).A-G Sectoral Background Data for Industrial Processes. A.7.

The reference for activity data for the production of glass and glass wool are obtained from the producers published in their environmental reports. Emission factors are based on stoichiometric relations between raw materials and CO_2 emissions.

Mineral products: Yellow bricks. CRF Table 2(I).A-G Sectoral Background Data for Industrial Processes. A.7.

The production of lime and yellow bricks gives rise to CO_2 emissions. The emission factors are based on stoichiometric relations, assumption on $CaCO_3$ content in clay as well as a default emission factor for expanded clay products.

Chemical Industry. Nitric Acid production: CRF Table 2(I).A-G Sectoral Background Data for Industrial Processes. B.2.

There is one producer. To date, the data in the inventory relies on information from the producer. The producer reports emissions of NO_x and NH_3 as measured emissions and emissions of N_2O for 2003 as estimated emissions. The emission of N_2O in 2005 and forward is not occurring as the nitric acid production was closed down in the middle of 2004.

Chemical Industry. Catalysts/fertilisers: CRF Table 2(I).A-G Sectoral Background Data for Industrial Processes. B.5 Others

There is one producer. The data in the inventory relies on information published by the producer in environmental reports.

Metal production. Steelwork: CRF Table 2(I).A-G Sectoral Background Data for Industrial Processes. C.1.

There is one producer. The activity data as well as data on consumption of raw materials (coke) has been published by the producer in environmental reports. Emission factors are based on stoichiometric relations between raw materials and CO_2 emission.

F-gases (HFCs, PFCs and SF_6): CRF Sectoral Report for Industrial Processes Table2(I) and 2(II) and Sectoral Background Data for Industrial Processes Tables 2(II).F

The inventory on the F-gases (HFCs, PFCs and SF_6) is based on work carried out by the Danish Consultant Company "Planmiljø". Their yearly report (Danish Environmental Protection Agency, 2009) documents the inventory data up to the year 2007. The methodology is implemented for the whole time-series 1990-2007, but full information on activities only exists since 1995.

Please refer to Chapter 4 for further information on industrial processes.

1.4.4 Solvents

CRF Table 3.A-D. Sectorial background data for solvents and other product use

The approach for calculating the emissions of Non-Methane Volatile Organic Carbon (NMVOC) from industrial and household use in Denmark focuses on single chemicals rather than activities. This leads to a clearer picture of the influence from each specific chemical, which enables a more detailed differentiation on products and the influence of product use on emissions. The procedure is to quantify the use of the chemicals and estimate the fraction of the chemicals that is emitted as a consequence of use.

The detailed approach in EMEP/CORINAIR (2004) is used. Here all relevant consumption data on all relevant solvents must be inventoried or at least those together representing more than 90 % of the total NMVOC emission. Simple mass balances for calculating the use and emissions of chemicals are set up 1) use = production + import – export, 2) emission = use * emission factor. Production, import and export figures are extracted from Statistics Denmark, from which a list of 427 single chemicals, a few groups and products is generated. For each of these, a "use" amount in tonnes pr yr (from 1995 to 2007) is calculated. It is found that 44 different NMVOCs comprise over 95 % of the total use and it is these 44 chemicals that are investigated further. The "use" amounts are distributed across industrial activities according to the Nordic SPIN (Substances in Preparations in Nordic Countries) database, where information on industrial use categories and products is available in a NACE coding system. The chemicals are also related to specific products. Emission factors are obtained from regulators or the industry.

Outputs from the inventory are: a list where the 44 most predominant NMVOCs are ranked according to emissions to air; specification of emissions from industrial sectors and from households - contribution from each chemical to emissions from industrial sectors and households; tidal (annual) trend in NMVOC emissions, expressed as total NMVOC and single chemical, and specified in industrial sectors and households.

This years solvent use emission inventories include with this submission from inventory year 2005 for the first time N_2O emissions. Five companies sell N_2O in Denmark and only one company produces N_2O. Due to confidentiality no data on produced amount are available and thus the emissions related to N_2O production are unknovn. An emission factor of one is assumed for all these uses, which equals the sold amount to the emitted amount.

Please refer to Chapter 5 for further information on the emission inventory for solvents.

1.4.5 Agriculture

CRF Table 4.A-F. Sectorial background data for agriculture

The emissions are given in CRF: Table 4 Sectoral Report for Agriculture and Table 4.A, 4.B(a), 4.B(b) and 4.D Sectoral Background Data for Agriculture. The calculation of emissions from the agricultural sector is based on methods described in the IPCC Guidelines (IPCC, 1996) and the Good Practice Guidance (IPCC, 2000). Activity data for livestock is on a one-year average basis from the agriculture statistics published by Statistics Denmark (2007). Data concerning the land use and crop yield is also from the agricultural statistics. Data concerning the feed consumption and nitrogen excretion is based on information from the Faculty of Agricultural Science, University of Aarhus. The CH_4 Implied Emission Factors for Enteric Fermentation and Manure Management are based on a Tier 2 approach for all animal categories. All livestock categories in the Danish emission inventory are based on an average of certain subgroups separated by differences in animal breed, age and weight class. The emissions from enteric fermentation for poultry and fur farming are not estimated. There is no default value recommended in the IPCC guidelines (Table A-4 in Good Practice Guidance).

Emission of N_2O is closely related to the nitrogen balance. Thus, quite a lot of the activity data is related to the Danish calculations for ammonia emission (Hutchings et al.; 2001, Mikkelsen et al., 2006). National standards are used to estimate the amount of ammonia emission. When estimating the N_2O emission the IPCC standard value is used for all emission sources. The emission of CO_2 from Agricultural Soils is included in the LULUCF sector.

A model-based system is applied for the calculation of the emissions in Denmark. This model (IAD – Inventory Agriculture Data based on the model DIEMA – Danish Integrated Emission Model for Agriculture) is used to estimate emission from both greenhouse gases and ammonia. A more detailed description on DIEMA is published in Mikkelsen et al. (2006). The emission from the agricultural sector is mainly related to livestock production. IAD works on a detailed level and includes around 32 livestock categories, and each category is subdivided according to stable type and manure type. The emission is calculated from each subcategory and the emission is aggregated in accordance with the livestock category given in the CRF.

To ensure data quality, both data used as activity data and background data used to estimate the emission factor are collected, and discussed in cooperation with specialists and researchers in different institutes and research sections. Thus, the emission inventory will be evaluated continuously according to the latest knowledge. Furthermore, time-series both of emission factors and emissions in relation to the CRF categories are prepared. Any considerable variations in the time-series are explained.

The uncertainties for assessment of emissions from enteric fermentation, manure management and agricultural soils have been estimated based on a Tier 1 approach. The most significant uncertainties are related to the N_2O emission.

A more detailed description of the methodology for the agricultural sector is given in Chapter 6 and Annex 3D.

1.4.6 Forestry, Land Use and Land Use Change

CRF Table 5 Sectoral Report for Land-Use Change and Forestry and Table 5.A Sectoral Background Data for Land-Use Change and Forestry.

As in previous submissions for forest land remaining forest land, only carbon (C) stock change in living biomass is reported. Change in C stocks is based on Equation 3.2.1 in the IPCC GPG (IPCC, 2000), where C lost due to annual harvests is subtracted from C sequestered in growing biomass for the area of forest land remaining forest land. The data for forest area and growth rates are obtained from the latest Forestry Census conducted in 2000 and remain similar during the period 2000-2006. For 2007, the forest area and growth rates were based on the new plot-based NFI. Harvesting data were obtained from Statistics Denmark. Wood volumes are converted to C stocks by a combination of country-specific values, literature values from the northwest European region and default values. There were no changes in methodology for the 2009 submission.

For cropland converted to forest land (afforestation), the reported change in C stock also concerned living biomass and forest floor. The change in C stock is estimated using a model based on country-specific increment tables for oak (representing broadleaves) and Norway spruce (representing conifers). The model calculates annual growth for annual cohorts of afforestation areas since 1990. Data on annual afforestation area is for the most part obtained from the Danish Forest and Nature Agency (subsidised private afforestation, municipal afforestation and afforestation by state forest districts). Afforestation by private landowners without subsidies was based on total afforested area recorded by the Forestry Census 2000 for the period 1990-99, with subtraction of the above categories of afforestation. Wood volumes estimated by the model are converted to C-stocks as for forest land remaining forest land. The first harvestings have been assumed for coniferous stands. Harvesting data were obtained from standard national yield tables for sites of good productivity. Changes in C stocks of forests floors have been reported based on various national experimental work. No changes in methodology or recalculations were done for the 2009 submission.

CO_2 emissions from cropland and grassland are based on census data from Statistics Denmark as regards size of area and crop yield combined with GIS-analysis on land use. The emission from mineral soils for both cropland and grassland is estimated with a three-pooled dynamical soil C model (C-TOOL). C-TOOL was initialised in 1980. The model is run for each county in Denmark. Emissions from organic soils are based on IPCC Tier 1b. The area with organic soils is based on soil maps combined with field-specific crop data. National models have been developed for the horticultural area based on area statistics from Statistic Denmark. Sinks in hedgerows are based on a national developed model. The area with hedgerows is based on hedgerows established with financial support from the Danish Government. Emissions from liming are based on annual sales data collected by the Danish Agricultural Advisory Centre, combined with the acid neutralisation capacity for each lot produced. The acid neutralisation capacity is estimated by the Danish Plant Directorate. "Settlement" and "Other land" is not estimated.

1.4.7 Waste

CRF Table 6 Sectoral Report for Waste Table 6.A.C Sectoral Background Data for Waste.

For 6.A Solid Waste Disposal on Land, only managed waste disposal is of importance and registered. The data used for the amounts of municipal solid waste deposited at solid waste disposal sites is according to the official registration performed by the Danish Environmental Protection Agency (DEPA). The data is registered in the ISAG database, where the latest yearly report is Waste Statistics 2007 (Danish Environmental Protection Agency, 2009). CH_4 emissions from solid waste disposal sites are calculated with a model suited to Danish conditions. The model is based on the IPCC Tier 2 approach using a First Order Decay approach. The model is unchanged for the whole time-series. Several studies to analyse the sensitivity of the model has been undertaken. These studies and the model are described in Chapter 8.

For 6.B Waste Water Handling, country-specific methodologies for calculating the emissions of CH_4 and N_2O at wastewater treatment plants (WWTPs) were prepared and implemented first time for the 2005 submissions. There have been smaller methodological revisions in the submissions in 2006 (Illerup et al., 2006). In the 2007 submission no revisions were introduced. For this submission minor revisions have been introduced. These are related to the calculation of the Gross Methan emissions.

The methodology for CH_4 is developed following the IPCC Guidelines and the IPCC Good Practice Guidance. The data available for the volume of wastewater is registered by DEPA. The wastewater flow to WWTPs and the resulting sludge consists of a municipal and industrial part. From the registration performed by DEPA, no data exists to allow for a separation of the domestic/municipal contribution from the industrial contribution. A significant fraction of the industrial wastewater is treated at centralised municipal WWTPs. In addition, it is not possible to separate the contribution to methane emission from sludge versus wastewater. The methodology is based on information on the amount of organic degradable matter in the influent wastewater and the fraction which is treated by anaerobic wastewater treatment processes. The amount of CH_4 not emitted, the CH_4 recovered or combusted, has been calculated based on yearly reported national final sludge disposal data from DEPA. No emissions originating from on-site industrial treatment processes have been included.

For the methodology for N_2O emissions, both anaerobic and aerobic conditions have been considered. The methodology has been divided into two parts, i.e. direct and indirect emissions. The direct emission originates from wastewater treatment processes at the WWTPs and a minor indirect emission contribution originates from the effluent's content of nitrogen compounds. The direct emission from wastewater treatment processes is calculated according to the equation:

$$E_{N_2O,WWTP,direct} = N_{pop} \cdot F_{connected} \cdot EF_{N_2O,WWTP,direct}$$

where N_{pop} is the size of the Danish population, $F_{connected}$ is the fraction of the Danish population connected to the municipal sewer system (90 %) and $EF_{N2O.WWTP.direct}$ is the emission factors. The latter has been adjusted by a correction factor, accounting for an increasing influent of nitrogen-containing wastewater from industry from 1990 to 1998, after which the industrial contribution reached a constant level. The methodology for calculation of the indirect N_2O emission includes emissions from human sewage based on annual pr capita protein intake, improved by including the fraction of non-consumption protein in domestic wastewater. Emission of N_2O originating from effluent-recipient nitrogen discharges from the following point sources has been included: industry discharges, rainwater conditioned effluents, effluent from scattered houses, effluent from aquaculture and fish farming and effluent from municipal and private WWTPs. Data on nitrogen effluent contributions has been obtained from national statistics.

6.C Waste Incineration.

All waste incinerated is used for energy and heat production. This production is included in the energy statistics, hence emissions are included in *CRF Table 1A.1a Public Electricity and Heat Production*. Only very small emissions due to gasification of waste are included here for the years 1994-2005. In 2006 these emissions do not occur.

Please refer to Chapter 8 and Annex 3E for further information on emission inventories for waste.

1.5 Brief description of key categories

A key category analysis (KCA) for year 1990 and 2007 has been carried out in accordance with the IPCC Good Practice Guidance. The present KCA differs from the previous KCA in the NIR 2008 since the previous categories for Non-CO_2 from stationæry combustion for CH_4 and N_2O respectively, has been splittet up in 7 categories for CH_4 and 5 for N_2O according to different activities. Further, a new category in the industry sector has been included in the KCA. Besides these changes the analysis, as regards the basic categorisation, has been kept unchanged since previous analysis. The categorisation used results in a total of 102 categories. In the level KCA for the inventory for 1990, 23 key categories were identified. For the KCA for 2007, 21 categories were identified as key categories due to both level and trend. The energy sector and CO_2 emissions from stationary combustion contributes to those 21 key sources with 11 key sources, of which CO_2 from coal combustion in the analysis contributes most with 25.5 % of the national total (this contribution and the percentage contrutions in the following are results from the level KCA based on the absolut values of the emissions; this contribution as percentages may differ somewhat from the percentage used in the sectoral chapters). The category, CO_2 emissions from mobile combustion and road transportation, is also a key source and the second highest contributor, with 18.4 %. CO_2 from natural gas is the third largest contributor with 13.5 %. The industrial sector contributes with 2 level and trend key sources: CO_2 from cement production (contributes 2.0 %) and HFC and PFC emissions from refrigeration and air (1.0 %). In the agricultural sector, there are 4 trend and level key categories, of which 3 are among the 6 highest contributors to the national total. These three categories are direct N_2O emissions from agriculture soils, CH_4 from enteric fermentation and indirect N_2O emissions from nitrogen used in agriculture, contributing 4.1, 3.9 and 3.8 %, respectively, to the national total in 2007. The fourth agricultural key category is CH_4 from manure management contributing 1.5 %. The LULUCF sector contributes with 3 level and trend key categories. These are forest land remaining forest land, broadleaves (1.4 % contribution, CO_2 removal), cropland remaining cropland, agriculture soils (2.1 %, CO_2 emission) and forest land remaining forest land, conifers (1.4 %, removal). The waste sector includes one level and trend key category, which is CH_4 from solid waste disposal on land, contributing 1.5 % to the national total. The categorisation used, results, etc. are included in Annex 1.

1.6 Information on QA/QC plan including verification and treatment of confidential issues where relevant

1.6.1 Introduction

This section outlines the Quality Control (QC) and Quality Assurance (QA) plan for greenhouse gas emission inventories performed by the Danish National Environmental Research Institute (Sørensen et al., 2005). The plan is in accordance with the guidelines provided by the UNFCCC (IPCC, 1997), and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). The ISO 9000 standards are also used as important input for the plan.

1.6.2 Concepts of quality work

The quality planning is based on the following definitions as outlined by the ISO 9000 standards as well as the Good Practice Guidance (IPCC, 2000):

- Quality management (*QM*) Coordinates activity to direct and control with regard to quality.

- Quality Planning (*QP*) Defines quality objectives including specification of necessary operational processes and resources to fulfil the quality objectives.
- Quality Control (*QC*) Fulfils quality requirements.
- Quality Assurance (*QA*) Provides confidence that quality requirements will be fulfilled.
- Quality Improvement (*QI*) Increases the ability to fulfil quality requirements.

The activities are considered inter-related in this report as shown in Figure 1.2.

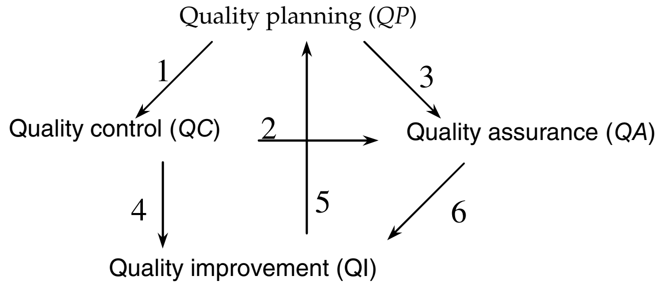


Figure 1.2 Interrelation between the activities with regard to quality. The arrows are explained in the text below this figure.

1: The *QP* sets up the objectives and, from these, measurable properties valid for the *QC*.

2: The *QC* investigates the measurable properties that are communicated to *QA* for assessment in order to ensure sufficient quality.

3. The *QP* identifies and defines measurable indicators for the fulfilment of the quality objectives. This yields the basis for the *QA* and has to be supported by the input coming from the *QC*.

4: The result from *QC* highlights the degree of fulfilment for every quality objective. It is thus a good basis for suggestions for improvements to the inventory to meet the quality objectives.

5: Suggested improvements in the quality may induce changes in the quality objectives and their measurability.

6: The evaluation carried out by external authorities is important input when improvements in quality are being considered.

1.6.3 Definition of quality

A solid definition of quality is essential. Without such a solid definition, the fulfilment of the objectives will never be clear and the process of quality control and assurance can easily turn out to be a fuzzy and unpleasant experience for the people involved. On the contrary, in case of a solid definition and thus a clear goal, it will be possible the make a valid statement of “good quality” and thus form constructive conditions and motivate the inventory work positively. A clear definition of quality has not been given in the UNFCCCC guidelines. In the Good Practice Guidance, Chapter 8.2, however, it is mentioned that:

“Quality control requirements, improved accuracy and reduced uncertainty need to be balanced against requirements for timeliness and cost effectiveness.” The statement of balancing requirements and costs is not a solid basis for QC as long as this balancing is not well defined.

The resulting standard of the inventory is defined as being composed of accuracy and regulatory usefulness. The goal is to maximise the standard of the inventory and the following statement defines the quality objective:

The quality objective is only inadequately fulfilled if it is possible to make an inventory of higher standard without exceeding the frame of resources.

1.6.4 Definition of Critical Control Points (*CCP*)

A Critical Control Point (*CCP*) is defined in this submission as an element or an action which needs to be taken into account in order to fulfil the quality objectives. Every *CCP* has to be necessary for the objectives and the *CCP* list needs to be extended if other factors, not defined by the *CCP* list, are needed in order to reach at least one of the quality objectives.

The objectives for the *QM*, as formulated by IPCC (2000), are to improve elements of transparency, consistency, comparability, completeness and confidence. In the UNFCCC guidelines (IPCC, 1997), the element “confidence” is replaced by “accuracy” and in this plan “accuracy” is used.

The objectives for the *QM* are used as *CCP*s, including the elements mentioned above. The following explanation is given by UNFCCC guidelines (IPCC, 1997) for each *CCP*:

Transparency means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of the inventories is fundamental to the success of the process for communication and consideration.

Consistency means that an inventory should be internally consistent in all its elements with inventories of other years. An inventory is consistent if the same methodologies are used for the base and for all subsequent years and if consistent datasets are used to estimate emissions or removals from source or sinks. Under certain circumstances, an inventory using different methodologies for different years can be considered to be consistent if it has been recalculated in a transparent manner in accordance with the Intergovernmental Panel on Climate Change (IPCC) guidelines and good practice guidance.

Comparability means that estimates of emission and removals reported by Annex I Parties in inventories should be comparable among Annex I parties. For this purpose, Annex I Parties should use the methodologies and formats agreed upon by the COP for estimating and reporting inventories. The allocation of different source/sink categories should follow the split of *Revised 1996 IPCC Guidelines for national Greenhouse Gas Inventories* (IPCC, 1997) at the level of its summary and sectoral tables.

Completeness means that an inventory covers all sources and sinks, as well as all gases, included in the IPCC guidelines as well as other existing relevant source/sink categories, which are specific to individual Annex I Parties and, therefore, may not be included in the IPCC guidelines. Completeness also means full geographic coverage of sources and sinks of an Annex I Party.

Accuracy is a relative measure of the exactness of an emission or removal estimate. Estimates should be accurate and should systematically neither over nor underestimate emissions or removals. Uncertainties on estimates should be reduced if possible. Appropriate methodologies should be used in accordance with the *IPCC good practice guidance*, to promote data accuracy in inventories.

The robustness against unexpected disturbance of the inventory work has to be high in order to secure high quality, which is not covered by the *CCP*s above. The correctness of the inventory is formulated as an independent objective. This is so because the correctness of the inventory is a condition for all other objectives to be effective. A large part of the Tier 1 procedure given by the Good Practice Guidance (IPCC, 2000) is actually checks for miscalculations and, thus, supports the objective of correctness. Correctness, as defined here, is not similar to accuracy, because the correctness takes into account miscalculations, while accuracy relates to minimizing the always present data-value uncertainty.

Robustness implies arrangement of inventory work as regards e.g. inventory experts and data sources in order to minimize the consequences of any unexpected disturbance due to external and internal conditions. A change in an external condition could be interruption of access to an external data source and an internal change could be a sudden reduction in qualified staff, where a skilled person suddenly leaves the inventory work.

Correctness has to be secured in order to avoid uncontrollable occurrence of uncertainty directly due to errors in the calculations.

The different *CCP*s are not independent and represent different degrees of generality. E.g. deviation from *comparability* may be accepted if a high degree of *transparency* is applied. Furthermore, there may even be a conflict between the different *CCP*s. E.g. new knowledge may suggest improvements in calculation methods for better *completeness*, but the same improvements may to some degree violate the *consistency* and *comparability* criteria with regard to earlier years' inventories and the reporting from other nations. It is, therefore, a multi-criteria problem of optimisation to apply the set of *CCP*s in the aim for good quality.

1.6.5 Process-oriented QC

The strategy is based on a process-oriented principle (ISO 9000 series) and the first step is, thus, to set up a system for the process of the inventory work. The product specification for the inventory is a dataset of emission figures and the process, thereby, equates with the data flow in the preparation of the inventory.

The data flow needs to support the QC/QA in order to facilitate a cost-effective procedure. The flow of data has to take place in a transparent way by making the transformation of data detectable. It should be easy to find the original background data for any calculation and to trace the sequence of calculations from the raw data to the final emission result. Computer programming for automated calculations and checking will enhance the accuracy and minimize the number of miscalculations and flaws in input value settings. Especially manual typing of numbers needs to be minimized. This assumes, however, that the quality of the programming has been verified to ensure the correctness of the automated calculations. Automated value control is also one of the important means to secure accuracy. Realistic uncertainty estimates are necessary for securing accuracy, but they can be difficult to produce due to the uncertainty related to the uncertainty estimates themselves. It is, therefore, important to include the uncertainty calculation procedures into the data structure as far as possible. The QC/QA needs to be supported as far as possible by the data structure; otherwise the procedures can easily become troublesome and subject to frustration.

Both data processing and data storage form the data structure. The data processing is carried out using mathematical operations or models. The models may be complicated where they concern human activity or be simple summations of lower aggregated data. The data storage includes databases and file systems of data that are either calculated using the data processing at the lower level, using input to new processing steps or even using both output and input in the data structure. The measure for quality is basically different for processing and storage, so these need to be kept separate in a well-designed quality manual. A graphical display of the data flow is seen in Figure 1.3 and explained in the following.

The data storage takes place for the following types of data:

***External Data*:** a single numerical value of a parameter coming from an external source. These data govern the calculation of *Emission calculation input.*

***Emission calculation input*:** Data for input to the final emission calculation in terms of data for release source strength and activity. The data is directly applicable for use in the standardized forms for calculation. These data are calculated using external data or represent a direct use of *External Data* when they are directly applicable for *Emission Calculations*.

***Emission Data*:** Estimated emissions based on the *emission calculation input.*

***Emission Reporting*:** Reporting of emission data in requested formats and aggregation level.

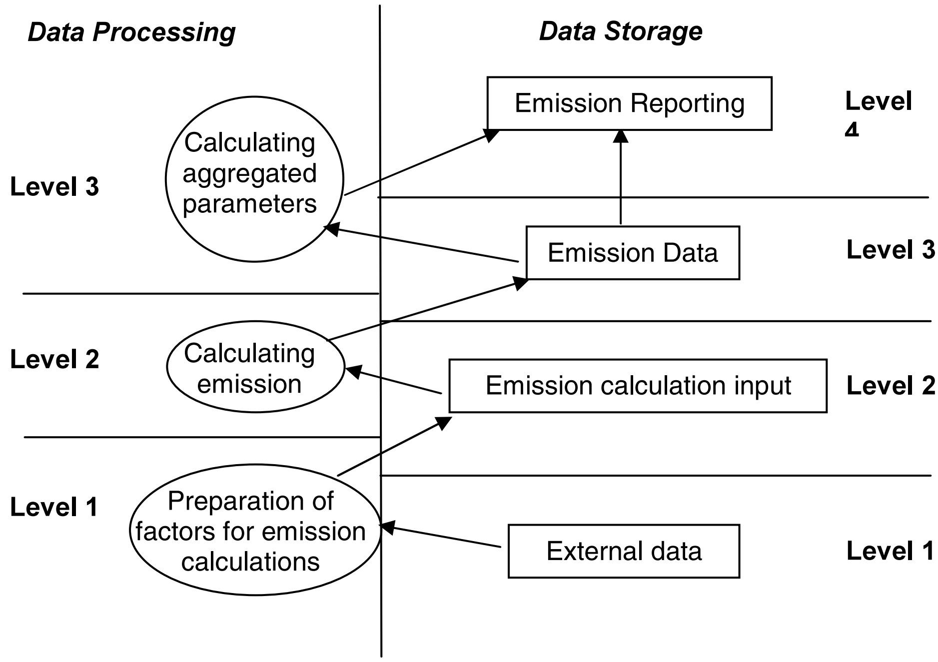


Figure 1.3 The general data structure for the emission inventory.

Key levels are defined in the data structure as:

Data storage Level 1, External data

Collection of external data for calculation of emission factors and activity data. The activity data are collected from different sectors and statistical surveys, typically reported on a yearly basis. The data consist of raw data, having an identical format to the data received and gathered from external sources. Level 1 data acts as a base-set, on which all subsequent calculations are based. If alterations in calculation procedures are made, they are based on the same dataset. When new data are introduced they can be implemented in accordance with the QA/QC structure of the inventory.

Data storage Level 2, Data directly usable for the inventory

This level represents data that have been prepared and compiled in a form that is directly applicable for calculation of emissions. The compiled data are structured in a database for internal use as a link between more or less raw data and data that are ready for reporting. The data are compiled in a way that elucidates the different approaches in emission assessment: (1) directly on measured emission rates, especially for larger point sources, (2) based on activities and emission factors, where the value setting of these factors are stored at this level.

Data storage Level 3, Emission data

The emission calculations are reported by the most detailed figures and divided in sectors. The unit at this level is typically mass pr yr for the country. For sources included in the SNAP system, the SNAP level 3 is relevant. Internal reporting is performed at this level to feed the external communication of results.

Data storage Level 4, Final reports for all subcategories

The complete emission inventory is reported to UNFCCC at this level by summing up the results from every subcategory.

Data processing Level 1 Compilation of external data

Preparation of input data for the emission inventory based on the external data sources. Some external data may be used directly as input to the data processing at level 2, while other data needs to be interpreted using more or less complicated models, which takes place at this level. The interpretation of activity data is to be seen in connection with availability of emission factors and vice versa. These models are compiled and processed as an integrated part of the inventory preparation.

Data processing Level 2 Calculation of inventory figures

The emission for every subcategory is calculated, including the uncertainty for all sectors and activities. The summation of all contributions from sub-sources makes up the inventory.

Data processing Level 3 Calculation aggregated parameters

Some aggregated parameters need to be reported as part of the final reporting. This does not involve complicated calculations but important figures, e.g. implied emission factors at a higher aggregated level to be compared in time-series and with other countries.

1.6.6 Definition of Point of Measurements (*PM*)

The *CCP*s have to be based on clear measurable factors, otherwise the *QP* will end up being just a loose declaration of intent. Thus, in the following, a series of *Points for Measuring* (*PM*) is identified as building blocks for a solid *QC*. Table 8.1 in Good Practice Guidance is a listing of such *PM*s. However, the listing in Table 1.1 below is an extended and modified listing, in comparison to Table 8.1. in the Good Practice Guidance supporting all the *CCP*s. The *PM*s will be routinely checked in the QC reporting and, when external reviews take place, the reviewers will be asked to assess the fulfilment of the *PM*s using a checklist system. The list of *PM*s is continually evaluated and modified to offer the best possible support for the *CCP*s. The actual list used is seen in Table 1.2.

Table 1.2 The list of *PM*s as used.

Level	CCP	Id	Description
Data Storage level 1	1. Accuracy	DS.1.1.1	General level of uncertainty for every dataset including the reasoning for the specific values
		DS.1.1.2	Quantification of the uncertainty level of every single data value, including the reasoning for the specific values.
	2. Comparability	DS1.2.1	Comparability of the data values with similar data from other countries, which are comparable with Denmark, and evaluation of the discrepancy.
	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included, by setting down the reasoning behind the selection of datasets.
	4.Consistency	DS.1.4.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PMs)
	6.Robustness	DS.1.6.1	Explicit agreements between the external institution holding the data and NERI about the conditions of delivery
		DS.1.6.2	At least two employees must have a detailed insight into the gathering of every external dataset.
	7.Transparency	DS.1.7.1	Summary of each dataset including the reasoning behind the selection of the specific dataset
		DS.1.7.2	The archiving of datasets needs to be easily accessible for any person in the emission inventory
		DS.1.7.3	References for citation for any external dataset have to be available for any single number in any dataset.
		DS.1.7.4	Listing of external contacts for every dataset
Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to type of variability. (Distribution as: normal, log normal or other type of variability)
		DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals)
		DP.1.1.3	Evaluation of the methodological approach using international guidelines
		DP.1.1.4	Verification of calculation results using guideline values
	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCCC and IPCC.
	3.Completeness	DP.1.3.1	Assessment of the most important quantitative knowledge which is lacking.
		DP.1.3.2	Assessment of the most important cases where access is lacking with regard to critical data sources that could improve quantitative knowledge.
	4.Consistency	DP.1.4.1	In order to keep consistency at a high level, an explicit description of the activities needs to accompany any change in the calculation procedure
		DP.1.4.2	Identification of parameters (e.g. activity data, constants) that are common to multiple source categories and confirmation that there is consistency in the values used for these parameters in the emission calculations
	5.Correctness	DP.1.5.1	Shows at least once, by independent calculation, the correctness of every data manipulation
		DP.1.5.2	Verification of calculation results using time-series
		DP.1.5.3	Verification of calculation results using other measures
		DP.1.5.4	Show one-to-one correctness between external data sources and the databases at Data Storage level 2

Continued

Level	CCP	Id	Description
	6.Robustness	DP.1.6.1	Any calculation must be anchored to two responsible persons who can replace each other in the technical issue of performing the calculations.
	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described
		DP.1.7.2	The theoretical reasoning for all methods must be described
		DP.1.7.3	Explicit listing of assumptions behind all methods
		DP.1.7.4	Clear reference to dataset at Data Storage level 1
		DP.1.7.5	A manual log to collect information about recalculations
Data Storage level 2	2.Comparability	DS.2.2.1	Comparison with other countries that are closely related to Denmark and explanation of the largest discrepancies
	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data types at level 2 to data at level 1
		DS.2.5.2	Check if a correct data import to level 2 has been made
	6.Robustness	DS.2.6.1	All persons in the inventory work must be able to handle and understand all data at level 2.
	7.Transparency	DS.2.7.1	The time trend for every single parameter must be graphically available and easy to map
		DS.2.7.2	A clear Id must be given in the dataset having reference to level 1.
Data Processing level 2	1. Accuracy	DP.2.1.1	Documentation of the methodological approach for the uncertainty analysis
		DP.2.1.2	Quantification of uncertainty
	2.Comparability	DP.2.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCCC and IPCC
	6.Robustness	DP.2.6.1	Any calculation at level 4 must be anchored to two responsible persons who can replace each other in the technical issue of performing the calculations.
	7.Transparency	DP.2.7.1	Reporting of the calculation principle and equations used
		DP.2.7.2	Reporting of the theoretical reasoning for all methods
		DP.2.7.3	Reporting of assumptions behind all methods
		DP.2.7.4	The reasoning for the choice of methodology for uncertainty analysis needs to be written explicitly.
Data Storage level 3	1. Accuracy	DS.3.1.1	Quantification of uncertainty
	5.Correctness	DS.3.5.1	Comparison with inventories of the previous years on the level of the categories of the CRF as well as on SNAP source categories. Any major changes are checked, verified, etc.
		DS.3.5.2	Total emissions, when aggregated to CRF source categories, are compared with totals based on SNAP source categories (control of data transfer).
		DS.3.5.3	Checking of time-series of the CRF and SNAP source categories as they are found in the Corinair databases. Considerable trends and changes are checked and explained.
	7.Transparency	DS.3.7.1	Documentation of a correct connection between all data types at DS3 to data at level DS2

Continued

Level	CCP	Id	Description
Data Processing level 3	7.Transparency	DP.3.7.1	In the calculation sheets, there must be clear Id to Data Storage level 3 data
Data Storage level 4	1. Accuracy	DS.4.1.1	Questionnaire to external experts: The performance of the PMs that relate to accuracy.
	2.Comparability	DS.4.2.1	Description of similarities and differences in relation to other countries' inventories for the methodological approach.
	3.Completeness	DS.4.3.1	Questionnaire to external experts: The performance of the PMs that relate to completeness.
		DS.4.3.2	National and international verification including explanation of the discrepancies.
	4.Consistency	DS.4.4.1	The inventory reporting must follow the international guidelines suggested by UNFCCC and IPCC.
	7.Transparency	DS.4.7.1	External review for evaluation of the communication performance.

1.6.7 Plan for the quality work

The IPCC uses the concept of a tiered approach, i.e. a stepwise approach, where complexity, advancement and comprehensiveness increase. Generally, more detailed and advanced methods are recommended in order to give guidance to countries which have more detailed datasets and more capacity, as well as to countries with less available data and manpower. The tiered approach helps to focus attention on the areas of the inventories that are relatively weak, rather than investing effort in irrelevant areas. Furthermore, the IPCC guidelines recommend using higher tier methods for key categories in particular. Therefore, the identification of key categories is crucial for planning quality work. However, there exist several issues regarding the listing of priority categories: (1) The contribution to the total emission figure (key source listing); (2) The contribution to the total uncertainty; (3) Most critical categories in relation to implementation of new methodologies and thus highest risk for miscalculations. All the points listed are necessary for different aspects of producing high quality work. These listings will be used to secure implementation of the full quality scheme for the most relevant categories. Verification in relation to other countries has been undertaken for priority categories.

1.6.8 Implementation of the QA/QC plan

The PMs listed in Table 1.2 are described for each sector in the QA/QC sections of Chapters 3-8, where a status with regard to implementation is also given. Some of the PMs are the same for all sectors and a common description for these PMs is given in Section 1.6.10, below. The focus has been on level 1 for both data storage and data processing as this is the most labour-intensive part. The quality system will be evaluated and adjusted continuously.

1.6.9 Archiving of data and documentations

The QA/QC work is supported by an inventory file system, where all data, models and QA/QC procedures and checks are stored as files in folders (Figure 1.4).

Figure 1.4 Schematic diagram of the folder structure in the inventory file system.

The inventory file system consists of the following levels: year, sector and the level for the process of the inventory work, as illustrated in Figure 1.4. The first level in the file system is year, which here means the inventory year and not the calendar year. The sector level contains the PMs relevant for the individual sectors i.e. the first levels (DS1 and DP1) (except the PMs described in Section 1.6.10), while the rest of the PMs (DS2-4 and DP2-3), are common for all sectors.

All data, models and other QA/QC related files are stored in the inventory file system and are accessible for all staff involved in the inventory work.

1.6.10 Common QA/QC PMs

The following PMs are common for all the sectors:

Data storage Level 1

Data Storage level 1	6. Robustness	DS.1.6.2	At least two employees must have a detailed insight into the gathering of every external dataset.

For energy, industrial processes, solvent and other product use, agriculture and waste, two persons have detailed insight in data gathering and processing, while this is only partly achieved for the LULUCF sector. Work is ongoing to ensure the robustness of the inventory process for LULUCF.

Data Storage level 1	7. Transparency	DS.1.7.2	The archiving of datasets needs to be easy accessible for any person involved in the emission inventory.

All data, models and other QA/QC related files are stored in the inventory file system and are accessible for all inventory staff members. Refer to Section 1.6.9.

Data processing Level 1

Data Processing level 1	4. Consistency	DP.1.4.2	Identification of parameters (e.g. activity data, constants) that are common to multiple source categories and confirmation that there is consistency in the values used for these parameters in the emission calculations.

This PM is supported by the inventory file system where it is possible to compare and harmonise parameters that are common to multiple source categories.

Data Processing level 1	6.Robustness	DP.1.6.1	Any calculation must be anchored to two responsible persons who can replace each other in the technical issue of performing the calculations.

All data, models and other QA/QC related files are stored in the inventory file system and are accessible for all inventory staff members. Refer to Section 1.6.9.

Data storage Level 2

Data Storage level 2	2.Comparability	DS.2.2.1	Comparison with other countries that are closely related to Denmark and explanation of the largest discrepancies.

Systematic inter-country comparison has only been made on data storage level 4. Refer to DS 4.3.2.

Data Storage level 2	6.Robustness	DS.2.6.1	All persons in the inventory work must be able to handle and understand all data at level 2.

This PM is fulfilled for all sectors. The PM is supported by the inventory file system. Refer to Section 1.6.9.

Data Storage level 2	7.Transparency	DS.2.7.1	The time trend for every single parameter must be graphically available and easy to map.

Programs exist to make time-series for all parameters. A tool for graphically showing time-series has not yet been developed.

Data Storage level 2	7.Transparency	DS.2.7.2	A clear Id must be given in the dataset having reference to level 1.

An overview of all external data is given in DS 1.4.1 including ID numbers for all external datasets. Many references already exist in the databases (level 2) which point to the original source of data, but ID numbers have to be implemented and extended to all data in the databases.

Data Processing Level 2

Data Processing level 2	1. Accuracy	DP.2.1.1	Documentation of the methodological approach for the uncertainty analysis

Refer to Section 1.7 in the Danish NIR.

Data Processing level 2	1. Accuracy	DP.2.1.2	Quantification of uncertainty

Refer to Section 1.7 in the Danish NIR and the QA/QC sections in the sector chapters.

Data Processing level 2	2.Comparability	DP.2.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCCC and IPCC.

The emission calculations follow the international guidelines.

Data Processing level 2	6.Robustness	DS.2.6.1	All persons in the inventory work must be able to handle and understand all data at level 2.

At present the emission calculations are carried out using applications developed at NERI. The software development and programme runs are anchored to two inventory staff members.

Data Processing level 2	7.Transparency	DP.2.7.1	Reporting of the calculation principle and equations used.

Due to the uniform treatment of input data in the calculation routines used by the NERI software programmes, a central documentation of calculation principles, equations, theoretical reasoning and assumptions must be given, treating all national emission sources. This documentation still remains to be made, but is planned to be carried out in the future.

Data Processing level 2	7.Transparency	DP.2.7.2	Reporting of the theoretical reasoning for all methods

Due to the uniform treatment of input data in the calculation routines used by the NERI software programmes, a central documentation of calculation principles, equations, theoretical reasoning and assumptions must be given, treating all national emission sources. This documentation still remains to be made, but is planned to be carried out in the future.

Data Processing level 2	7.Transparency	DP.2.7.3	Reporting of assumptions behind all methods

Due to the uniform treatment of input data in the calculation routines used by the NERI software programmes, a central documentation of calculation principles, equations, theoretical reasoning and assumptions must be given, treating all national emission sources. This documentation still remains to be made, but is planned to be carried out in the future.

Data Processing level 2	7.Transparency	DP.2.7.4	The reasoning for the choice of methodology for uncertainty analysis needs to written explicitly.

Refer to Section 1.7 in the Danish NIR and the QA/QC sections in the sector chapters.

Data storage Level 3

Data Storage level 3	1. Accuracy	DS.3.1.1	Quantification of uncertainty

Refer to Section 1.7 in the Danish NIR and the QA/QC sections in the sector chapters.

Data Storage level 3	5.Correctness	DS.3.5.1	Comparison with inventories of the previous years on the level of the categories of the CRF as well as on SNAP source categories. Any major changes are checked, verified, etc.

Time-series is prepared and checked, any major change is closely examined with the purpose of verifying and explaining changes from earlier inventories.

Data Storage level 3	5.Correctness	DS.3.5.2	Total emissions when aggregated to CRF source categories are compared with totals based on SNAP source categories (control of data transfer).

Total emission, when aggregated to IPCC and LRTAP reporting tables, is compared with totals based on SNAP source categories (control of data transfer).

Data Storage level 3	5.Correctness	DS.3.5.3	Checking of time-series of the CRF and SNAP source categories as they are found in the Corinair databases. Considerable trends and changes are checked and explained.

Time-series are prepared and checked, any major change is closely examined with the purpose of verifying and explaining fluctuations.

Data Storage level 3	7.Transparency	DS.3.7.1	Documentation of a correct connection between all data types at DS3 to data at level DS2

A central documentation will be provided, treating all national emission sources.

Data Processing Level 3

Data Processing level 3	7.Transparency	DP.3.7.1	In the calculation sheets, there must be clear Id to Data Storage level 3 data.

A central documentation will be provided, treating all national emission sources.

Data Storage Level 4

Data Storage level 4	1. Accuracy	DS.4.1.1	Questionnaire to external experts: The performance of the PMs that relates to accuracy

This PM is checked when the sectoral reports are reviewed by external experts.

Data Storage level 4	2.Comparability	DS.4.2.1	Description of similarities and differences in relation to other countries' inventories for the methodological approach

For each key source category, a comparison has been made between Denmark and the EU-15 countries. This is performed by comparing emission density indicators, defined as emission intensity value divided by a chosen indicator. The indicators are identical to the ones identified in the Norwegian verification inventory (Holtskog et al., 2000). The correlation between emissions and an independent indicator does not necessarily imply cause and effect, but in cases where the indicator is directly associated with the emission intensity value, such as for the energy sector, the emission density indicator is a measure of the implied emission factor and a direct comparison can be made. A qualitative verification of implied emission factors can, furthermore, be made when a measured or theoretical value of the CO_2 content in the respective fuel type (or other relevant parameter) is available. For the energy sector, all countries are, in principle, comparable and inter-country deviations arise from variations in fuel purities and fuel combustion efficiencies. A comparison of national emission density indicators, analogous to the implied emission factors, will give valuable information on the quality and efficiency of the national energy sectors.

Furthermore, the inter-country comparison of emission density indicators and comparison of theoretical values gives a methodological verification of the derivation of emission intensity values, and of the correlation between emission intensity values and activity values.

When emissions are compared with non-dependent parameters, similarities with regard to geography, climate, industry structure and level of economic development may be necessary for obtaining comparable emission density indicators (Fauser et al., 2007).

Data Storage level 4	3.Completeness	DS.4.3.1	Questionnaire to external experts: The performance of the PMs that relate to completeness

This PM is checked when the sectoral reports are reviewed by external experts.

Data Storage level 4	3.Completeness	DS.4.3.2	National and international validation including explanation of the discrepancies.

Refer to DS 4.2.1

Data Storage level 4	4.Consistency	DS.4.4.1	The inventory reporting must follow the international guidelines suggested by UNFCCC and IPCC.

The inventory reporting is in accordance with the UNFCCC guidelines on reporting and review (UNFCCC, 2002). The present report includes detailed and complete information on the inventories for all years from the base year to the year of the current annual inventory submission, in order to ensure the transparency of the inventory. The annual emission inventory for Denmark is reported in the Common Reporting Format (CRF) as requested in the reporting guidelines. 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 complete sets of CRF-files are available on the NERI homepage (www.dmu.dk).

Data Storage level 4	7.Transparency	DS.4.7.1	External review for evaluation of the communication performance

The transparency of the CRF reporting is reviewed by experts when UNFCCC performs annual review of the Danish GHG inventory.

1.7 General uncertainty evaluation, including data on the overall uncertainty for the inventory totals

The uncertainty estimates are based on the Tier 1 methodology in the IPCC Good Practice Guidance (GPG) (IPCC, 2000). Uncertainty estimates for the following sectors are included in the current year: stationary combustion plants, mobile combustion, fugitive emissions from fuels, industry, solid waste and wastewater treatment, CO_2 from solvents, agriculture and LULUCF. The sources included in the uncertainty estimate cover 99.9 % of the total net Danish greenhouse gas emissions and removals. N_2O from product use (CRF sector 3D) and CO_2 from use of lubricants (CRF sector 2G) are not included at the moment. Work is ongoing to ensure uncertainty estimates for these sectors.

The uncertainties for the activity rates and emission factors are shown in Table 1.4.

The estimated uncertainties for total GHG and for CO_2, CH_4, N_2O and F-gases are shown in Table 1.3. The base year for F-gases is 1995 and for all other sources the base year is 1990. The total Danish GHG emission is estimated with an uncertainty of ±5.8 % and the trend in GHG emission since 1990 has been estimated to be -6.3 % ± 2.5 %-age points. The GHG uncertainty estimates do not take into account the uncertainty of the GWP factors.

The uncertainty on N_2O from stationary combustion plants, N_2O emission from agricultural soils and CH_4 emission from manure management are the largest sources of uncertainty for the Danish GHG inventory.

The uncertainty of the GHG emission from combustion (sector 1A) is 5.9 % and the trend uncertainty is 0.5 % ±1.8 %-age points.

Table 1.3 Uncertainties 1990-2007.

1)	Uncertainty [%]	Trend [%]	Uncertainty in trend [%-age points]
GHG	5.8	-6.3	2.5
CO_2	3.1	-2.1	±2.4
CH_4	23	0.9	±10.3
N_2O	47	-36	±13
F-gases	48	+172	±66

[1] Including only emission sources for which the uncertainty has been estimated. N_2O from solvents and other product use and CO_2 from lubricants are not included.

Table 1.4 Uncertainty rates for each emission source.

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty
		Gg CO_2 eq	Gg CO_2 eq	%	%
Stationary Combustion, Coal	CO_2	24077	18302	1	5
Stationary Combustion, BKB	CO_2	11	0	3	5
Stationary Combustion, Coke	CO_2	138	121	3	5
Stationary Combustion, Petroleum coke	CO_2	410	970	3	5
Stationary Combustion, Plastic waste	CO_2	349	728	5	5
Stationary Combustion, Residual oil	CO_2	2505	1655	2	2
Stationary Combustion, Gas oil	CO_2	4547	1614	4	5
Stationary Combustion, Kerosene	CO_2	366	9	4	5
Stationary Combustion, Natural gas	CO_2	4320	9702	3	1
Stationary Combustion, LPG	CO_2	169	90	4	5
Stationary Combustion, Refinery gas	CO_2	806	906	3	5
Stationary combustion plants, gas engines	CH_4	7	215	2,2	40
Stationary combustion plants, other	CH_4	115	217	2,2	100
Stationary combustion plants	N_2O	240	277	2,2	1000
Transport, Road transport	CO_2	9275	13198	2	5
Transport, Military	CO_2	119	175	2	5
Transport, Railways	CO_2	297	228	2	5
Transport, Navigation (small boats)	CO_2	48	101	21	5
Transport, Navigation (large vessels)	CO_2	666	352	11	5
Transport, Fisheries	CO_2	591	382	2	5
Transport, Agriculture	CO_2	1272	1166	13	5
Transport, Forestry	CO_2	36	17	16	5
Transport, Industry (mobile)	CO_2	842	1088	18	5
Transport, Residential	CO_2	113	232	18	5
Transport, Civil aviation	CO_2	243	107	10	5
Transport, Road transport	CH_4	55	25	2	40
Transport, Military	CH_4	0	0	2	100
Transport, Railways	CH_4	0	0	2	100
Transport, Navigation (small boats)	CH_4	0	1	21	100
Transport, Navigation (large vessels)	CH_4	0	0	11	100
Transport, Fisheries	CH_4	0	0	2	100
Transport, Agriculture	CH_4	2	2	13	100
Transport, Forestry	CH_4	0	0	16	100
Transport, Industry (mobile)	CH_4	1	1	18	100
Transport, Residential	CH_4	3	5	18	100
Transport, Civil aviation	CH_4	0	0	10	100
Transport, Road transport	N_2O	97	127	2	50
Transport, Military	N_2O	1	2	2	1000
Transport, Railways	N_2O	3	2	2	1000
Transport, Navigation (small boats)	N_2O	0	1	21	1000
Transport, Navigation (large vessels)	N_2O	13	7	11	1000
Transport, Fisheries	N_2O	11	7	2	1000
Transport, Agriculture	N_2O	15	15	13	1000
Transport, Forestry	N_2O	0	0	16	1000
Transport, Industry (mobile)	N_2O	11	14	18	1000
Transport, Residential	N_2O	1	1	18	1000
Transport, Civil aviation	N_2O	3	2	10	1000
Energy, fugitive emissions, oil and natural gas	CO_2	263	367	15	5
Energy, fugitive emissions, oil and natural gas	CH_4	40	128	15	50
Energy, fugitive emissions, oil and natural gas	N_2O	1	1	15	50
6 A. Solid Waste Disposal on Land	CH_4	1335	1063	10	63

Continued IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty
		Gg CO_2 eq	Gg CO_2 eq	%	%
6 B. Wastewater Handling	CH_4	126	256	20	35
6 B. Wastewater Handling	N_2O	88	47	10	30
2A1 Cement production	CO_2	882	1407	1	2
2A2 Lime production	CO_2	116	67	5	5
2A3 Limestone and dolomite use	CO_2	18	51	5	5
2A5 Asphalt roofing	CO_2	0	0	5	25
2A6 Road paving with asphalt	CO_2	2	2	5	25
2A7 Glass and Glass wool	CO_2	55	80	5	2
2B5 Catalysts/Fertilizers, Pesticides and Sulphuric acid	CO_2	1	2	5	5
2C1 Iron and steel production	CO2	28	0	5	5
2B2 Nitric acid production	N2O	1043	0	2	25
2F Consumption of HFC	HFC	218	840	10	50
2F Consumption of PFC	PFC	1	15	10	50
2F Consumption of SF6	SF_6	107	30	10	50
4A Enteric Fermentation	CH_4	3259	2787	10	8
4B Manure Management	CH_4	751	1048	10	100
4B Manure Management	N_2O	685	586	10	100
4D Agricultural Soils	N_2O	8314	5652	7,4	22,9
5A Forests	CO_2	-2831	-2977	20	20
5B Cropland	CO_2	2722	1587	7	32
5CGrassland	CO_2	93	84	10	50
5D Wetlands	CO_2	2	-13	10	50
Liming	CO_2	566	192	5	50
5D Wetlands	CH_4	-1	0	10	100
5D Wetlands	N_2O	0	0	10	100
3 Solvents	CO_2	179	87	50	325

1.8 General assessment of the completeness

The present Danish greenhouse gas emission inventory includes all major sources identified by the Revised IPPC Guidelines. Please see Annex 5 for detailed discussion on minor sources that are not included.

References

Danish Environmental Protection Agency, 2009: Ozone depleting substances and the greenhouse gases HFCs, PFCs and SF_6. Danish consumption and emissions 2007. Tomas Sander Poulsen, PlanMiljø. To be published.

Danish Environmental Protection Agency, 2009: Waste Statistics 2007. Affaldsstatistik 2007. To be published.

EMEP/CORINAIR, 2004: Emission Inventory Guidebook 3rd edition, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections, 2004 update. Available at: http://reports.eea.eu.int/E-MEPCORINAIR4/en (15-04-2005)

Fauser, P., Thomsen, M., Nielsen, O-K., Winther, M., Gyldenkærne, S., Hoffmann, L., Lyck, E. & Illerup, J.B. 2007: Verification of the Danish emission inventory data by national and international data comparisons. National Environmental Research Institute, University of Aarhus, Denmark. 53 pp. – NERI Technical Report no. 627. Available at: http://www.dmu.dk/Pub/FR627.pdf

Hutchings, N.J., Sommer, S.G., Andersen, J.M., Asman, W.A.H. 2001: A detailed ammonia emission inventory for Denmark. Atmospheric Environment 35 (2001) 1959-1968

Illerup, J.B., Lyck, E., Winther, M. & Rasmussen, E. 2000: Denmark's National Inventory Report – Submitted under the United Nations Framework Convention on Climate Change. Emission Inventories. Research Notes from National Environmental Research Institute, Denmark no. 127, 326 pp. Available at: http://www.dmu.dk/1_viden/2_Publikationer/3_arbrapporter/rapporter/ar127.pdf

IPCC, 1997: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Available at: http://www.ipccnggip.iges.or.jp/public/gl/i-nvs6.htm (15-04-2007).

IPCC, 2000: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Available at: http://www.ipcc-nggip.iges.or.jp/public/gp/english/ (15-04-2007).

IPCC, 2007: Climate Change 2007. The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z.Chen. M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA 996 pp.

Mikkelsen M.H., Gyldenkærne, S., Poulsen, H.D., Olesen, J.E. & Sommer, S.G. 2006: Emission of ammonia, nitrous oxide and methane from Danish Agriculture 1985 – 2002. Methodology and Estimates. National Environmental Research Institute, Denmark. 90 pp – Research Notes from NERI No. 231. Available at: http://www.dmu.dk/Pub/AR231.pdf.

Pulles, T., Mareckova, K., Svetlik, J., Linek, M., & Skakala, J. 1999: CollectER -Installation and User Guide, EEA Technical Report No 31. Available at: http://reports.eea.eu.int/binaryttech31pdf/en

Ntziachristos, L. & Samaras, Z. 2000: COPERT III Computer Programme to Calculate Emissions from Road Transport - Methodology and Emission Factors (Version 2.1). Technical report No 49. European Environment Agency, November 2000, Copenhagen. Available at: http://reports.eea.eu.int/Technical_report_No_49/en

Holtskog, S., Haakonsen, G., Kvingedal, E., Rypdal, K. & Tornsjø, B., 2000: Verification of the Norwegian emission inventory – Comparing emission intensity values with similar countries. The Norwegian Pollution Control Authority in cooperation with Statistics Norway. SFT report 1736/2000.

Statistics Denmark, 2007: Agriculture Statistics 2007. Copenhagen, Denmark.

Sørensen, P.B., Illerup, J.B., Nielsen, M., Lyck, E., Bruun, H.G., Winther, M., Mikkelsen, M.H. & Gyldenkærne, S. 2005: Quality manual for the green house gas inventory. Version 1. National Environmental Research Institute. - Research Notes from NERI 224: 25 pp. (electronic). Available at:
http://www2.dmu.dk/1_viden/2_Publikationer/3_arbrapporter/rapporter/AR224.pdf

UNFCCC, 2002: Guidelines on reporting and review of greenhouse gas inventories. Available at:
http://unfccc.int/resource/docs/cop8/08.pdf

2 Trends in Greenhouse Gas Emissions

2.1 Description and interpretation of emission trends for aggregated greenhouse gas emissions

Greenhouse Gas Emissions

The greenhouse gas emissions are estimated according to the IPCC guidelines and are aggregated into seven main sectors. The greenhouse gases include CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. Figure 2.1 shows the estimated total greenhouse gas emissions in CO_2 equivalents from 1990 to 2007. The emissions are not corrected for electricity trade or temperature variations. CO_2 is the most important greenhouse gas contributing in 2007 to National total in CO_2 equiv. excluding LULUCF (Land Use and Land Use Change and Forestry with 79.9 %, followed by N_2O with 10.2 %, CH_4 8.6 % and F-gases (HFCs, PFCs and SF_6) with 1.3 %. Seen over the time-series from 1990 to 2007 these percentages have been increasing for F-gases, almost constant for CO_2 and CH_4 and falling for N_2O. Stationary combustion plants, transport and agriculture represent the largest categories, followed by Industrial processes, Waste and Solvents, see Figure 2.1. The net CO_2 removal by forestry and soil is in 2007 1.7 % of the total emission in CO_2 equivalents. The National total greenhouse gas emission in CO_2 equivalents excluding LULUCF has decreased by 3.5 % from 1990 to 2007 and decreased 5.9 % including LULUCF. Comments on the overall trends etc seen in Figure 2.1 are given in the sections below on the individual greenhouse gases.

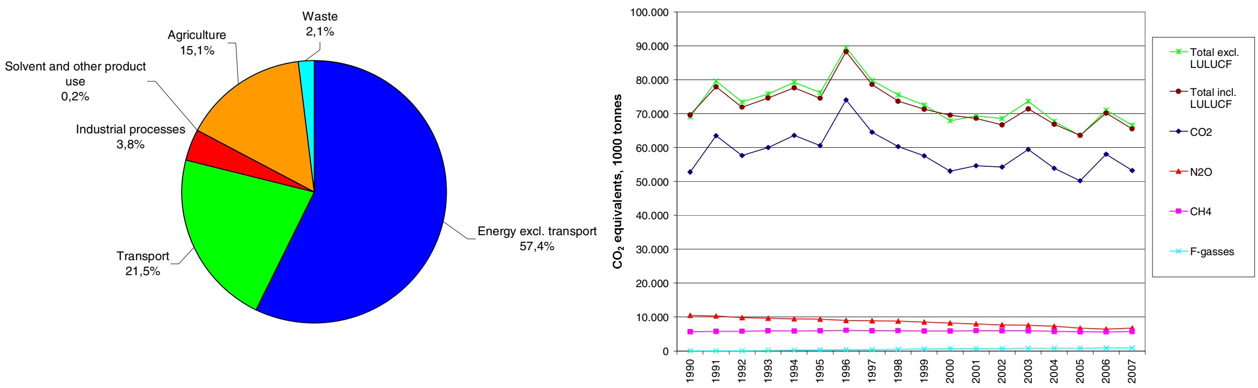


Figure 2.1 Greenhouse gas emissions in CO_2 equivalents distributed on main sectors for 2007 and time-series for 1990 to 2007.

2.2 Description and interpretation of emission trends by gas

Carbon dioxide

The largest source to the emission of CO_2 is the energy sector, which includes combustion of fossil fuels like oil, coal and natural gas (Figure 2.2). Energy Industries contribute with 47 % of the emissions (excl. LULUCF). About 26 % come from the transport sector. The CO_2 emission (excl. LULUCF) decreased by approximately 9.2 % from 2006 to 2007. The main reason for this decrease was a lower export of electricity in

2007 compared to 2006. In 2007, the actual CO_2 emission (incl. LULUCF) was about 2 % lower than the emission in 1990.

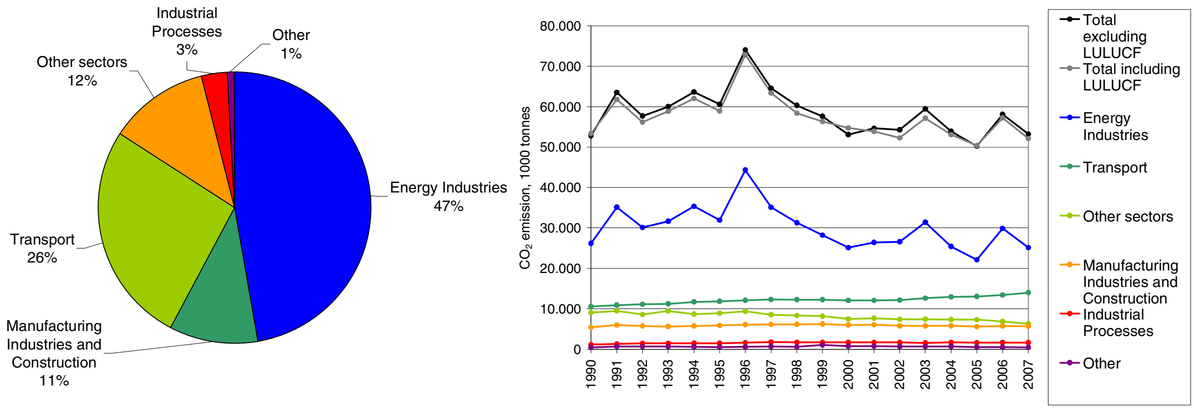


Figure 2.2 CO_2 emissions. Distribution according to the main sectors (2007) and time-series for 1990 to 2007.

Nitrous oxide

Agriculture is the most important N_2O emission source in 2007 contributing 92 % (Figure 2.3) of which N_2O from soil dominates (83.4 %). N_2O is emitted as a result of microbial processes in the soil. Substantial emissions also come from drainage water and coastal waters where nitrogen is converted to N_2O through bacterial processes. However, the nitrogen converted in these processes originates mainly from the agricultural use of manure and nitrogen fertilisers. The main reason for the drop in the emissions of N_2O in the agricultural sector of 31 % from 1990 to 2007 is legislation to improve the utilisation of nitrogen in manure. The legislation has resulted in less nitrogen excreted pr unit of livestock produced and a considerable reduction in the use of nitrogen fertilisers. The basis for the N_2O emission is then reduced. Combustion of fossil fuels in the energy sector, both stationary and mobile sources, contributes 6.8 %. The N_2O emission from transport contributes by 2 % in 2007. This emission has increased during the nineties because of the increase in the use of catalyst cars. Production of nitric acid stopped in 2004 and the emissions from industrial processes is therefore not occurring from 2005 onwards. The sector other covers N_2O from product use, e.g. anaesthesia.

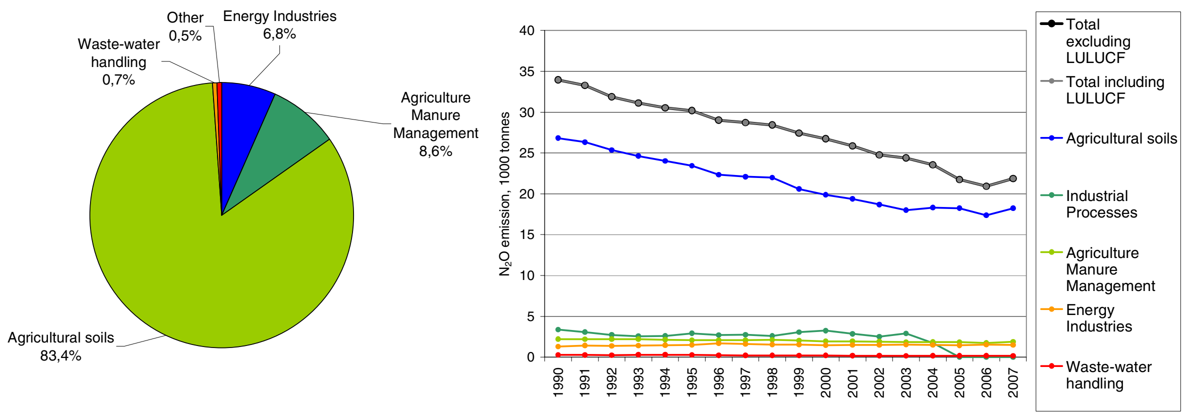


Figure 2.3 N_2O emissions. Distribution according to the main sectors (2007) and time-series for 1990 to 2007.

Methane

The largest sources of anthropogenic CH_4 emissions are agricultural activities contributing in 2007 with 66.7 %, waste (22.9 %), public power and district heating plants (3.4 %), see Figure 2.4. The emission from agriculture derives from enteric fermentation (48.5 %) and management of animal manure (18.2 %). The CH_4 emission from public power and district heating plants increased from the mid-1990s to 2003 due to the increasing use of gas engines in the decentralised cogeneration plant sector. Up to 3 % of the natural gas in the gas engines is not combusted. 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. Over the time-series from 1990 to 2007, the emission of CH_4 from enteric fermentation has decreased 14.5 % due to the decrease in the number of cattle. However, the emission from manure management has in the same period increased 39.5 % due to a change in traditional stable systems towards an increase in slurry-based stable systems. Altogether, the emission of CH_4 from the agriculture sector has decreased by 4.4 % from 1990 to 2007. The emission of CH_4 from waste disposal has decreased slightly due to an increase in the incineration of waste.

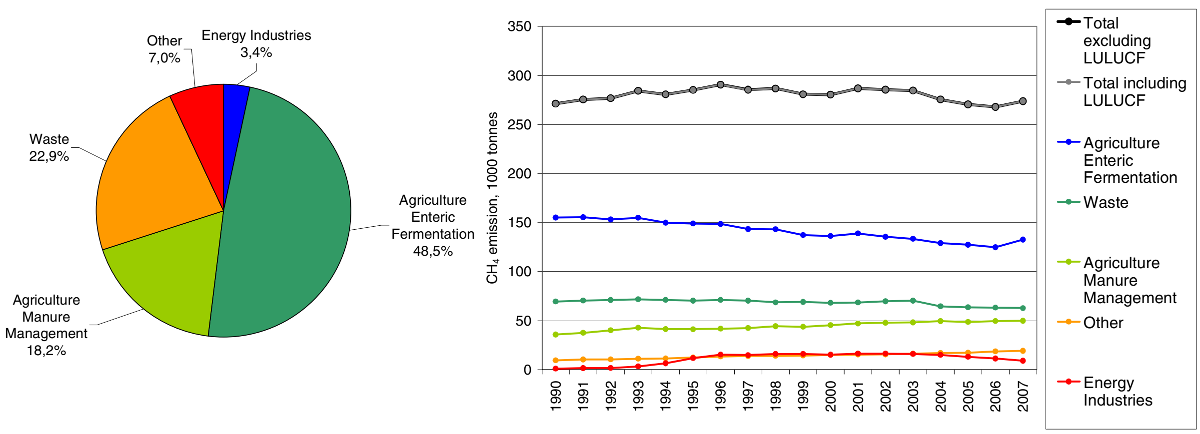


Figure 2.4 CH_4 emissions. Distribution according to the main sectors (2007) and time-series for 1990 to 2007.

HFCs, PFCs and SF_6

This part of the Danish inventory only comprises a full data set for all substances from 1995. From 1995 to 2000, there has been a continuous and substantial increase in the contribution from the range of F-gases as a whole, calculated as the sum of emissions in CO_2 equivalents, see Figure 2.5. This increase is simultaneous with the increase in the emission of HFCs. For the time-series 2000-2007, the increase is lower than for the years 1995 to 2000. The increase from 1995 to 2007 is 172 %. SF_6 contributed considerably to the F-gas sum in earlier years, with 33 % in 1995. Environmental awareness and regulation of this gas under Danish law has reduced its use in industry, see Figure 2.5. A further result is that the contribution of SF_6 to F-gases in 2007 was only 3.4 %. The use of HFCs has increased several fold. HFCs have, therefore, become dominant F-gases, comprising 66.9 % in 1995, but 94.8 % in 2007. HFCs are mainly used as a refrigerant. Danish legislation regulates the use of F-gases, e.g. since January 1, 2007 new HFC-based refrigerant stationary systems are forbidden. Refill of old systems are still allowed. The use of air conditioning in mobile systems and the amount of HFC for this purpose increases.

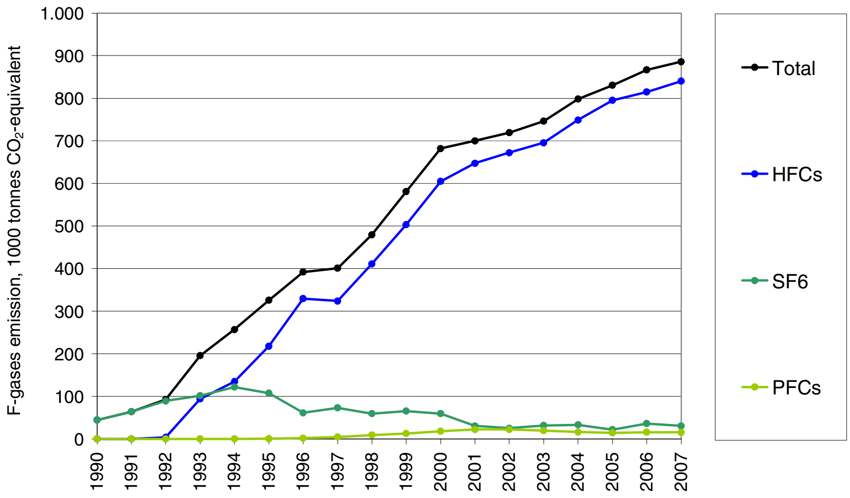


Figure 2.5 F-gas emissions. Time-series for 1990 to 2007.

2.3 Description and interpretation of emission trends by source

Energy

The emission of CO_2 from Energy Industries has decreased by approximately 4 % from 1990 to 2007. The relatively large fluctuation in the emission is due to inter-country electricity trade. Thus, the high emissions in 1991, 1996, 2003 and 2006 reflect a large electricity export and the low emissions in 1990 and 2005 are due to a large import of electricity. The increasing emission of CH_4 is due to the increasing use of gas engines in decentralised cogeneration plants, the CH_4 emissions from this sector has been decreasing in later years due to the liberalisation of the electricity market. The CO_2 emission from the transport sector increased by 33 % from 1990 to 2007, mainly due to increasing road traffic.

Industrial processes

The emissions from industrial process, i.e. emissions from processes other than fuel combustion, amount in 2007 to 3.8 % of the total emission in CO_2 equivalents (excl. LULUCF). The main sources are cement production, refrigeration, foam blowing and calcination of limestone. The CO_2 emission from cement production – which is the largest source contributing in 2007 with 2.1 % of the National total – increased by 59 % from 1990 to 2007. 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.

Agriculture

The agricultural sector contributes in 2007 with 15.1 % of the total greenhouse gas emission in CO_2 equivalents (excl. LULUCF) and is the most important sector regarding the emissions of N_2O and CH_4. In 2007, the contribution of N_2O and CH_4 to the total emission of these gases was 92.0 % and 66.7 %, respectively. The N_2O emission decreased by 31.7 % and the CH_4 emission by 4.4 % from 1990 to 2007.

Forest

The annual C-stock change for forest land remaining forest land was reduced from 3326 Gg CO_2 in 2004 to 1639 Gg CO_2 in 2005 due to storms. As no storms occurred in 2006 or 2007 this figure increased to 2600 Gg CO_2 in 2006 and 2769 Gg CO_2 in 2007. The annual C sequestration in forests remaining forests was slightly lower in 2006 and 2007 than in previous years because the harvested amount of wood was relatively high for a year without windthrows. The gross C sequestration due to increment of woody biomass in the forest was slightly higher for 2007. This is due to calculation of increment rate based on the new plot-based forest inventory (2002-2006). The higher gross C sequestration is mainly due to a larger forest area in 2007 compared to the previous Forest Census based on questionnaires. The total forest area was estimated at 526,552 ha. The area of forest remaining forests in 2007 was estimated by subtracting the afforested area 1990-2004. The area of forests remaining forests is therefore currently reported as 498,950 ha. The C sequestration in afforested stands increases and will continue to do so over the coming decades due to i) increasing growth rates as afforested stands grow older and ii) an increase in the total area under afforestation.

Cropland, grassland and wetlands

The emission estimates from mineral soils is very variable across the years due to variations in yield level and annual temperatures which affect the degradation rate in the applied Tier 3 model. In 2007 the emission from cropland has been estimated to 1779 Gg CO_2 despite the very warm year. The emission is mainly due to emission from the organic soils which is relatively constant between years. The reported emission from mineral soils is a five-year average 2005-2009. 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. A continuous increase in raised number of shelterbelts increases the C sequestration here. Emissions from managed wetlands with peat extraction are unaltered at a low level.

Waste

The waste sector contributes in 2007 with 2.1 % to the National total of greenhouse gas emissions (excl. LULUCF), 22.9 % of the total CH_4 emission and 0.7 % of the total N_2O emission. The emission from the sector has decreased by 11.8 % from 1990 to 2007. This decrease is a result of (1) a decrease in the CH_4 emission from solid waste disposal sites (SWDS) by 20 % due to the increasing use of waste for power and heat production, and (2) a decrease in emission of N_2O from wastewater (WW) handling systems of 46 % due to upgrading of WW treatment plants. These decreases are counteracted by an increase in CH_4 from WW of 104 % due to increasing industrial load to WW systems. In 2007 the contribution of CH_4 from SWDS was 18.5 % of the total CH_4 emission. The CH_4 emission from WW amounts in 2007 to 4.4 % of the total CH_4 emissions. The emission of N_2O from WW is in 2007 0.7 % of national total of N_2O. Since all incinerated waste is used for power and heat production, the emissions are included in the 1A IPCC category.

2.4 Description and interpretation of emission trends for indirect greenhouse gases and SO_2

NO_X

The largest sources of emissions of NO_X are other mobile sources followed by road transport and combustion in energy industries (mainly public power and district heating plants). The transport sector is the sector contributing the most to the emission of NO_X and, in 2007, 45 % of the Danish emissions of NO_X stems from road transport, national navigation, railways and civil aviation. Also emissions from national fishing and off-road vehicles contribute significantly to the NO_X emission. For non-industrial combustion plants, the main sources are combustion of gas oil, natural gas and wood in residential plants. The emissions from energy industries have decreased by 65 % from 1985 to 2007. In the same period, the total emission decreased by 43 %. The reduction is due to the increasing use of catalyst cars and installation of low-NO_X burners and denitrifying units in power and district heating plants.

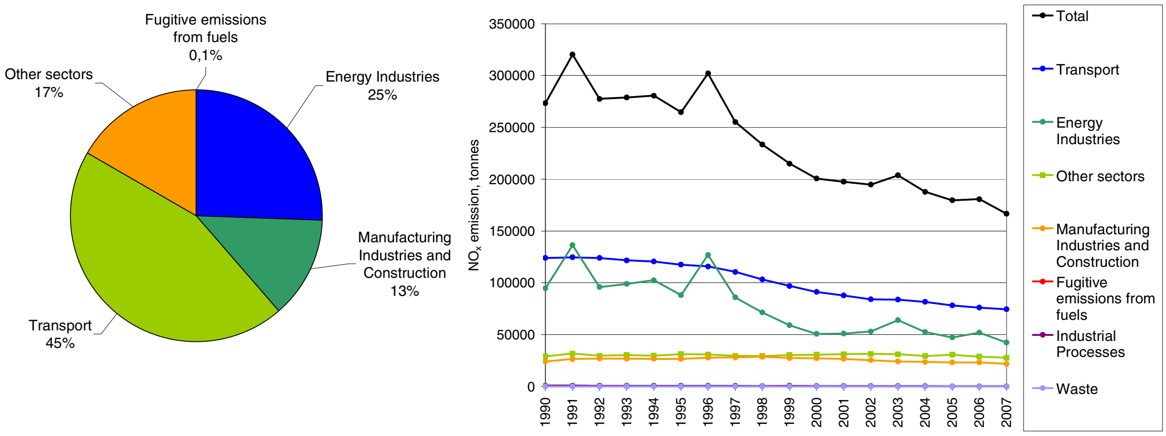


Figure 2.6 NO_X emissions. Distribution according to the main sectors (2007) and time-series for 1990 to 2007.

CO

Other mobile sources and non-industrial combustion plants contribute significantly to the total emission of this pollutant. Transport is the second largest contributor to the total CO emission. The emission decreased by 38 % from 1990 to 2007, largely because of decreasing emissions from road transportation.

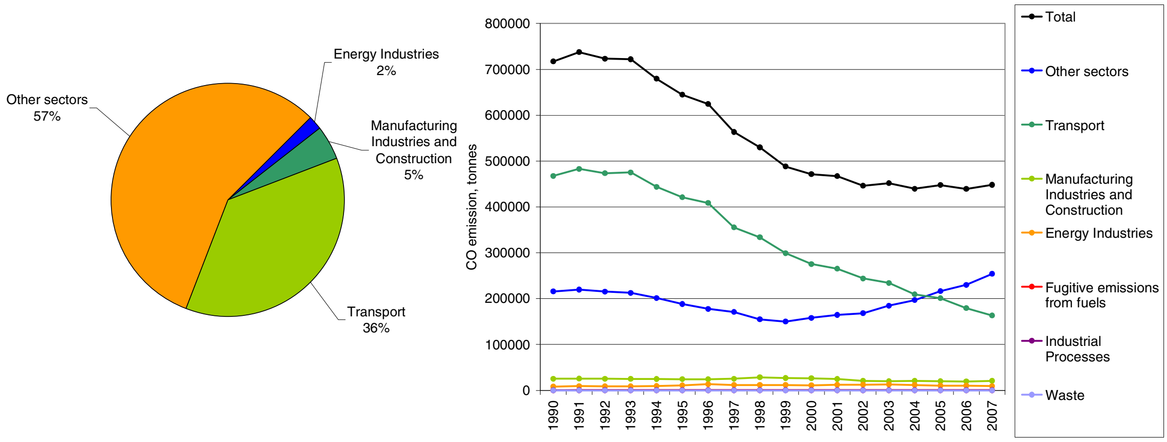


Figure 2.7 CO emissions. Distribution according to the main sectors (2007) and time-series for 1990 to 2007.

NMVOC

The emissions of NMVOC originate from many different sources and can be divided into two main groups: incomplete combustion and evaporation. Road vehicles and other mobile sources such as national navigation vessels and off-road machinery are the main sources of NMVOC emissions from incomplete combustion processes. Road transportation vehicles are still the main contributors even though the emissions have declined since the introduction of catalyst cars in 1990. The evaporative emissions mainly originate from the use of solvents and the extraction, handling and storage of oil and natural gas. The emissions from the energy industries have increased during the nineties due to the increasing use of stationary gas engines, which have much higher emissions of NMVOC than conventional boilers. The total anthropogenic emissions have decreased by 48 % from 1985 to 2007, largely due to the increased use of catalysts in cars and reduced emissions from use of solvents.

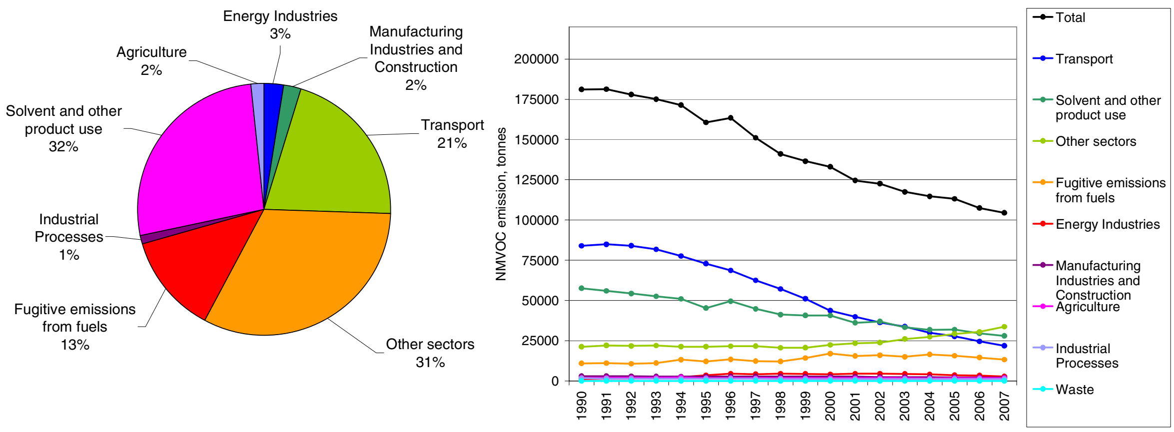


Figure 2.8 NMVOC emissions. Distribution according to the main sectors (2007) and time-series for 1990 to 2007.

SO_2

The main part of the SO_2 emission originates from combustion of fossil fuels, i.e. mainly coal and oil, in public power and district heating plants. From 1980 to 2007, the total emission decreased by 95 %. The large reduction is largely due to installation of desulphurisation plant and use of fuels with lower content of sulphur in public power and district heating plants. Despite the large reduction of the SO_2 emissions, these plants make up 39 % of the total emission. Also emissions from industrial combustion plants, non-industrial combustion plants and other mobile sources are important. National sea traffic (navigation and fishing) contributes with about 6 % of the total SO_2 emission. This is due to the use of residual oil with high sulphur content.

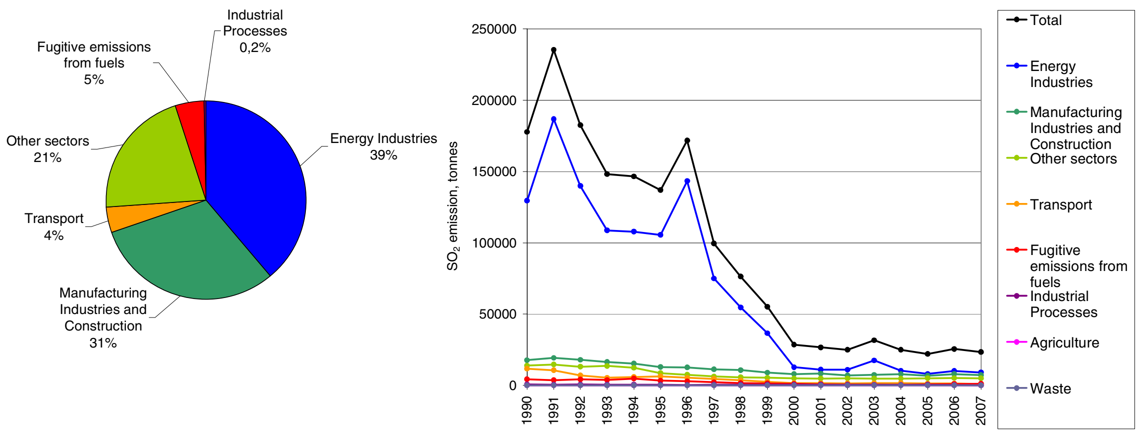


Figure 2.9 SO_2 emissions. Distribution according to the main sectors (2007) and time-series for 1990 to 2007.

3 Energy (CRF sector 1)

3.1 Overview of the sector

The energy sector has been reported in four main chapters:

3.2 Stationary combustion plants (CRF sector 1A1, 1A2 and 1A4)
3.3 Transport (CRF sector 1A2, 1A3, 1A4 and 1A5)
3.4 Additional information on fuel combustion (CRF sector 1A)
3.5 Fugitive emissions (CRF sector 1B)

Though industrial combustion is part of stationary combustion, detailed documentation for some of the specific industries is discussed in the industry chapters. Table 3.1 shows detailed source categories for the energy sector and plant category in which the sector is discussed in this report.

Table 3.1 CRF energy sectors and relevant NIR chapters.

IPCC id	IPCC sector name	NERI documentation
1	Energy	Stationary combustion, Transport, Fugitive, Industry
1A	Fuel Combustion Activities	Stationary combustion, Transport, Industry
1A1	Energy Industries	Stationary combustion
1A1a	Electricity and Heat Production	Stationary combustion
1A1b	Petroleum Refining	Stationary combustion
1A1c	Solid Fuel Transf./Other Energy Industries	Stationary combustion
1A2	Fuel Combustion Activities/Industry (ISIC)	Stationary combustion, Transport, Industry
1A2a	Iron and Steel	Stationary combustion, Industry
1A2b	Non-Ferrous Metals	Stationary combustion, Industry
1A2c	Chemicals	Stationary combustion, Industry
1A2d	Pulp, Paper and Print	Stationary combustion, Industry
1A2e	Food Processing, Beverages and Tobacco	Stationary combustion, Industry
1A2f	Other (please specify)	Stationary combustion, Transport, Industry
1A3	Transport	Transport
1A3a	Civil Aviation	Transport
1A3b	Road Transportation	Transport
1A3c	Railways	Transport
1A3d	Navigation	Transport
1A3e	Other (please specify)	Transport
1A4	Other Sectors	Stationary combustion, Transport
1A4a	Commercial/Institutional	Stationary combustion
1A4b	Residential	Stationary combustion, Transport
1A4c	Agriculture/Forestry/Fishing	Stationary combustion, Transport
1A5	Other (please specify)	Stationary combustion, Transport
1A5a	Stationary	Stationary combustion
1A5b	Mobile	Transport
1B	Fugitive Emissions from Fuels	Fugitive
1B1	Solid Fuels	Fugitive
1B1a	Coal Mining	Fugitive
1B1a1	Underground Mines	Fugitive
1B1a2	Surface Mines	Fugitive
1B1b	Solid Fuel Transformation	Fugitive
1B1c	Other (please specify)	Fugitive
1B2	Oil and Natural Gas	Fugitive
1B2a	Oil	Fugitive
1B2a2	Production	Fugitive
1B2a3	Transport	Fugitive
1B2a4	Refining/Storage	Fugitive
1B2a5	Distribution of oil products	Fugitive
1B2a6	Other	Fugitive
1B2b	Natural Gas	Fugitive
1B2b1	Production/processing	Fugitive
1B2b2	Transmission/distribution	Fugitive
1B2c	Venting and Flaring	Fugitive
1B2c1	Venting and Flaring Oil	Fugitive
1B2c2	Venting and Flaring Gas	Fugitive
1B2d	Other	Fugitive

Summary tables for the energy sector are shown below.

Table 3.2 CO_2 emission from the energy sector.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
					(Gg)					
1. Energy	51.462	61.974	56.067	58.365	61.982	58.938	72.285	62.616	58.455	55.765
A. Fuel Combustion (Sectoral Approach)	51.198	61.456	55.532	57.896	61.514	58.576	71.886	62.053	58.034	54.869
1. Energy Industries	26.173	35.113	30.082	31.627	35.352	31.934	44.321	35.084	31.277	28.231
2. Manufacturing Industries and Construction	5.424	5.944	5.769	5.609	5.769	5.891	6.081	6.124	6.154	6.222
3. Transport	10.528	10.904	11.102	11.225	11.712	11.852	12.109	12.303	12.275	12.271
4. Other Sectors	8.954	9.208	8.439	9.198	8.430	8.646	9.199	8.372	8.125	7.963
5. Other	119	287	141	237	252	252	176	171	204	182
B. Fugitive Emissions from Fuels	263	518	534	468	468	363	399	563	421	896
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	263	518	534	468	468	363	399	563	421	896

Continued	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	51.263	52.839	52.442	57.756	52.091	48.525	56.327	51.494
A. Fuel Combustion (Sectoral Approach)	50.670	52.208	51.910	57.208	51.485	48.085	55.903	51.127
1. Energy Industries	25.130	26.415	26.584	31.402	25.406	22.140	29.869	25.132
2. Manufacturing Industries and Construction	6.005	6.071	5.788	5.751	5.798	5.576	5.756	5.686
3. Transport	12.061	12.057	12.159	12.621	12.933	13.050	13.418	13.986
4. Other Sectors	7.364	7.568	7.289	7.341	7.109	7.048	6.734	6.148
5. Other	111	97	89	92	239	271	126	175
B. Fugitive Emissions from Fuels	593	631	533	548	606	440	425	367
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	593	631	533	548	606	440	425	367

Table 3.3 CH_4 emission from the energy sector.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
					(Gg)					
1. Energy	10.69	11.92	12.39	14.74	18.05	24.28	28.90	28.97	30.35	30.64
A. Fuel Combustion (Sectoral Approach)	8.80	9.64	10.22	12.35	15.50	21.34	26.07	25.85	27.23	27.07
1. Energy Industries	1.11	1.54	1.86	3.46	6.53	11.84	15.41	14.92	16.16	16.09
2. Manufacturing Industries and Construction	0.71	0.74	0.72	0.73	0.74	0.84	1.28	1.28	1.37	1.37
3. Transport	2.67	2.71	2.68	2.65	2.56	2.42	2.32	2.23	2.14	2.03
4. Other Sectors	4.31	4.63	4.96	5.50	5.67	6.21	7.05	7.40	7.55	7.57
5. Other	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
B. Fugitive Emissions from Fuels	1.89	2.28	2.17	2.39	2.55	2.94	2.83	3.12	3.12	3.56
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	1.89	2.28	2.17	2.39	2.55	2.94	2.83	3.12	3.12	3.56

Continued	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	30.45	32.10	32.16	32.40	32.30	30.49	30.11	28.32
A. Fuel Combustion (Sectoral Approach)	26.64	28.28	28.22	28.38	27.47	25.68	23.95	22.21
1. Energy Industries	15.28	16.55	16.48	16.17	15.18	13.20	11.42	9.18
2. Manufacturing Industries and Construction	1.57	1.64	1.50	1.50	1.49	1.29	1.17	0.97
3. Transport	1.91	1.78	1.68	1.62	1.53	1.42	1.32	1.23
4. Other Sectors	7.88	8.31	8.56	9.09	9.26	9.75	10.03	10.82
5. Other	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01
B. Fugitive Emissions from Fuels	3.81	3.82	3.94	4.02	4.84	4.81	6.16	6.11
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	3.81	3.82	3.94	4.02	4.84	4.81	6.16	6.11

Table 3.4 N_2O emission from the energy sector.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
					(Gg)					
1. Energy	1.28	1.42	1.37	1.42	1.47	1.49	1.69	1.60	1.54	1.53
A. Fuel Combustion (Sectoral Approach)	1.28	1.41	1.36	1.41	1.46	1.49	1.69	1.59	1.53	1.51
1. Energy Industries	0.38	0.47	0.43	0.45	0.49	0.50	0.65	0.57	0.53	0.52
2. Manufacturing Industries and Construction	0.18	0.19	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.19
3. Transport	0.37	0.40	0.41	0.43	0.46	0.48	0.50	0.51	0.50	0.50
4. Other Sectors	0.34	0.35	0.33	0.35	0.32	0.33	0.34	0.32	0.30	0.30
5. Other	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01
B. Fugitive Emissions from Fuels	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	0.005	0.009	0.009	0.008	0.008	0.006	0.007	0.010	0.007	0.016
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
1. Energy	1.47	1.49	1.48	1.53	1.48	1.44	1.52	1.48		
A. Fuel Combustion (Sectoral Approach)	1.46	1.48	1.48	1.52	1.47	1.43	1.51	1.47		
1. Energy Industries	0.48	0.51	0.52	0.55	0.50	0.46	0.54	0.48		
2. Manufacturing Industries and Construction	0.19	0.19	0.18	0.18	0.19	0.18	0.19	0.19		
3. Transport	0.48	0.47	0.46	0.46	0.46	0.45	0.44	0.45		
4. Other Sectors	0.30	0.31	0.31	0.32	0.31	0.33	0.34	0.35		
5. Other	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01		
B. Fugitive Emissions from Fuels	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00		
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO		
2. Oil and Natural Gas	0.010	0.011	0.009	0.010	0.011	0.008	0.007	0.003		

3.2 Stationary combustion (CRF sector 1A1, 1A2 and 1A4)

Fuel consumption and emissions from stationary combustion plants in CRF sectors 1A1, 1A2 and 1A4 are all included in this chapter. Further details on the inventories for stationary combustion are enclosed in Annex 3A.

3.2.1 Source category description

Emission source categories, fuel consumption data and emission data are presented in this chapter.

Emission source categories

In the Danish emission database, all activity rates and emissions are defined in SNAP sector categories (Selected Nomenclature for Air Pollution) according the CORINAIR system. The emission inventories are prepared from a complete emission database, based on the SNAP sectors. Aggregation to the IPCC sector codes is based on a correspondence list between SNAP and IPCC sectors enclosed in Annex 3A. Stationary combustion is defined as combustion activities in the SNAP sectors 01-03.

Stationary combustion plants are included in the emission source subcategories:

- 1A1 Energy, Fuel consumption, Energy Industries
- 1A2 Energy, Fuel consumption, Manufacturing Industries and Construction
- 1A4 Energy, Fuel consumption, Other Sectors

The emission sources *1A2* and *1A4,* however also include emissions from transport subsectors. The emission source *1A2* includes emissions from some off-road machinery in the industries. The emission source *1A4* includes off-road machinery in agriculture/forestry and household-/gardening. Further emissions from national fishing are included in subsector *1A4*.

The emission and fuel consumption data presented in tables and figures in Chapter 3.2 only includes emissions originating from stationary combustion plants of a given IPCC sector. The IPCC sector codes have been applied unchanged, but some sector names have been changed to reflect the stationary combustion element of the source.

Fuel consumption

In 2007, the total fuel consumption for stationary combustion plants was 559 PJ of which 446 PJ was fossil fuels.

Fuel consumption distributed according to the stationary combustion subsectors is shown in Figure 3.1 and Figure 3.2. The majority - 59 % - of all fuels is combusted in the sector, *Public electricity and heat production.* Other sectors with high fuel consumption are *Residential* and *Industry*.

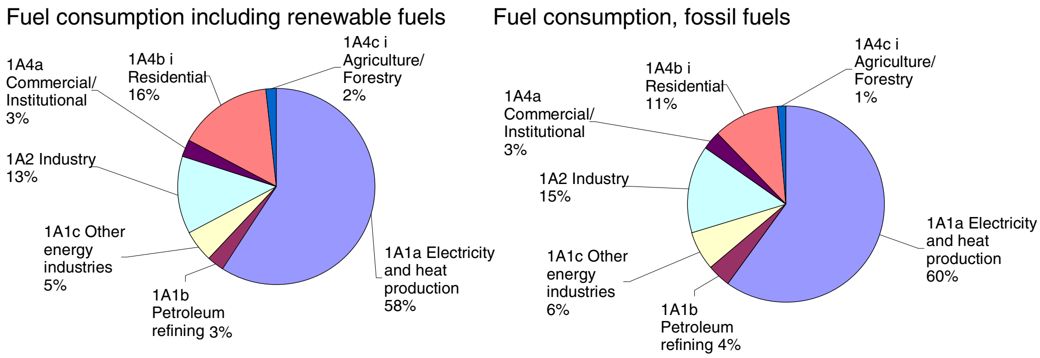


Figure 3.1 Fuel consumption rate of stationary combustion, 2007 (based on DEA 2008a).

Coal and natural gas are the most utilised fuels for stationary combustion plants. Coal is mainly used in power plants and natural gas is used in power plants and decentralised CHP plants, as well as in industry, district heating and households.

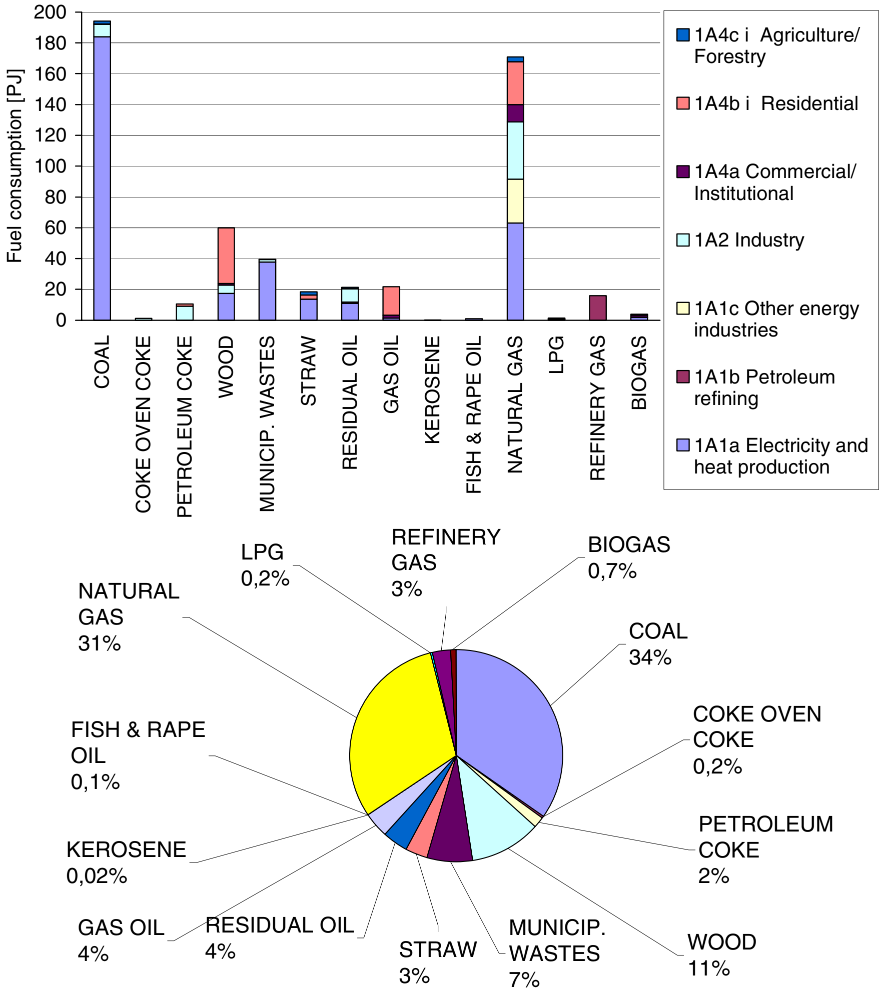
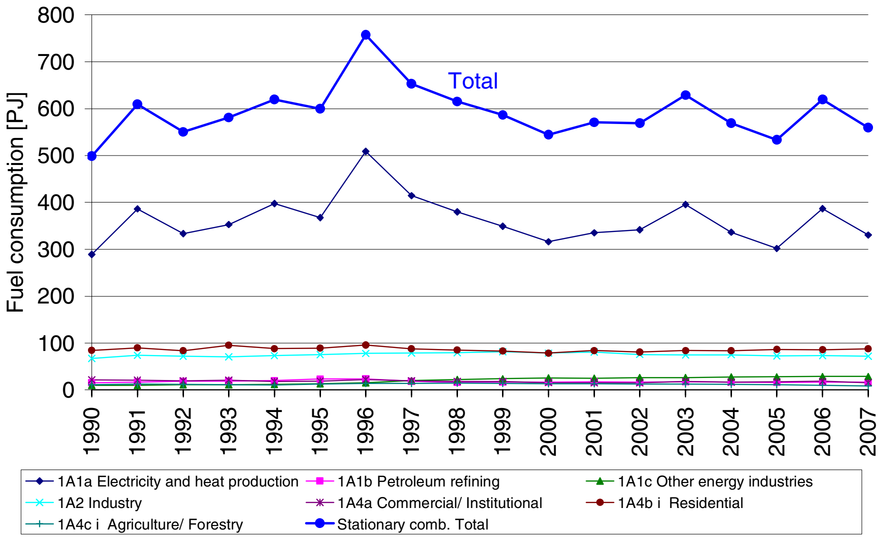


Figure 3.2 Fuel consumption of stationary combustion plants 2007 (based on DEA 2008a).

Fuel consumption time-series for stationary combustion plants are presented in Figure 3.3. The total fuel consumption has increased by 12 % from 1990 to 2007, while the fossil fuel consumption has decreased by 2 %. The consumption of natural gas and renewable fuels has increased since 1990, whereas the consumption of coal has decreased.

The fuel consumption rate fluctuates considerably, largely due to electricity import/export but also due to outdoor temperature variations. The fuel consumption fluctuation is further discussed in the chapter "Emissions".



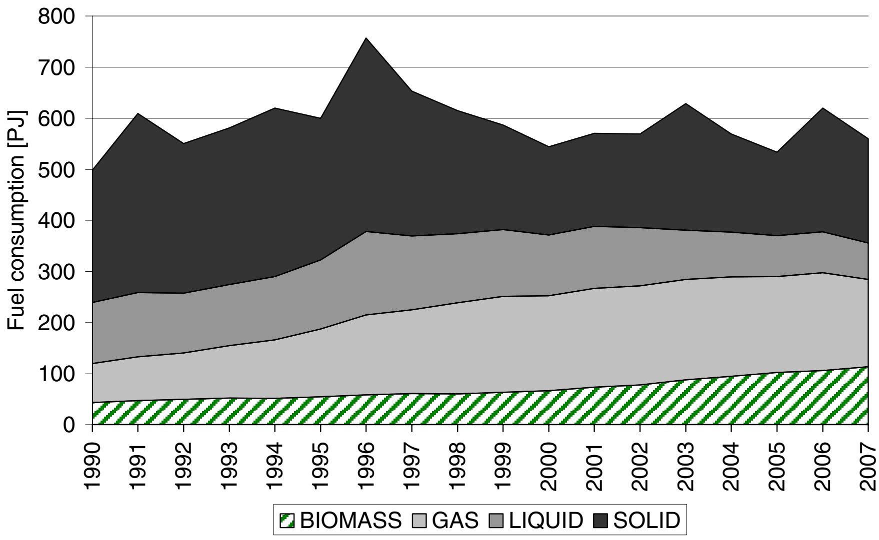


Figure 3.3 Fuel consumption time-series, stationary combustion (based on DEA 2008a).

Emissions

The greenhouse gas (GHG) emissions from stationary combustion are listed in Table 3.5. The emission from stationary combustion accounts for 52 % of the national GHG emission.

The CO_2 emission from stationary combustion plants accounts for 64 % of the national CO_2 emission (excluding net CO_2 emission from LULUCF[1]). The CH_4 emission from stationary combustion accounts for 8 % of the national CH_4 emission and the N_2O emission from stationary combustion accounts for 4 % of the national N_2O emission.

[1] Land Use, Land Use Change and Forestry

Table 3.5 Greenhouse gas emission for the year 2007 [1].

	CO_2	CH_4	N_2O
	Gg CO_2 equivalent		
1A1 Fuel consumption, Energy industries	25132	193	150
1A2 Fuel consumption, Manufacturing Industries and Construction [1]	4609	19	45
1A4 Fuel consumption, Other sectors [1]	4351	220	83
Total emission from stationary combustion plants	34092	433	278
National (excluding net emission from LULUCF)	53228	5748	6444
		%	
Emission share for stationary combustion	64 %	8 %	4 %

1) Only stationary combustion sources of the sector is included.

CO_2 is the most important GHG pollutant and accounts for 98.0 % of the GHG emission (CO_2 eqv.) from stationary combustion plants.

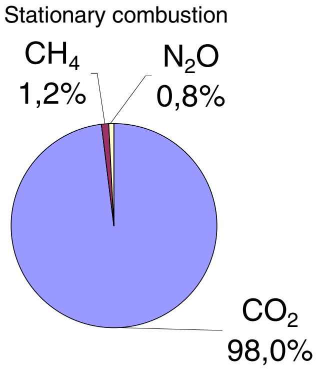


Figure 3.4 GHG emission (CO_2 equivalent) from stationary combustion plants.

Figure 3.5 depicts the time-series of GHG emission (CO_2 eqv.) from stationary combustion and it can be seen that the GHG emission development follows the CO_2 emission development very closely. Both the CO_2 and the total GHG emission are lower in 2007 than in 1990 – CO_2 by 10 % and GHG by 9 %. However, fluctuations in the GHG emission level are large.

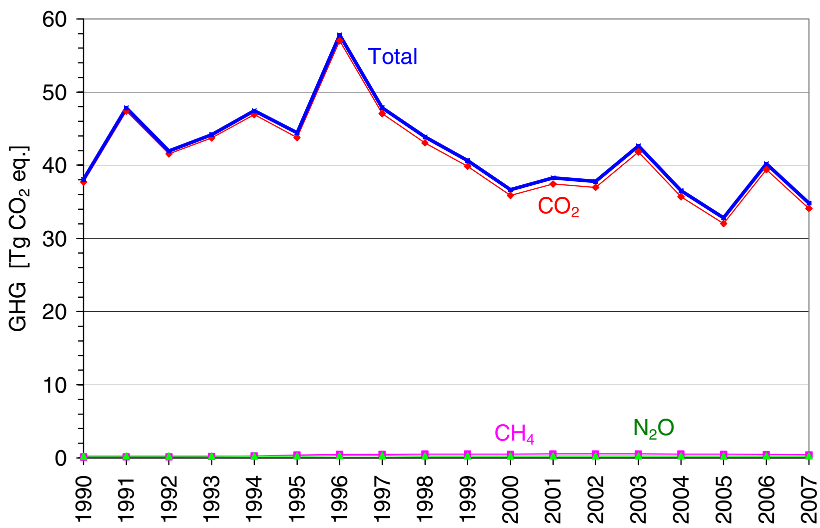


Figure 3.5 GHG emission time-series for stationary combustion.

The fluctuations in the time-series are largely a result of electricity import/export activity, but also of outdoor temperature variations from year to year. These fluctuations are shown in Figure 3.6. The fluctuations follow the fluctuations in fuel consumption.

In 1990, the Danish electricity import was large causing relatively low fuel consumption, whereas the fuel consumption was high in 1996 due to a large electricity export. In 2007 the net electricity export was 3420 TJ which is a lower export rate than in 2006. The large electricity export that occurs in some years is a result of low rainfall in Norway and Sweden causing insufficient hydropower production in both countries.

To be able to follow the national energy consumption, and for statistical and reporting purposes, the Danish Energy Authority produces a correction of the actual emissions without random variations in electricity imports/exports and in ambient temperature. This emission trend, which is smoothly decreasing, is also illustrated in Figure 3.6. The corrections are included here to explain the fluctuations in the emission time-series. The GHG emission corrected for electricity import/export and ambient temperature has decreased by 22 % since 1990, and the CO_2 emission by 23 %.

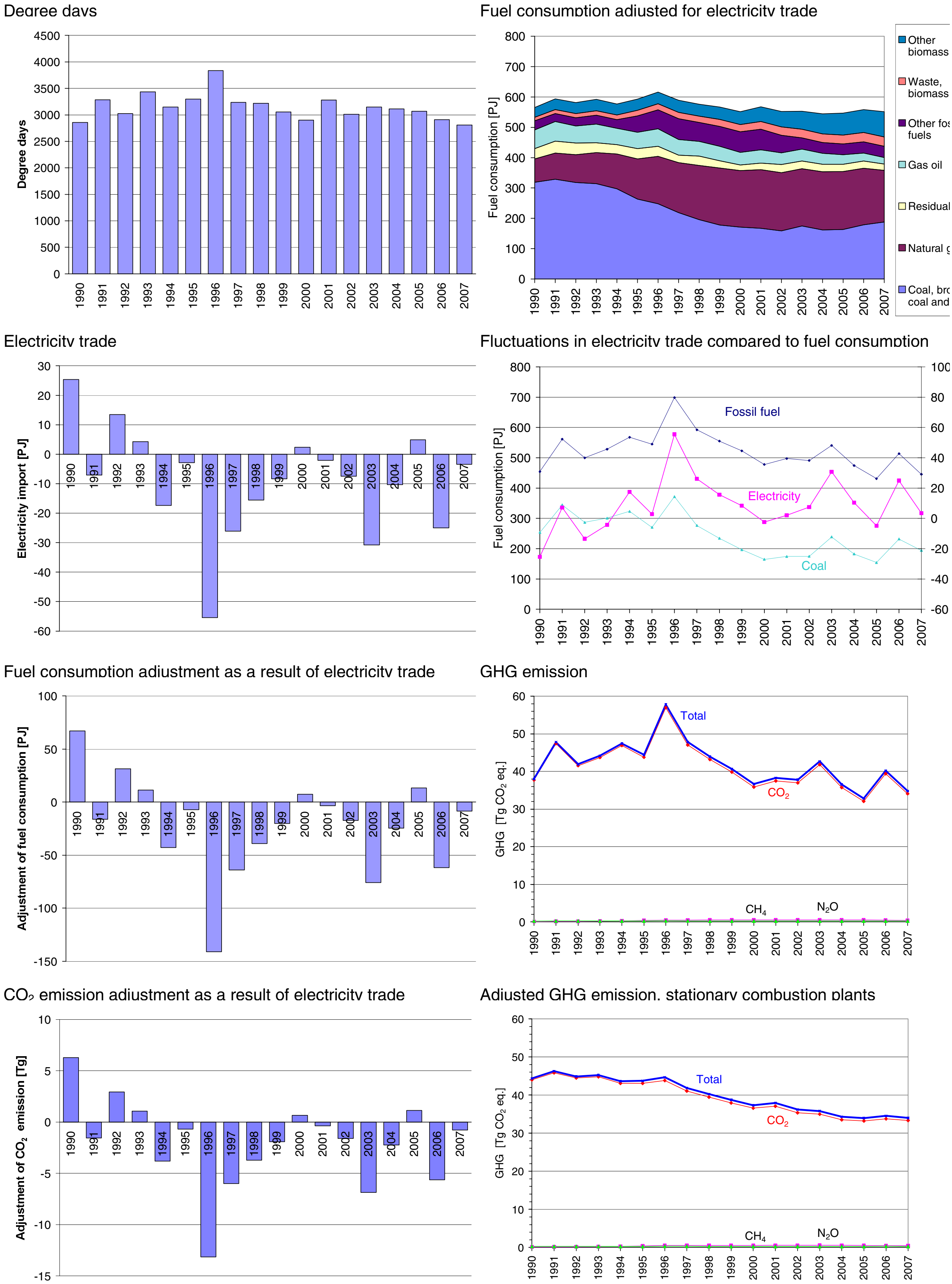


Figure 3.6 GHG emission time-series for stationary combustion and adjustment for electricity import/export and temperature variations (DEA 2008b).

CO_2

The CO_2 emission from stationary combustion plants is one of the most important GHG emission sources. Thus the CO_2 emission from stationary combustion plants accounts for 64 % of the national CO_2 emission. Table 3.6 lists the CO_2 emission inventory for stationary combustion plants for 2007. Figure 3.7 reveals that *Electricity and heat production* accounts for 66 % of the CO_2 emission from stationary combustion. This share is somewhat higher than the fossil fuel consumption share for this sector, which is 59 % (Figure 3.1). Other large CO_2 emission sources are industrial plants and residential plants. These are the sectors, which also account for a considerable share of fuel consumption.

Table 3.6 CO_2 emission from stationary combustion plants 2007[1)].

CO_2	2007	
1A1a Public electricity and heat production	22 545	Gg
1A1b Petroleum refining	970	Gg
1A1c Other energy industries	1 617	Gg
1A2 Industry	4 599	Gg
1A4a Commercial / Institutional	790	Gg
1A4b Residential	3 136	Gg
1A4c Agriculture / Forestry / Fisheries	425	Gg
Total	34 082	Gg

[1)]Only emission from stationary combustion plants in the sectors is included.

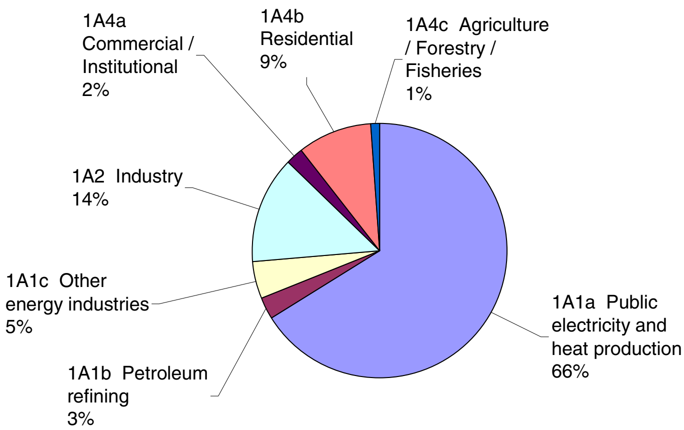


Figure 3.7 CO_2 emission sources, stationary combustion plants, 2007.

The CO_2 emission from combustion of biomass fuels is not included in the total CO_2 emission data, because biomass fuels are considered CO_2 neutral. The CO_2 emission from biomass combustion is reported as a memo item in the Climate Convention reporting. In 2007, the CO_2 emission from biomass combustion was 12 078 Gg.

Time-series for CO_2 emissions are provided in Figure 3.8. Despite an increase in fuel consumption of 12 % since 1990, CO_2 emission from stationary combustion has decreased by 10 % due to the change in the type of fuels used.

The fluctuations of CO_2 emission are discussed earlier.

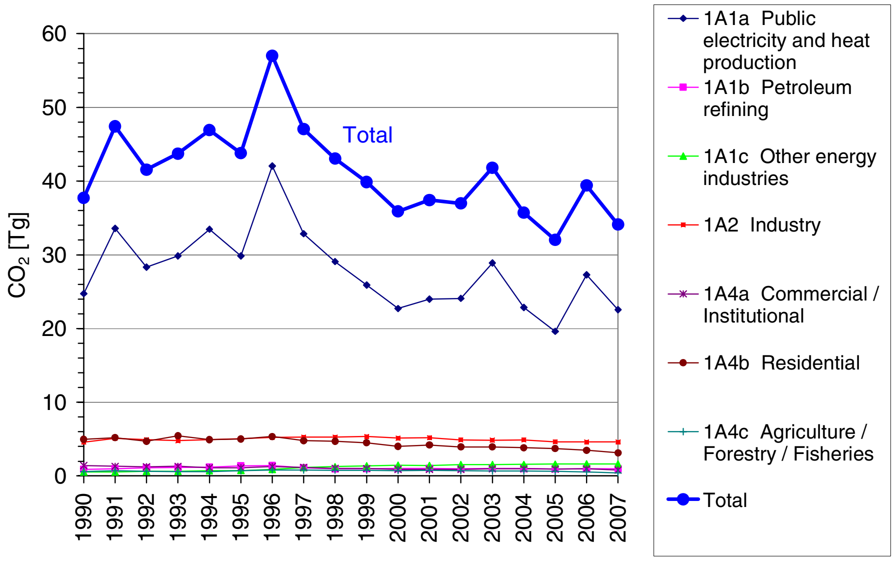


Figure 3.8 CO_2 emission time-series for stationary combustion plants.

Detailed trend discussion on CRF category level is available in Annex 3A.

CH_4

CH_4 emission from stationary combustion plants accounts for 8 % of the national CH_4 emission. Table 3.7 lists the CH_4 emission inventory for stationary combustion plants in 2007. Figure 3.9 reveals that *Electricity and heat production* accounts for 44 % of the CH_4 emission from stationary combustion, which is somewhat less than the fuel consumption share. Residential plants accounts for 42 % of the emission.

Table 3.7 CH_4 emission from stationary combustion plants 2007 [1)].

CH_4	2007	
1A1a Public electricity and heat production	9 101	Mg
1A1b Petroleum refining	3	Mg
1A1c Other energy industries	78	Mg
1A2 Industry	927	Mg
1A4a Commercial / Institutional	794	Mg
1A4b Residential	8 594	Mg
1A4c Agriculture / Forestry / Fisheries	1 105	Mg
Total	20 603	Mg

[1)]Only emission from stationary combustion plants in the sectors is included.

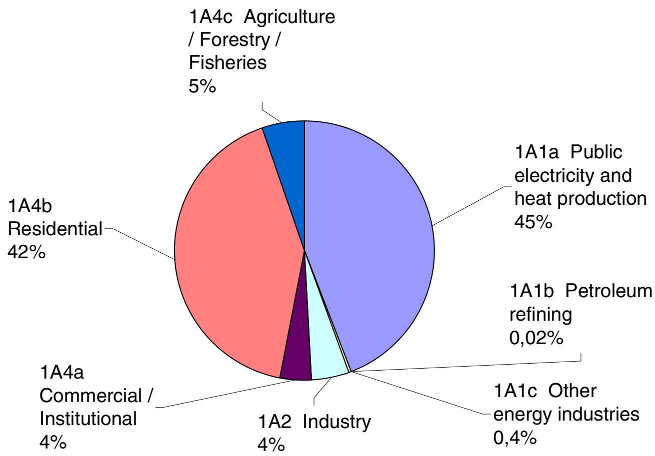


Figure 3.9 CH_4 emission sources, stationary combustion plants, 2007.

The CH_4 emission factor for reciprocating lean-burn gas engines is much higher than for other combustion plants due to the continuous ignition/burn-out of the gas. Lean-burn gas engines have an especially high emission factor as discussed in the chapter regarding emission factors. A considerable number of lean-burn gas engines are in operation in Denmark and these plants account for 50 % of the CH_4 emission from stationary combustion plants (Figure 3.10). The engines are installed in CHP plants and the fuel used is either natural gas or biogas.

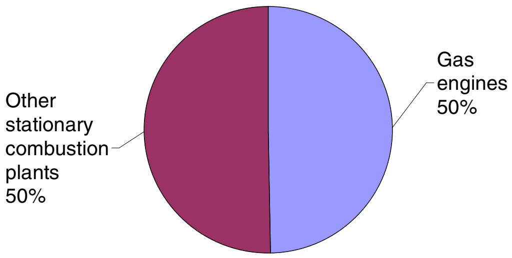


Figure 3.10 Gas engine CH_4 emission share, 2007.

The CH_4 emission from stationary combustion increased by a factor of 3.6 since 1990 (Figure 3.11). This is due to the considerable number of lean-burn gas engines installed in CHP plants in Denmark during the 1990s. This increase is also the reason for the increasing IEF (implied emission factor) for gaseous fuels and biomass in the CRF sectors *1A1*, *1A2* and *1A4*. Figure 3.12 provides time-series for the fuel consumption rate in gas engines and the corresponding increase in CH_4 emission. The decline in later years is due to structural changes in the Danish electricity market, which means that the fuel consumption in gas engines has been decreasing.

The emission from residential plants has increased since 1990 due to increased combustion of biomass in residential plants. Combustion of wood accounts for more than 80 % of the emission from residential plants.

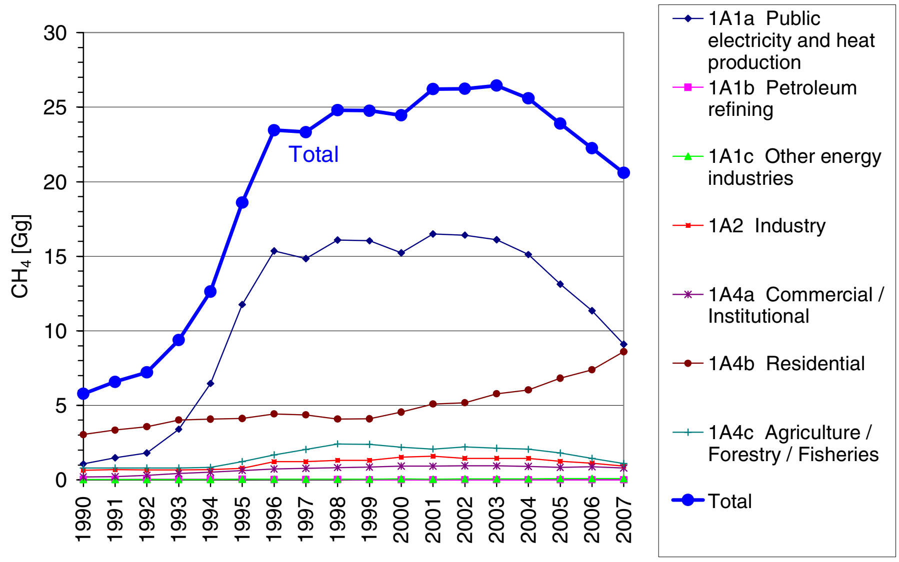


Figure 3.11 CH_4 emission time-series for stationary combustion plants.

Detailed trend discussion on CRF category level is available in Annex 3A.

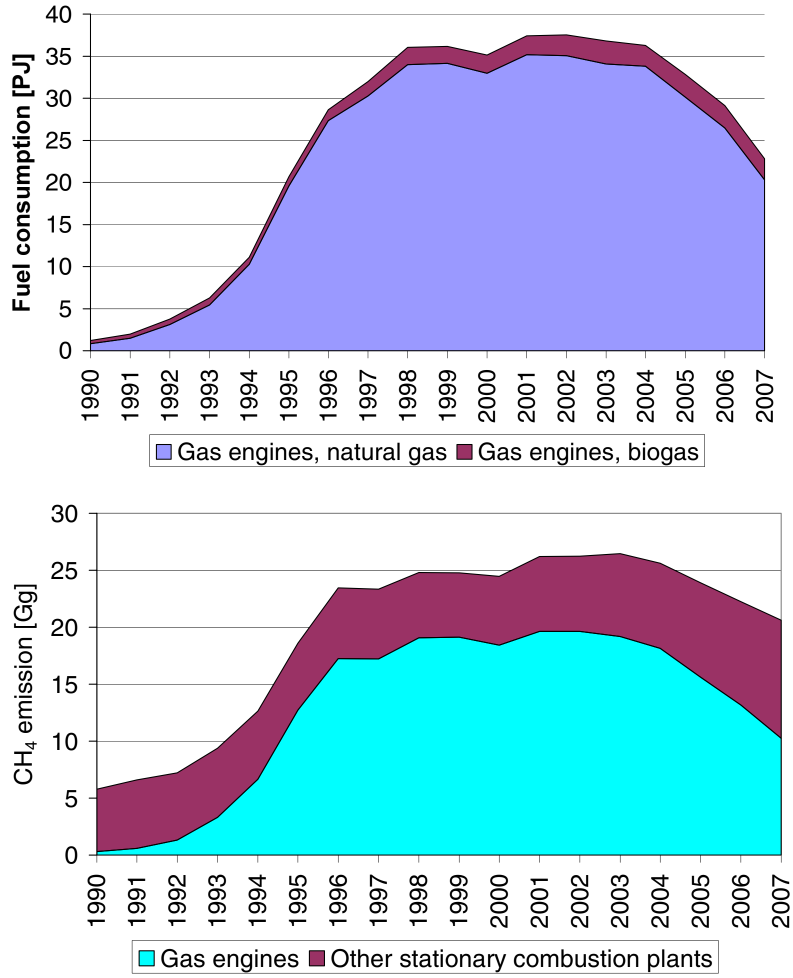


Figure 3.12 Fuel consumption and CH_4 emission from gas engines, time-series.

N_2O

The N_2O emission from stationary combustion plants accounts for 4 % of the national N_2O emission. Table 3.8 lists the N_2O emission inventory for stationary combustion plants in the year 2007. Figure 3.13 reveals that *Electricity and heat production* accounts for 43 % of the N_2O emission from stationary combustion. This is lower than the fuel consumption share.

Table 3.8 N_2O emission from stationary combustion plants 2007[1)].

N_2O	2007	
1A1a Public electricity and heat production	387	Mg
1A1b Petroleum refining	34	Mg
1A1c Other energy industries	62	Mg
1A2 Industry	144	Mg
1A4a Commercial / Institutional	22	Mg
1A4b Residential	227	Mg
1A4c Agriculture / Forestry / Fisheries	20	Mg
Total	897	Mg

[1)]Only emission from stationary combustion plants in the sectors is included.

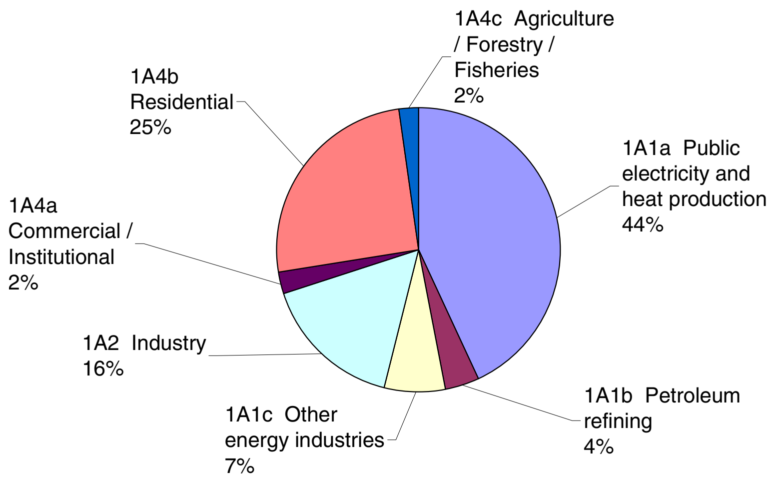


Figure 3.13 N_2O emission sources, stationary combustion plants, 2007.

Figure 3.14 shows the time-series for the N_2O emission. The N_2O emission from stationary combustion increased by 16 % from 1990 to 2007, but, again, fluctuations in emission level due to electricity import/export are considerable.

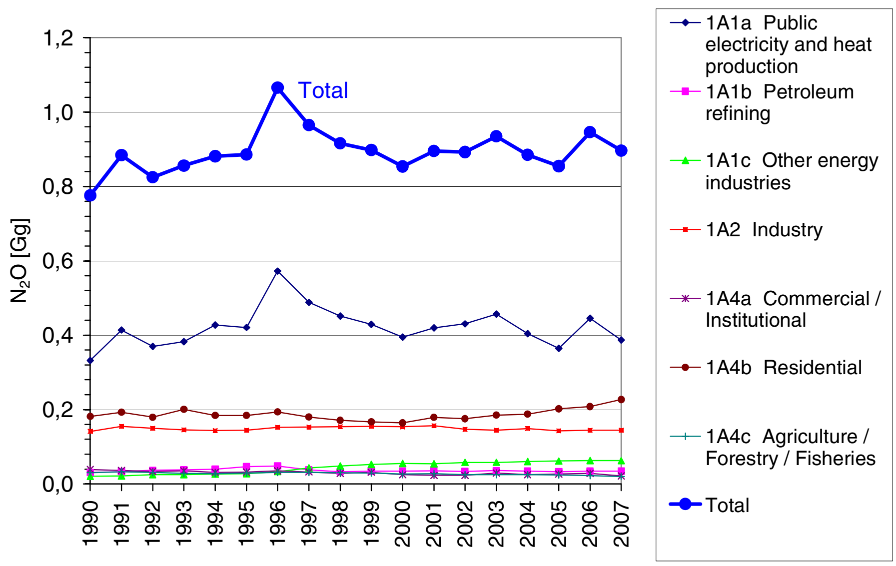


Figure 3.14 N_2O emission time-series for stationary combustion plants.

Detailed trend discussion on CRF category level is available in Annex 3A.

SO_2, NO_x, NMVOC and CO

The emissions of SO_2, NO_x, NMVOC and CO from Danish stationary combustion plants 2007 are presented in Table 3.9. Further details are shown in Annex 3A. SO_2 from stationary combustion plants accounts for 88 % of the national SO_2 emission. NO_x, CO and NMVOC account for 37 %, 38 % and 25 %, respectively, of the national emissions for these substances.

Table 3.9 SO_2, NO_x, NMVOC and CO emission from stationary combustion plants 2007.

Pollutant	NO_x	CO	NMVOC	SO_2
	Gg	Gg	Gg	Gg
1A1 Fuel consumption, Energy industries	42.5	9.3	2.7	9.1
Fuel consumption, Manufacturing Industries and Construction (Stationary combustion)	11.1	13.6	0.6	7.2
1A4 Fuel consumption, Other sectors (Stationary combustion)	8.5	147.6	23.1	4.4
Emission from stationary combustion plants	62.1	170.5	26.4	20.6
National emission	166.7	448.1	104.4	23.3
		%		
Emission share for stationary combustion	37	38	25	88

Only emissions from stationary combustion plants in the sectors are included.

3.2.2 Methodological issues

The Danish emission inventory is based on the CORINAIR (CORe INventory on AIR emissions) system, which is a European program for air emission inventories. CORINAIR includes methodology structure and software for inventories. The methodology is described in the EEA Emission Inventory Guidebook 3rd edition 2007 update, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections (EEA 2007). Emission data are stored in an Access database, from which data are transferred to the reporting formats.

The emission inventory for stationary combustion is based on activity rates from the Danish energy statistics. General emission factors for various fuels, plants and sectors have been determined. Some large plants, such as power plants, are registered individually as large point sources and plant-specific emission data are used.

Large point sources

Large emission sources such as power plants, industrial plants and refineries are included as large point sources in the Danish emission database. Each point source may consist of more than one part, e.g. a power plant with several units. By registering the plants as point sources in the database, it is possible to use plant-specific emission factors.

In the inventory for the year 2007, 71 stationary combustion plants are specified as large point sources. These point sources include:

- Power plants and decentralised CHP plants (combined heat and power plants)

- Municipal waste incineration plants
- Large industrial combustion plants
- Petroleum refining plants

The criteria for selection of point sources consist of the following:

- All centralised power plants, including smaller units.
- All units with a capacity above 25 MW_e.
- All district heating plants with an installed effect of 50 MW or above and a significant fuel consumption.
- All waste incineration plants included in the Danish law with regard to the preparation of "green accounts" "*Bekendtgørelse om visse listevirksomheders pligt til at udarbejde grønt regnskab*".
- Industrial plants,
  - with an installed effect of 50 MW or above and significant fuel consumption.
  - with a significant process-related emission.

The fuel consumption of stationary combustion plants registered as large point sources is 333 PJ (2007). This corresponds to 60 % of the overall fuel consumption for stationary combustion.

Further details regarding the large point sources are provided in Annex 3A. The number of large point sources registered in the databases increased from 1990 to 2007.

The emissions from a point source are based either on plant-specific emission data or, if plant specific data are not available, on fuel consumption data and the general Danish emission factors.

CO_2 emissions from some plants are available through the EU emission trading scheme (ETS). SO_2 and NO_x emissions from large point sources are often plant-specific, based on emission measurements. Emissions of CO and NMVOC are also plant-specific for some plants. Plant-specific emission data are obtained from:

- Annual environmental reports.
- Annual plant-specific reporting of SO_2 and NO_x from power plants >25MW_e prepared for the Danish Energy Authority due to Danish legislatory requirements.
- Emission data reported by DONG Energy and Vattenfall, the two major electricity suppliers.
- Emission data reported from industrial plants.
- CO_2 emission data reported by plants under the EU ETS.

Annual environmental reports for the plants include a considerable number of emission datasets. Emission data from annual environmental reports are, in general, based on emission measurements, but some emissions have potentially been calculated from general emission factors.

If plant-specific emission factors are not available, general area source emission factors are used.

Area sources

Fuels not combusted in large point sources are included as sector-specific area sources in the emission database. Plants such as residential boilers, small district heating plants, small CHP plants and some industrial boilers are defined as area sources. Emissions from area sources are based on fuel consumption data and emission factors. Further information on emission factors is provided below.

Activity rates, fuel consumption

The fuel consumption rates are based on the official Danish energy statistics prepared by the Danish Energy Authority (DEA). The DEA aggregates fuel consumption rates to SNAP sector categories (DEA 2008a). The link between the official energy statistics and the SNAP nomenclature as well as a description of the national energy statistics is included in Annex 3A. Some fuel types in the official Danish energy statistics are added to obtain a less detailed fuel aggregation level, see Annex 3A. The calorific values on which the energy statistics are based are also included in the annex.

A small consumption of town gas is included as part of the fuel category natural gas. This is further discussed in Annex 3A.

The fuel consumption of the IPCC sector *1A2 Manufacturing industries and construction* (corresponding to SNAP sector *03 Combustion in manufacturing industries)* is not disaggregated into specific industries in the NERI emission database. Disaggregation into specific industries is estimated for the reporting to the Climate Convention. The disaggregation of fuel consumption and emissions from the industrial sector are discussed in a later chapter.

Both traded and non-traded fuels are included in the Danish energy statistics. Thus, for example, estimation of the annual consumption of non-traded wood is included.

Petroleum coke purchased abroad and combusted in Danish residential plants (border trade of 628 TJ) is added to the apparent consumption of petroleum coke and the emissions are included in the inventory.

The DEA compiles a database for the fuel consumption of each district heating and power-producing plant based on data reported by plant operators. The fuel consumption of large point sources specified in the Danish emission database refers to the DEA database (DEA 2008c).

The fuel consumption of area sources is calculated as total fuel consumption minus fuel consumption of large point sources.

Emissions from non-energy use of fuels are included in other sectors of the Danish inventory (*2. Industrial Processes* and *3. Solvents*). The non-energy use of fuels is included in the reference approach for Climate Convention reporting. The Danish energy statistics include three fuels used for non-energy purposes: bitumen, white spirit and lube oil. The fuels used for non-energy purposes add up to about 2 % of the total fuel consumption in stationary combustion plants in Denmark. See annex 3A for more on non-energy use of fuels.

In Denmark, all municipal waste incineration is utilised for heat and power production. Thus, incineration of waste is included as stationary combustion in the IPCC Energy sector (source categories *1A1*, *1A2* and *1A4*).

Fuel consumption data is presented in Chapter 3.2.1.

Emission factors

For each fuel and SNAP category (sector and e.g. type of plant) a set of general area source emission factors has been determined. The emission factors are either nationally referenced or based on the international guidebooks: EEA Guidebook (EEA 2007) and IPCC Reference Manual (IPCC 1997).

A complete list of emission factors, including time-series and references, is shown in Annex 3A.

CO_2, use of EU ETS data

The use of EU ETS data started in the 2008 submission, this is therefore the second year where the inventory includes EU ETS data. NERI performs QA/QC checks on the emission reports made by the plants.

The rules for measuring, reporting and verifying are established by an EU Commission decision (EU Commission, 2004). For more information regarding the specifics of the EU ETS please refer to the Commission webpage:
http://ec.europa.eu/environment/climat/emission/implementation_en.htm

The Danish emission inventory only includes data from plants using higher tier methods as defined in the EU decision, where the specific methods for determining carbon contents, oxidation factor and calorific value are specified.

The 14 coal fired plants where plant specific information is used accounts for roughly 85 % of the Danish coal consumption and 34 % of the total CO_2 emission from stationary combustion plants. The average CO_2 emission factor for coal for these 14 plants was 94.1 kg pr GJ (Table 3.10).

Table 3.10 Data from reports for 14 coal fired power plants made under the EU ETS.

	Heating value, GJ pr tonne	Oxidation factor	CO_2 implied emission factor, kg pr GJ
Minimum value	23.8	0.97	93.2
Maximum value	24.9	0.998	95.1
Average	24.3	0.99	94.1

Regarding the historic time-series the emission factor were held constant from 1990 to 2005, due to lack of better information. During the UNFCCC review the Expert Review Team suggested using the heating values provided by the DEA in the formula provided in the 1996 IPCC Guidelines p. 1.25. However, the Guidelines specify that the gross heating value should be between 31 and 37 TJ pr ktonnefor the formula to be valid, this is not the case for electricity plant coal used in Denmark. Using the formula anyway leads to CO_2 emission factors in the range of 93.3 to 94.6 kg pr GJ. It is not believed that this improves the accuracy of the inventory, therefore no changes are made to the CO_2 emission factor for coal from 1990 to 2005.

Data for residual oil and gas oil is also available through EU ETS. For residual oil information from 17 units is available, for gas oil only two plants provide detailed data. See the tables below.

Table 3.11 Data from reports for 17 residual oil fired power plants made under the EU ETS.

	Heating value, GJ pr tonne	Oxidation factor	CO_2 implied emission factor, kg pr GJ
Minimum value	40.2	0.995	76.4
Maximum value	41.9	0.995	79.5
Average	40.8	0.995	78.3

Table 3.12 Data from reports for two gas oil fired power plants made under the EU ETS.

	Heating value, GJ pr tonne	Oxidation factor	CO_2 implied emission factor, kg pr GJ
Minimum value	42.5	0.995	74.0
Maximum value	42.7	0.995	75.7
Average	42.6	0.995	74.9

Plant specific CO_2 emission factors for fuel consumption data have also been applied for cement production which is part of sector 1A2f Industry. These data also refer to EU ETS. The applied fuels are: Coal, residual oil, petroleum coke and waste (biomass and fossil). This is further discussed in the industry chapter of the National Inventory Report 2009 (Nielsen et al., 2009). The emission is however included as part of stationary combustion.

CO_2, other emission factors

The CO_2 emission factors applied for 2007 are presented in Table 3.13. For municipal waste and natural gas, time-series have been estimated. For all other fuels the same emission factor is applied for 1990-2007.

CO_2 emission data reported under the EU ETS (KEMIN, 2008), has not given reason to change the CO_2 emission factors applied for other plants. These CO_2 emission factors have been confirmed by the two major power plant operators, both directly (Christiansen, 1996; Andersen, 1996) and indirectly, by the large power plants' applying the NERI emission factors in their annual environmental reports and by the acceptance of the NERI factors in Danish legislation.

In reporting to the Climate Convention, the CO_2 emission is aggregated to five fuel types: Solid fuel, Liquid fuel, Gas, Biomass and Other fuels. The correspondence list between the NERI fuel categories and the IPCC fuel categories is also provided in Table 3.13. The emission factors are further discussed in Annex 3A.

The CO_2 emission from incineration of municipal waste (94.5 + 17.6 kg pr GJ) is divided into two parts: the emission from combustion of the plastic content of the waste (which is included in the national total) and the emission from combustion of the rest of the waste – the biomass part (which is reported as a memo item). In the IPCC reporting, the CO_2 emission from combustion of the plastic content of the waste is reported in the fuel category, *Other fuels*. However, this split is not applied in either fuel consumption or other emissions, as it is only relevant for CO_2. Thus, the full consumption of municipal waste is included in the fuel category, *Biomass,* and the full amount of non-CO_2 emissions from municipal waste combustion is also included in the *Biomass*-category.

Table 3.13 CO_2 emission factors 2007.

Fuel	Emission factor Biomass	Fossil fuel	Unit	Reference type	IPCC fuel Category
Coal		95*	kg pr GJ	Country specific	Solid
Brown coal briquettes		94.6	kg pr GJ	IPCC reference manuall	Solid
Coke oven coke		108	kg pr GJ	IPCC reference manuall	Solid
Petroleum coke		92	kg pr GJ	Country specific	Liquid
Wood	102		kg pr GJ	Corinair	Biomass
Municipal waste	94.5	17.6	kg pr GJ	Country specific	Biomass/Other fuels
Straw	102		kg pr GJ	Country specific	Biomass
Residual oil		78*	kg pr GJ	Corinair	Liquid
Gas oil		74*	kg pr GJ	Corinair	Liquid
Kerosene		72	kg pr GJ	Corinair	Liquid
Fish & rape oil	74		kg pr GJ	Country specific	Biomass
Orimulsion		80	kg pr GJ	Country specific	Liquid
Natural gas		56.78	kg pr GJ	Country specific	Gas
LPG		65	kg pr GJ	Corinair	Liquid
Refinery gas		56.9	kg pr GJ	Country specific	Liquid
Biogas	83.6		kg pr GJ	Country specific	Biomass

*Data from EU ETS incorporated for individual plants

CH_4

The CH_4 emission factors applied for 2007 are presented in Table 3.14. In general, the same emission factors have been applied for 1990-2007. However, time-series have been estimated for both natural gas fuelled engines and biogas fuelled engines. The emission factors and references are further discussed in Annex 3A.

Emission factors for gas engines, gas turbines and CHP plants combusting wood, straw or municipal waste all refer to emission measurements carried out on Danish plants (Nielsen & Illerup, 2003). For natural gas fired gas engines the emission factor refers to an updated study (Nielsen et al., 2008). Most other emission factors refer to the EMEP/CORINAIR Guidebook (EEA, 2004).

Gas engines, combusting natural gas or biogas account for approximately half of the CH_4 emission from stationary combustion plants. The relatively high emission factor for gas engines is well documented, based on a very high number of emission measurements in Danish plants. The factor is further discussed in Annex 3A. Due to the considerable consumption of natural gas and biogas in gas engines, the implied emission factor (IEF) in CRF sector *1A1*, *1A2* and *1A4*, fuel categories *Gaseous fuels* and *Biomass* is relatively high. The considerable change in the IEF is a result of the increasing consumption of natural gas and biogas in gas engines as discussed in earlier.

Table 3.14 CH_4 emission factors 2007.

Fuel group	Fuel	CRF sector	CRF sector	SNAP	Emission factor g pr GJ	Reference
BIOMASS	WOOD	1A1a	Electricity and heat production	010102, 010103, 010104	2	Nielsen & Illerup 2003
				010202, 010203	32	EEA 2004
		1A2	Industry	030100, 030102, 030103	32	EEA 2004
		1A4a	Commercial/Institutional	020100, 020105	200	EEA 2004
		1A4b i	Residential	020200	200	EEA 2004
		1A4c i	Agriculture/Forestry	020300	200	EEA 2004
	STRAW	1A1a	Electricity and heat production	010101, 010102, 010103, 010104	0,5	Nielsen & Illerup 2003
				010202, 010203	32	EEA 2004
		1A4b i	Residential	020200	200	EEA 2004
		1A4c i	Agriculture/Forestry	020300	200	EEA 2004
				020302	32	EEA 2004
	FISH & RAPE OIL	1A1a	Electricity and heat production	010101, 010102, 010103, 010202, 010203	1.5	EEA 2004, assuming same emission factor as for gas oil
		1A2	Industry	030105	1.5	EEA 2004, assuming same emission factor as for gas oil
		1A4a	Commercial/Institutional	020105	1.5	EEA 2004, assuming same emission factor as for gas oil
	BIOGAS	1A1a	Electricity and heat production	010102, 010103, 010203	4	EEA 2004
				010105, 010205	323	Nielsen & Illerup 2003
		1A1c	Other energy industries	010505	323	Nielsen & Illerup 2003
		1A2	Industry	030100, 030102	4	EEA 2004
				030105	323	Nielsen & Illerup 2003
		1A4a	Commercial/Institutional	020100, 020103	4	EEA 2004
				020105	323	Nielsen & Illerup 2003
		1A4c i	Agriculture/Forestry	020300	4	EEA 2004
				020304	323	Nielsen & Illerup 2003
OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010102, 010103	0.59	Nielsen & Illerup 2003
				010203	6	EEA 2004
		1A4a	Commercial/Institutional	020103	6	EEA 2004
GAS	NATURAL GAS	1A1a	Electricity and heat production	010100, 010101, 010102, 010202	6	DGC 2001
				010103, 010203	15	Gruijthuijsen & Jensen 2000
				010104 (Gas turbines)	1.5	Nielsen & Illerup 2003
				010105, 010205 (Gas engines)	465	Nielsen et al. 2008
		1A1c	Other energy industries	010504 (Gas turbines)	1.5	Nielsen & Illerup 2003
				010505 (Gas engines)	465	Nielsen et al. 2008
		1A2	Industry	030100	6	DGC 2001
				030103	15	Gruijthuijsen & Jensen 2000
				030104 (Gas turbines)	1.5	Nielsen & Illerup 2003
				030105 (Gas engines)	465	Nielsen et al. 2008
		1A4a	Commercial/Institutional	020100	6	DGC 2001
				020103	15	Gruijthuijsen & Jensen 2000
				020104 (Gas turbines)	1.5	Nielsen & Illerup 2003
				020105 (Gas engines)	465	Nielsen et al. 2008
		1A4b i	Residential	020200	6	DGC 2001
				020202	15	Gruijthuijsen & Jensen 2000
				020204 (Gas engines)	465	Nielsen et al. 2008
		1A4c i	Agriculture/Forestry	020300	6	DGC 2001
				020303 (Gas turbines)	1.5	Nielsen & Illerup 2003
				020304 (Gas engines)	465	Nielsen et al. 2008
LIQUID	PETROLEUM COKE	1A4a	Commercial/Institutional	020100	15	EEA 2004
		1A4b i	Residential	020200	15	EEA 2004
	RESIDUAL OIL	1A1a	Electricity and heat production	010101, 010102, 010104, 010202, 010203	3	EEA 2004

Fuel group	Fuel	CRF sector	CRF sector	SNAP	Emission factor g pr GJ	Reference
Continued						
		1A1b	Petroleum refining	010306	3	EEA 2004
		1A2	Industry	030100, 030102	3	EEA 2004
		1A4a	Commercial/Institutional	020100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004
		1A4c i	Agriculture/Forestry	020300, 020302	3	EEA 2004
	GAS OIL	1A1a	Electricity and heat production	010101, 010102, 010103, 010104, 010105, 010201, 010202, 010203, 010204, 010205	1.5	EEA 2004
		1A1b	Petroleum refining	010306	1.5	EEA 2004
		1A1c	Other energy industries	010505	1.5	EEA 2004
		1A2	Industry	030100, 030102, 030104	1.5	EEA 2004
		1A4a	Commercial/Institutional	020100, 020103, 020105	1.5	EEA 2004
		1A4b i	Residential	020200	1.5	EEA 2004
		1A4c i	Agriculture/Forestry	020304	1.5	EEA 2004
	KEROSENE	1A2	Industry	030100	7	EEA 2004
		1A4a	Commercial/Institutional	020100	7	EEA 2004
		1A4b i	Residential	020200	7	EEA 2004
		1A4c i	Agriculture/Forestry	020300	7	EEA 2004
	LPG	1A2	Industry	030100	1	EEA 2004
		1A4a	Commercial/Institutional	020100, 020105	1	EEA 2004
		1A4b i	Residential	020200	1	EEA 2004
		1A4c i	Agriculture/Forestry	020300	1	EEA 2004
	REFINERY GAS	1A1b	Petroleum refining	010304, 010306	1.5	EEA 2004
SOLID	COAL	1A1a	Electricity and heat production	010101, 010102	1.5	EEA 2004
				010202	15	EEA 2004
		1A2	Industry	030100	15	EEA 2004
		1A4b i	Residential	020200	15	EEA 2004
		1A4c i	Agriculture/Forestry	020300	15	EEA 2004
	COKE OVEN COKE	1A2	Industry	030100	15	EEA 2004, assuming same emission factor as for coal
		1A4b i	Residential	020200	15	EEA 2004, assuming same emission factor as for coal

[1)]2007 emission factor. Time-series is shown in Annex 3A.

N_2O

The N_2O emission factors applied for the 2007 inventory are listed in Table 3.15. The same emission factors have been applied in the period 1990-2007.

Emission factors for gas engines, gas turbines and CHP plants combusting wood, straw or municipal waste all refer to emission measurements carried out in Danish plants (Nielsen & Illerup, 2003). Emission factor for coal-powered plants in the public power sector refers to research conducted by Elsam[2]. Other emission factors refer to the EMEP/Corinair Guidebook (EEA, 2004).

[2] Now part of DONG Energy

Table 3.15 N_2O emission factors 2007.

Fuel group	Fuel	CRF sector	CRF sector	SNAP	Emission factor g pr GJ	Reference
BIOMASS	WOOD	1A1a	Electricity and heat production	010102, 010103, 010104 010202, 010203	0.8 4	Nielsen & Illerup 2003 EEA 2004
		1A2	Industry	all	4	EEA 2004
		1A4a	Commercial/Institutional	all	4	EEA 2004
		1A4b i	Residential	020200	4	EEA 2004
		1A4c i	Agriculture/Forestry	020300	4	EEA 2004
	STRAW	1A1a	Electricity and heat production	010101, 010102, 010103, 010104 010202, 010203	1.4 4	Nielsen & Illerup 2003 EEA 2004
		1A4b i	Residential	020200	4	EEA 2004
		1A4c i	Agriculture/Forestry	all	4	EEA 2004
	FISH & RAPE OIL	1A1a	Electricity and heat production	all	2	EEA 2004, assuming same emission factor as gas oil
		1A2	Industry	030105	2	EEA 2004, assuming same emission factor as gas oil
		1A4a	Commercial/ Institutional	020105	2	EEA 2004, assuming same emission factor as gas oil
	BIOGAS	1A1a	Electricity and heat production	010102, 010103, 010203 010105, 010205 (Gas engines)	2 0.5	EEA 2004 Nielsen & Illerup 2003
		1A1c	Other energy industries	010505 (Gas engines)	0.5	Nielsen & Illerup 2003
		1A2	Industry	030100, 030102 030105 (Gas engines)	2 0.5	EEA 2004 Nielsen & Illerup 2003
		1A4a	Commercial/ Institutional	020100, 020103 020105 (Gas engines)	2 0.5	EEA 2004 Nielsen & Illerup 2003
		1A4c i	Agriculture/ Forestry	020300 020304 (Gas engines)	2 0.5	EEA 2004 Nielsen & Illerup 2003
OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010102, 010103 010203	1.2 4	Nielsen & Illerup 2003 EEA 2004
		1A4a	Commercial/ Institutional	020103	4	EEA 2004
GAS	NATURAL GAS	1A1a	Electricity and heat production	010100, 010101, 010102, 010103, 010202, 010203 010104 (Gas turbines) 010105, 010205 (Gas engines)	1 2.2 1.3	EEA 2004 Nielsen & Illerup 2003 Nielsen et al. 2008
		1A1c	Other energy industries	010504 (Gas turbines) 010505 (Gas engines)	2.2 1.3	Nielsen & Illerup 2003 Nielsen et al. 2008
		1A2	Industry	030100, 030103 030104 (Gas turbines) 030105 (Gas engines)	1 2.2 1.3	EEA 2004 Nielsen & Illerup 2003 Nielsen et al. 2008
		1A4a	Commercial/ Institutional	020100, 020103 020104 (Gas turbines) 020105 (Gas engines)	1 2.2 1.3	EEA 2004 Nielsen & Illerup 2003 Nielsen et al. 2008
		1A4b i	Residential	020200, 020202 020204 (Gas engines)	1 1.3	EEA 2004 Nielsen et al. 2008
		1A4c i	Agriculture/ Forestry	020300 020303 (Gas turbines) 020304 (Gas engines)	1 2.2 1.3	EEA 2004 Nielsen & Illerup 2003 Nielsen et al. 2008
LIQUID	PETROLEUM COKE	1A4a	Commercial/ Institutional	020100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004
	RESIDUAL OIL	1A1a	Electricity and heat production	all	2	EEA 2004
		1A1b	Petroleum refining	010306	2	EEA 2004
		1A2	Industry	all	2	EEA 2004
		1A4a	Commercial/ Institutional	020100	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/ Forestry	all	2	EEA 2004
	GAS OIL	1A1a	Electricity and heat production	all	2	EEA 2004
		1A1b	Petroleum refining	010306	2	EEA 2004
		1A1c	Other energy industries	010505	2	EEA 2004

Continued

Fuel group	Fuel	CRF sector	CRF sector	SNAP	Emission factor g pr GJ	Reference
		1A2	Industry	all	2	EEA 2004
		1A4a	Commercial/ Institutional	all	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/ Forestry	020304	2	EEA 2004
	KEROSENE	1A2	Industry	030100	2	EEA 2004
		1A4a	Commercial/ Institutional	020100	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/ Forestry	020300	2	EEA 2004
	LPG	1A2	Industry	030100	2	EEA 2004
		1A4a	Commercial/ Institutional	all	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/ Forestry	020300	2	EEA 2004
	REFINERY GAS	1A1b	Petroleum refining	010304, 010306	2.2	Nielsen & Illerup 2003, assuming same emission factor as for natural gas
SOLID	COAL	1A1a	Electricity and heat production	010101, 010102	0.8	Elsam 2005
				010202	3	EEA 2004
		1A2	Industry	030100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004
		1A4c i	Agriculture/ Forestry	020300	3	EEA 2004
	COKE OVEN COKE	1A2	Industry	030100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004

SO_2, NO_x, NMVOC and CO

Emission factors for SO_2, NO_x, NMVOC and CO including time-series and references are listed in Annex 3A.

The emission factors refer to:

- The EMEP/CORINAIR Guidebook (EEA, 2004; EEA, 2007).
- The IPCC Guidelines, Reference Manual (IPCC, 1997).
- Danish legislation:
  - Miljøstyrelsen 2001 (Danish Environmental Protection Agency).
  - Miljøstyrelsen 1990 (Danish Environmental Protection Agency).
  - Miljøstyrelsen 1998 (Danish Environmental Protection Agency).
- Danish research reports including:
  - An emission measurement program for decentralised CHP plants (Nielsen & Illerup, 2003).
  - Measurement program for natural gas powered gas engines (Nielsen et al., 2008).
  - Research and emission measurements programs for biomass fuels:
    - Nikolaisen et al. (1998).
    - Jensen & Nielsen (1990).
    - Serup et al. (1999).
  - Research and environmental data from the gas sector:
    - Gruijthuijsen & Jensen (2000).
    - Danish Gas Technology Centre (2001).
- Calculations based on plant-specific emissions from a considerable number of power plants (Nielsen, 2003).
- Calculations based on plant-specific emission data from a considerable number of municipal waste incineration plants. These data refer to annual environmental reports published by plant operators.
- Sulphur content data from oil companies and the Danish gas transmission company.
- Additional personal communication.

Emission factor time-series have been estimated for a considerable number of the emission factors. These are provided in Annex 3A.

SO_2 and NO_x emissions from large point sources are often plant specific based on emission measurements. Emissions of CO and NMVOC are also plant specific for some plants.

Disaggregation to specific industrial subsectors

The national statistics on which the emission inventories are based do not include a direct disaggregation to specific industrial subsectors. However, separate national statistics from Statistics Denmark include a disaggregation to industrial subsectors. This part of the energy statistics is also included in the official energy statistics from the Danish Energy Authority.

Every other year, Statistics Denmark collects fuel consumption data for all industrial companies of a considerable size. The deviation between the total fuel consumption from the Danish Energy Authority and the data collected by Statistics Denmark is rather small. Thus, the disaggregation to industrial subsectors available from Statistics Denmark can be applied for estimating disaggregation keys for fuel consumption and emissions.

Three aspects of industrial fuel consumption are considered:

- Fuel consumption for transport. This part of the fuel consumption is not disaggregated to subsectors.
- Fuel consumption in power or district heating plants. Disaggregation of fuel and emissions is plant specific.
- Fuel consumption for other purposes. The total fuel consumption and the total emissions are disaggregated to subsectors.

All pollutants included in the Climate Convention reporting have been disaggregated to industrial subsectors.

3.2.3 Uncertainties and time-series consistency

Time-series for fuel consumption and emissions are shown and discussed in previous chapters.

Uncertainty estimates include uncertainty with regard to the total emission inventory as well as uncertainty with regard to trends. The GHG emission from stationary combustion plants has been estimated with an uncertainty interval of ±8.5 % and the decrease in the GHG emission since 1990 has been estimated to be 8.5 % ± 2.1 %-age-points.

Methodology

Greenhouse gases

The Danish uncertainty estimates for GHGs are based on the Tier-1 approach in IPCC Good Practice Guidance (IPCC, 2000). The uncertainty levels have been estimated for the following emission source subcategories within stationary combustion:

- CO_2 emission from each of the applied fuel categories.
- CH_4 emission from gas engines.

- CH_4 emission from all other stationary combustion plants.
- N_2O emission from all stationary combustion plants.

The separate uncertainty estimation for gas engine CH_4 emission and CH_4 emission from other plants does not follow the recommendations in the IPCC Good Practice Guidance (IPCC 2000). Disaggregation is applied, because, in Denmark, the CH_4 emission from gas engines is much larger than the emission from other stationary combustion plants and the CH_4 emission factor for gas engines is estimated with a much smaller uncertainty level than for other stationary combustion plants.

Most of the applied uncertainty estimates for activity rates and emission factors are default values from the IPCC Good Practice Guidelines (IPCC, 2000). A few of the uncertainty estimates are, however, based on national estimates.

Table 3.16 Uncertainty rates for activity rates and emission factors.

IPCC Source category	Gas	Activity data uncertainty %	Emission factor uncertainty %
Stationary Combustion, Coal	CO_2	1 [1)]	5 [3)]
Stationary Combustion, BKB	CO_2	3 [1)]	5 [1)]
Stationary Combustion, Coke oven coke	CO_2	3 [1)]	5 [1)]
Stationary Combustion, Petroleum coke	CO_2	3 [1)]	5 [1)]
Stationary Combustion, Plastic waste	CO_2	5 [4)]	5 [4)]
Stationary Combustion, Residual oil	CO_2	2 [1)]	2 [3)]
Stationary Combustion, Gas oil	CO_2	4 [1)]	5 [1)]
Stationary Combustion, Kerosene	CO_2	4 [1)]	5 [1)]
Stationary Combustion, Orimulsion	CO_2	1 [1)]	2 [3)]
Stationary Combustion, Natural gas	CO_2	3 [1)]	1 [3)]
Stationary Combustion, LPG	CO_2	4 [1)]	5 [1)]
Stationary Combustion, Refinery gas	CO_2	3 [1)]	5 [1)]
Stationary combustion plants, gas engines	CH_4	2.2 [1)]	40 [2)]
Stationary combustion plants, other	CH_4	2.2 [1)]	100 [1)]
Stationary combustion plants	N_2O	2.2 [1)]	1000 [1)]

[1)] IPCC Good Practice Guidance (default value).
[2)] Kristensen (2001).
[3)] Jensen & Lindroth (2002).
[4)] NERI assumption.

Other pollutants

With regard to other pollutants, IPCC methodologies for uncertainty estimates have been adopted for the LRTAP Convention reporting activities (Pulles & Aardenne, 2001). The Danish uncertainty estimates are based on the simple Tier-1 approach.

The uncertainty estimates are based on emission data and uncertainties for each of the main SNAP sectors. The assumed uncertainties for activity rates and emission factors are based on default values from Pulles & Aardenne 2001. The default uncertainties for emission factors are given in letter codes representing an uncertainty range. It has been assumed that the uncertainties were in the lower end of the range for all sources and pollutants. The uncertainties for emission factors are shown in Table 3.17. The uncertainty for fuel consumption in stationary combustion plants was assumed to be 2 %.

Table 3.17 Uncertainty rates for emission factors (%).

SNAP sector	SO_2	NO_x	NMVOC	CO
01	10	20	50	20
02	20	50	50	50
03	10	20	50	20

Results

The uncertainty estimates for stationary combustion emission inventories are shown in Table 3.18. Detailed calculation sheets are provided in Annex 3A.

The uncertainty interval for GHG is estimated to be ±8.5 % and the trend in GHG emission is -8.5 %±2.1 %-age points. The main sources of uncertainty for GHG emission are the N_2O emission (all plants) and the CO_2 emission from coal combustion. The main source of uncertainty in the trend in GHG emission is N_2O emission (all plants), the CO_2 emission from combustion of coal and the CO_2 emission from combustion of natural gas.

The total emission uncertainty is 7.1 % for SO_2, 16 % for NO_x, 44 % for NMVOC and 43 % for CO.

Table 3.18 Danish uncertainty estimates, 2007.

Pollutant	Uncertainty Total emission, %	Trend 1990-2007, %	Uncertainty Trend, %-age points
GHG	±8.5	-8.5	±2.1
CO_2	±2.9	-9.6	±1.5
CH_4	±54	256	±169
N_2O	±1000	15.2	±3.6
SO_2	±7.1	-87	±0.7
NO_x	±16	-46	±3
NMVOC	±44	109	±6
CO	±43	22	±4

3.2.4 Source specific QA/QC and verification

The elaboration of a formal QA/QC plan started in 2004. A first version is available (Sørensen et al., 2005).

The quality manual describes the concepts of quality work and definitions of sufficient quality, critical control points and a list of Points for Measuring (PMs). Please see the general chapter on QA/QC.

The QC work will continue in future years.

Data storage level 1

Table 3.19 List of external data sources for stationary combustion.

Dataset	Description	AD or Emf.	Reference	Contact(s)	Data agreement/Comment
Energiproducenttællingen	Dataset for all electricity and heat producing plants.	Activity data	The Danish Energy Authority (DEA)	Peter Dal	Data agreement in place
Gas consumption for gas engines and gas turbines 1990-1994		Activity data	DEA	Peter Dal	No data agreement. Historical data
Basic data (Grunddata.xls)	Dataset used for IPCC reference approach	Activity data	DEA	Peter Dal	Not necessary. Published as part of national energy statistics
Energy statistics	The Danish energy statistics on SNAP level	Activity data	DEA	Peter Dal	Data agreement in place
SO_2 & NO_x data, plants>25 MW_e		Emissions	DEA	Marianne Nielsen	No data agreement in place
Emission factors	Emission factors stems from a large number of sources	Emission factors	See chapter regarding emission factors		
HM and PM from public power plants	Emissions from the two large power plant operators in DK: Dong Energy and Vattenfall	Emissions	Dong Energy Vattenfall	Marina Snowman Møller Heidi Demant	No formal data agreement in place
Environmental reports	Emissions from plants defined as large point sources	Emissions	Various plants		No data agreement necessary. Plants are under obligation by law.
Additional data	Fuel consumption and emissions from large industrial plants	AD & emissions	Aalborg Portland Statoil Shell	Henrik M. Thomsen Peder Nielsen Lis R. Rasmussen	No formal data agreement in place

Data Storage level 1	1. Accuracy	DS.1.1.1	General level of uncertainty for every dataset including the reasoning for the specific values

Since the DEA are responsible for the official Danish energy statistics as well as reporting to the IEA, NERI regards the data as being complete and in accordance with the official Danish energy statistics and IEA reporting. The uncertainties connected with estimating fuel consumption do not, therefore, influence the accordance between IEA data, the energy statistics and the dataset on SNAP level utilised by NERI. For the remainder of the datasets, it is assumed that the level of uncertainty is relatively small. See chapter regarding uncertainties for further comments.

Data Storage level 1	1. Accuracy	DS.1.1.2	Quantification of the uncertainty level of every single data value, including the reasoning behind the specific values.

The uncertainty for external data is not quantified. The uncertainties of activity data and emission factors are quantified.

Data Storage level 1	2.Comparability	DS.1.2.1	Comparability of the data values with similar data from other countries, which are comparable with Denmark, and evaluation of discrepancy.

On the external data, the comparability has not been checked. However, at CRF level, a project has been carried out comparing the Danish inventories with those of other countries.

Data Storage level 1	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included, by setting down the reasoning behind the selection of datasets

See the above table for an overview of external datasets.

Danish Energy Authority

Statistics on fuel consumption from district heating and power plants

This statistics takes the form of a spreadsheet from the DEA listing fuel consumption of all plants included as large point sources in the emission inventory. The statistics on fuel consumption from district heating and power plants are regarded as complete and with no significant uncertainty since the plants are bound by law to report their fuel consumption and other information.

Gas consumption for gas engines and gas turbines 1990-1994

For the years 1990-1994, the DEA has estimated consumption of natural gas and biogas in gas engines and gas turbines. NERI assesses that the estimation by the DEA is the best available data.

Basic data

These data takes the form of a spreadsheet from DEA used for the CO_2 emission calculation in accordance with the IPCC reference approach. It is published annually on the DEA's webpage; therefore, a formal data delivery agreement is not deemed necessary.

Energy statistics on SNAP level

The DEA reports fuel consumption statistics on the SNAP level based on a correspondence table developed in co-operation with NERI. Both traded and non-traded fuels are included in the Danish energy statistics. Thus, for example, estimation of the annual consumption of non-traded wood is included. Petroleum coke, purchased abroad and combusted in Danish residential plants (border trade), is added to the apparent consumption of petroleum coke and the emissions are included in the inventory.

Emissions from non-energy use of fuels have been included in other sectors of the Danish inventory. The non-energy use of fuels is, however, included in the reference approach for Climate Convention reporting.

SO_2 and NO_x emission data from electricity producing plants > 25MWe

Plants larger than 25 MW_e are obligated to report SO_2 and NO_x emission data to the DEA annually. Data are on block level and are classified. The data on plant level are part of the plants' annual environmental reports. NERI's QC of the data consists of a comparison with data from previous years and with data from the plants' annual environmental reports.

Emission factors from a wide range of sources

For specific references, see chapter regarding emission factors.

Annual environmental reports from plants defined as large point sources

A large number of plants are obligated by law to publish an environmental report annually with information on emissions, among other things. NERI compares data with those from previous years and large discrepancies are checked.

Supplementing data from large industrial combustion plants

Fuel consumption and emission data from a few large industrial combustion plants are obtained directly from the plants concerned. NERI compares data with those from previous years and large discrepancies are checked.

Data Storage level 1	4.Consistency	DS.1.4.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PMs)

It is ensured that all external data are archived at NERI. Subsequent data processing takes place in other spreadsheets or databases. The datasets are archived annually in order to ensure that the basic data for a given report are always available in their original form.

Data Storage level 1	6.Robustness	DS.1.6.1	Explicit agreements between the external institution holding the data and NERI about the condition of delivery

For stationary combustion, a data delivery agreement is made with the DEA. Most of the other external data sources are available due to legislative requirements. See Table 3.19.

Data Storage level 1	7.Transparency	DS.1.7.1	Summary of each dataset, including the reasoning behind selection of the specific dataset

See DS 1.3.1

Data Storage level 1	7.Transparency	DS.1.7.3	References for citation for any external dataset have to be available for any single number in any dataset.

See Table 3.19 for general references. Much documentation already exists. However, some of the information used is classified and, therefore, not publicly available.

Data Storage level 1	7.Transparency	DS.1.7.4	Listing of external contacts for every dataset

See Table 3.19

Data Processing Level 1

Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to type of variability (Distribution as: normal, log normal or other type of variability)

The uncertainty assessment of activity data and emission factors is discussed in the chapter concerning uncertainties.

Data Processing level 1	1. Accuracy	DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals)

The uncertainty assessment of activity data and emission factors is discussed in the chapter concerning uncertainties.

Data Processing level 1	1. Accuracy	DP.1.1.3	Evaluation of the methodological approach using international guidelines

The methodological approach is consistent with international guidelines.

Data Processing level 1	1. Accuracy	DP.1.1.4	Verification of calculation results using guideline values

Calculated emission factors are compared with guideline emission factors to ensure that they are reasonable.

Data Processing level 1	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCCC and IPCC.

The calculations follow the principle in international guidelines.

Data Processing level 1	3.Completeness	DP.1.3.1	Assessment of the most important quantitative knowledge which is lacking.

Regarding the distribution of energy consumption for industrial sources, a more detailed and frequently updated data material would be preferred. There is ongoing work to increase the accuracy and completeness of this sector. It is not assessed that this has any influence on the estimates for the emission of greenhouse gases.

Data Processing level 1	3.Completeness	DP.1.3.2	Assessment of the most important cases where access is lacking with regard to critical data sources that could improve quantitative knowledge.

There is no problem with regard to access to critical data sources.

Data Processing level 1	4.Consistency	DP.1.4.1	In order to keep consistency at a high level,, an explicit description of the activities needs to accompany any change in the calculation procedure

A change in calculating procedure would entail that an updated description would be elaborated.

Data Processing level 1	5.Correctness	DP.1.5.1	Demonstration at least once, by independent calculation, the correctness of every data manipulation

During data processing, it is checked that calculations are being carried out correctly, however, a documentation system for this needs to be elaborated.

Data Processing level 1	5.Correctness	DP.1.5.2	Verification of calculation results using time-series

A time-series for activity data on SNAP level, as well as emission factors, is used to identify possible errors in the calculation procedure.

Data Processing level 1	5.Correctness	DP.1.5.3	Verification of calculation results using other measures

The IPCC reference approach validates the fuel consumption rates and CO_2 emissions of fuel combustion. Fuel consumption rates and CO_2 emissions differ by less than 1.6 % (1990-2007). The reference approach is further discussed below.

Data Processing level 1	5.Correctness	DP.1.5.4	Shows one-to-one correctness between external data sources and the databases at Data Storage level 2

There is a direct line between the external datasets, the calculation process and the input data used to Data storage level 2. During the calculation process, numerous controls are in place to ensure correctness, e.g. sum checks of the various stages in the calculation procedure.

Data Processing level 1	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described.
Data Processing level 1	7.Transparency	DP.1.7.2	The theoretical reasoning for all methods must be described.
Data Processing level 1	7.Transparency	DP.1.7.3	Explicit listing of assumptions behind all methods.

Where appropriate this is included in the present report with annexes.

Data Processing level 1	7.Transparency	DP.1.7.4	Clear reference to dataset at Data Storage level 1

There is a clear line between external data and the data processing.

Data Processing level 1	7.Transparency	DP.1.7.5	A manual log to collect information about recalculations

At present a manual log table is not in place on this level, however this feature will be implemented in the future. A manual log table is incorporated in the national emission database, Data Storage level 2.

Data Storage level 2	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data types at level 2 to data at level 1

To ensure a correct connection between data on level 2 to data on level 1, different controls are in place, e.g. control of sums and random tests.

Data Storage level 2	5.Correctness	DS.2.5.2	Check if a correct data import to level 2 has been made.

Data import is checked by use of sum control and random testing. The same procedure is applied every year in order to minimise the risk of data import errors.

Other QC procedures

The emission from each large point source is compared with the emission reported the previous year.

Some automated checks have been prepared for the emission databases:

- Checking units for fuel rate, emission factor and plant-specific emissions
- Checking emission factors for large point sources. Emission factors for pollutants that are not plant-specific should be the same as those defined for area sources.
- Additional checks on database consistency
- Most emission factor references are now incorporated in the emission database, itself.
- Annual environmental reports are kept for subsequent control of plant-specific emission data.
- QC checks of the country-specific emission factors have not been performed, but most factors are based on work from companies that have implemented some QA/QC work. The major power plant owners/operators in Denmark, DONG Energy and Vattenfall both obtained the ISO 14001 certification for an environmental management system. Danish Gas Technology Centre and Force both run accredited laboratories for emission measurements.

Suggested QA/QC plan for stationary combustion

The following points make up the list of QA/QC tasks to be carried out directly in relation to the stationary combustion part of the Danish emission inventories. The time plan for the individual tasks has not yet been made.

Data storage level 1

- A fully comprehensive list of references for emission factors and activity data.
- A comparison with external data from other countries in order to evaluate discrepancies.

Data processing level 1

- Documentation list of model and independent calculations to test every single mathematical relation.

3.2.5 Source specific recalculations

Improvements and recalculations since the 2008 emission inventory submission include:

- Update of fuel rates according to the latest energy statistics. The update included the years 1980-2006. The most changes were for the years 2005 and 2006.

- Data from the ETS has been utilised for the second time in the 2009 inventory submission. It was mainly coal and residual oil fuelled power plants where detailed information was available. One of the reports for 2007 was judged by NERI to be incorrect, and therefore not incorporated in the 2007 inventory. Following this the 2006 report for the same plant, which was also an outlier, was removed from the inventory.
- Based on the centralised review in September 2008 several improvements have been made to the NIR.
  - An improved documentation for the use of town gas has been included in the NIR.
  - An improved documentation concerning emissions from non-energy use of fuels has been incorporated, see annex 3A.
  - The documentation for the use of EU ETS data has been improved, see annex 3A.
  - Improved documentation for QA/QC of plant specific emission factors. (In connection with EU ETS data)

3.2.6 Source specific planned improvements

Some planned improvements to the emission inventories are discussed below.

1) Improved documentation for emission factors
The reporting of, and references for, the applied emission factors have been improved in the current year and will be further developed in future inventories. This will on the advice of the ERT include further QA/QC checks on plant specific emission factors.

2) Uncertainty estimates
Uncertainty estimates are largely based on default uncertainty levels for activity rates and emission factors. More country-specific uncertainty estimates will be incorporated in future inventories.

3) Further use and documentation of EU ETS data
The use of data from the EU ETS will continue and hopefully be expanded as more companies will provide detailed information, which can be utilised in the emission inventory.

References for Chapter 3.2

Andersen, M.A. 1996: Elkraft, personal communication letter 07-05-1996.

Christiansen, M. 1996: Elsam, personal communication, letter 07-05-1996.

Christiansen, M. 2001: Elsam, personal communication, e-mail 23-08-2001 to Jytte Boll Illerup.

Danish Energy Authority (DEA), 2008a: The Danish energy statistics aggregated to SNAP sectors. Not published.

Danish Energy Authority (DEA), 2008b: The Danish energy statistics, Available at: http://www.ens.dk/graphics/UK_Facts_Figures/Statistics/yearly_statistics/2007/BasicData2007.xls (2009-02-27)

Danish Energy Authority (DEA), 2008c: The Danish energy statistics, Energiproducenttællingen 2007. Not published.

EU Commission, 2004: COMMISSION DECISION of 29 January 2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. Available at:
http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:059:0001:0074:EN:PDF. Official translation to Danish with comments available:
http://www.ens.dk/graphics/Energipolitik/dansk_energipolitik/CO2_kvoter/publ/Vejledning%20om%20CO2-kvoteordningen_dec08.pdf

European Environmental Agency (EEA), 2007: EMEP/CORINAIR Emission Inventory Guidebook 2007, Technical Report No 16/2007. Prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections, 2007 update. Available at:
http://www.eea.europa.eu/publications/EMEPCORINAIR5 (2009-02-27). Previous version of the Guidebook can be linked from this page.

Intergovernmental Panel on Climate Change (IPCC), 1997: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Available at: http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html (2009-02-27).

Intergovernmental Panel on Climate Change (IPCC), 2000: Penman, J., Kruger, D., Galbally, I., Hiraishi, T., Nyenzi, B., Emmanuel, S., Buendia, L., Hoppaus, R., Martinsen, T., Meijer, J., Miwa, K. & Tanabe, K. (Eds). Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Published: IPCC/OECD/IEA/IGES, Hayama, Japan. Available at:
http://www.ipcc-nggip.iges.or.jp/public/gp/english/index.html

Jensen, B.G. & Lindroth, M. 2002: Kontrol af indberetning af CO_2-udledning fra el-producenter i 2003, Carl Bro for Energistyrelsens 6. Kontor (in Danish).

KEMIN, 2008: Ministry of Climate and Energy. Law on CO_2 quotas, nr. 348 of 09/05/2008. (Danish legislation). Only available in Danish at: https://www.retsinformation.dk/Forms/R0710.aspx?id=117147 (2009-03-01)

Kristensen, P.G. 2001: Personal communication, e-mail 10-04-2001, Danish Gas Technology Centre.

Miljøstyrelsen, 1990: Bekendtgørelse om begrænsning af emissioner af svovl-dioxid, kvælstofoxider og støv fra store fyringsanlæg, Bekendtgørelse 689 af 15/10/1990, (Danish legislation).

Miljøstyrelsen, 1998: Bekendtgørelseom begrænsning af svovlindholdet i visse flydende og faste brændstoffer, Bekendtgørelse 698 af 22/09/1998 (Danish legislation).

Miljøstyrelsen, 2001: Luftvejledningen, Begrænsning af luftforurening fra virksomheder, Vejledning fra Miljøstyrelsen nr. 2 2001 (Danish legislation).

Nielsen M., 2003. Estimates based on a large number of plant specific emission data. Not published.

Nielsen, M. & Illerup, J.B. 2003: Emissionsfaktorer og emissionsopgørelse for decentral kraftvarme. Eltra PSO projekt 3141. Kortlægning af emissioner fra decentrale kraftvarmeværker. Delrapport 6. Danmarks Miljøundersøgelser. 116 s. –Faglig rapport fra DMU nr. 442.(In Danish, with an English summary. Available at: http://www2.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR442.pdf (2009-02-27)

Nielsen, M., Illerup, J.B. & Birr-Petersen, K. 2008: Revised emission factors for gas engines including start/stop emissions. Sub-report 3 (NERI). National Environmental Research Institute, University of Aarhus. 69 pp. - NERI Technical Report No. 672. Available at: http://www.dmu.dk/Pub/FR672.pdf (2009-02-27)

Nielsen, O.-K., Lyck, E., Mikkelsen, M.H., Hoffmann, L., Gyldenkærne, S., Winther, M., Nielsen, M., Fauser, P., Thomsen, M., Plejdrup, M.S., Illerup, J.B., Sørensen, P.B. & Vesterdal, L. 2008: Denmark's National Inventory Report 2008 - Emission Inventories 1990-2006 - Submitted under the United Nations Framework Convention on Climate Change. National Environmental Research Institute, University of Aarhus. 701 pp. – NERI Technical Report no. 667. Available at: http://www.dmu.dk/Pub/FR667.pdf

Pulles, T. & Aardenne, J.v. 2004: Good Practice for CLRTAP Emission Inventories, 24. June 2004. Available at: http://www.eea.europa.eu/publications/EMEPCORINAIR4/BGPG.pdf (2009-02-27).

3.3 Transport and other mobile sources (CRF sector 1A2, 1A3, 1A4 and 1A5)

The emission inventory basis for mobile sources is fuel consumption information from the Danish energy statistics. In addition, background data for road transport (fleet and mileage), air traffic (aircraft type, flight numbers, origin and destination airports) and non-road machinery (engine no., engine size, load factor and annual working hours) are used to make the emission estimates sufficiently detailed. Emission data mainly comes from the EMEP/CORINAIR Emission Inventory Guidebook. However, for railways, specific Danish measurements are used.

In the Danish emissions database, all activity rates and emissions are defined in SNAP sector categories (Selected Nomenclature for Air Pollution) according to the CORINAIR system. The emission inventories are prepared from a complete emission database based on the SNAP sectors. The aggregation to the sector codes used for both the UNFCCC and UNECE Conventions is based on a correspondence list between SNAP and IPCC classification codes (CRF), shown in Table 3.17 (mobile sources only).

Table 3.17 SNAP – CRF correspondence table for transport.

SNAP classification	IPCC classification
07 Road transport	1A3b Transport-Road
0801 Military	1A5 Other
0802 Railways	1A3c Railways
0803 Inland waterways	1A3d Transport-Navigation
080402 National sea traffic	1A3d Transport-Navigation
080403 National fishing	1A4c Agriculture/forestry/fisheries
080404 International sea traffic	1A3d Transport-Navigation (international)
080501 Dom. airport traffic (LTO < 1000 m)	1A3a Transport-Civil aviation
080502 Int. airport traffic (LTO < 1000 m)	1A3a Transport-Civil aviation (international)
080503 Dom. cruise traffic (> 1000 m)	1A3a Transport-Civil aviation
080504 Int. cruise traffic (> 1000 m)	1A3a Transport-Civil aviation (international)
0806 Agriculture	1A4c Agriculture/forestry/fisheries
0807 Forestry	1A4c Agriculture/forestry/fisheries
0808 Industry	1A2f Industry-Other
0809 Household and gardening	1A4b Residential

Military transport activities (land and air) refer to the CRF/NFR sector Other (1A5), while the Transport-Navigation sector (1A3d) comprises national sea transport (ship movements between two Danish ports) and recreational craft (SNAP code 0803). For aviation, LTO (Landing and Take Off)[3] refer to the part of flying which is below 1000 m. The working machinery and equipment in industry (SNAP code 0808) is grouped in Industry-Other (1A2f), while agricultural and forestry non-road machinery (SNAP codes 0806 and 0807) is accounted for in the Agriculture/forestry/fisheries (1A4c) sector together with fishing activities.

For mobile sources, internal NERI databases for road transport, air traffic, sea transport and non road machinery have been set up in order to produce the emission inventories. The output results from the NERI databases are calculated in a SNAP format, as activity rates (fuel consumption) and emission factors, which are then exported directly to the central Danish CollectER database. Apart from national inventories, the NERI databases are used also as a calculation tool in research projects, environmental impact assessment studies, and to produce basic emission information which requires various aggregation levels.

3.3.1 Source category description

The following description of source categories explains the development in fuel consumption and emissions for road transport and other mobile sources.

[3] A LTO cycle consists of the flying modes approach/descent, taxiing, take off and climb out. In principle the actual times-in-modes rely on the actual traffic circumstances, the airport configuration, and the aircraft type in question.

Fuel consumption

Table 3.18 Fuel consumption (PJ) for domestic transport in 2007 in CRF sectors.

CRF ID	Fuel use (PJ)
Industry-Other (1A2f)	14.8
Civil Aviation (1A3a)	1.5
Road (1A3b)	179.6
Railways (1A3c)	3.1
Navigation (1A3d)	6.1
Residential (1A4b)	3.2
Ag./for./fish. (1A4c)	21.2
Military (1A5)	2.4
Total	231.8

Table 3.18 shows the fuel consumption for domestic transport based on DEA statistics for 2007 in CRF sectors. The fuel consumption figures in time-series 1990-2007 are given in Annex 3.B.15 (CRF format) and are shown for 1990 and 2007 in Annex 3.B.14 (CollectER format). Road transport has a major share of the fuel consumption for domestic transport. In 2007 this sector's fuel consumption share is 77 %, while the fuel consumption shares for Agriculture/forestry/fisheries and Industry-Other are 10 and 6 %, respectively. For the remaining sectors the total fuel consumption share is 7 %.

From 1990 to 2007, diesel and gasoline fuel consumption has increased by 41 % and 15 %, respectively, and in 2007 the fuel consumption shares for diesel and gasoline were 64 % and 35 %, respectively (Figures 3.15 and 3.16). Other fuels only have a 1 % share of the domestic transport total. Almost all gasoline is used in road transportation vehicles. Gardening machinery and recreational craft are merely small consumers. Regarding diesel, there is considerable fuel consumption in most of the domestic transport categories, whereas a more limited use of residual oil and jet fuel is being used in the navigation sector and by aviation (civil and military flights), respectively.

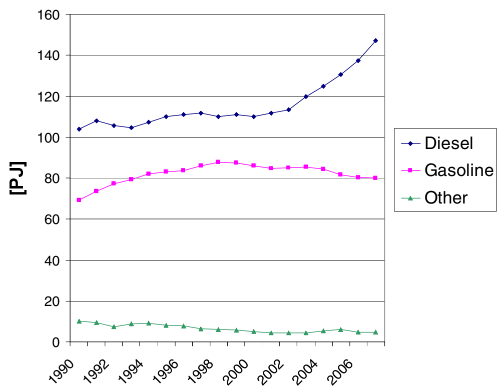


Figure 3.15 Fuel consumption pr fuel type for domestic transport 1990-2007.

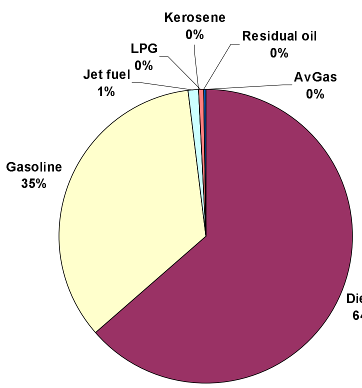


Figure 3.16 Fuel consumption share pr fuel type for domestic transport in 2007.

Road transport

As shown in Figure 3.17, the energy use for road transport has generally increased except from a small fuel consumption decline noted in 2000. The fuel consumption development is due to a slight decreasing trend in the use of gasoline fuels from 1999 onwards combined with a steady growth in the use of diesel. Within sub-sectors, passenger cars represent the most fuel-consuming vehicle category, followed by heavy-duty vehicles, light duty vehicles and 2-wheelers, in decreasing order (Figure 3.18).

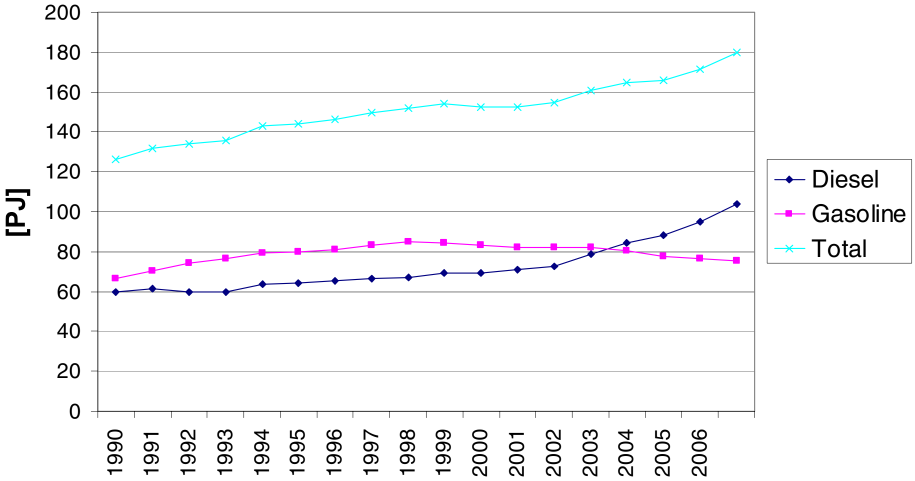


Figure 3.17 Fuel consumption pr fuel type and as totals for road transport 1990-2007.

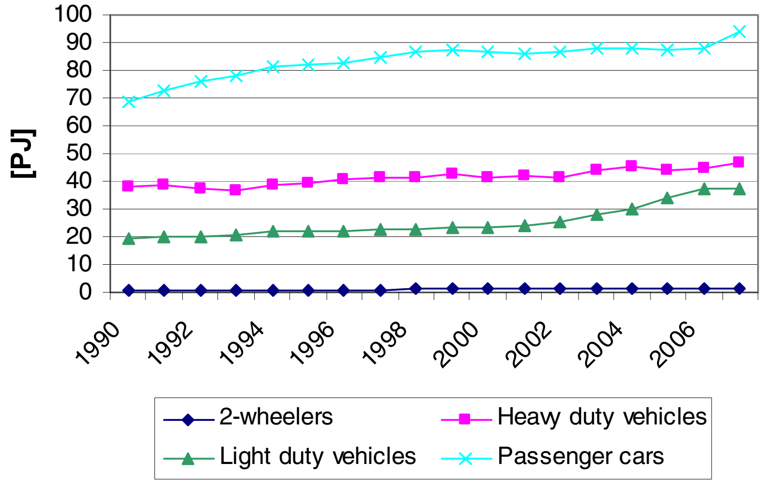


Figure 3.18 Total fuel consumption pr vehicle type for road transport 1990-2007.

As shown in Figure 3.19, fuel consumption for gasoline passenger cars dominates the overall gasoline consumption trend. The development in diesel fuel consumption in recent years (Figure 3.20) is characterised by increasing fuel consumption for diesel passenger cars and light duty vehicles, while the fuel consumption for trucks and buses (heavy-duty vehicles), since 1999, has fluctuated.

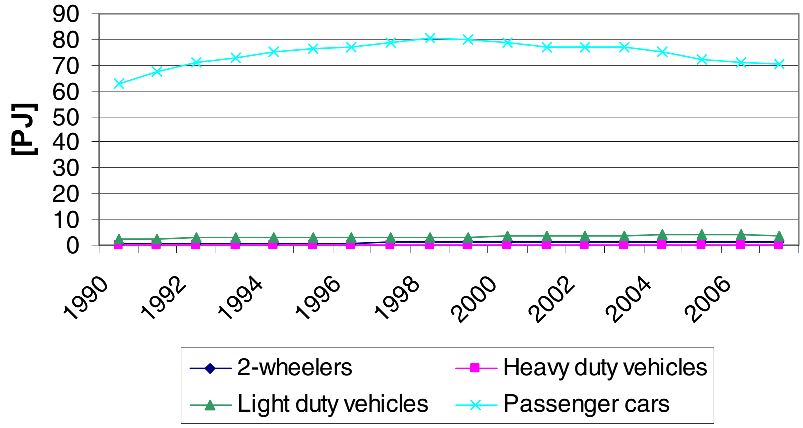


Figure 3.19 Gasoline fuel consumption pr vehicle type for road transport 1990-2007.

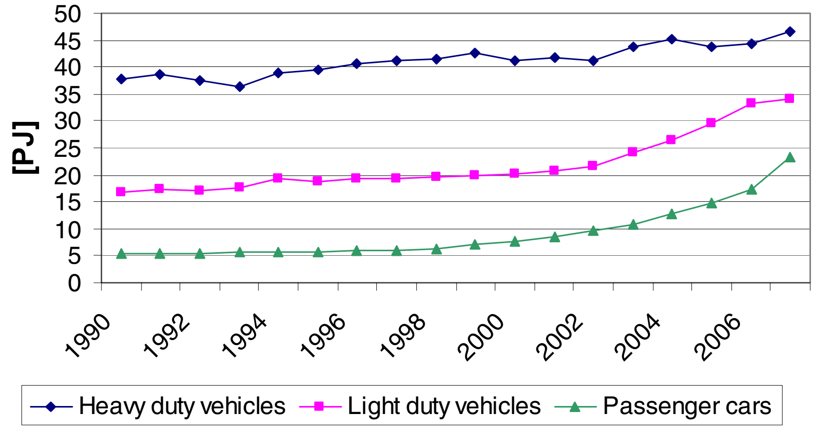


Figure 3.20 Diesel fuel consumption pr vehicle type for road transport 1990-2007.

In 2007, fuel consumption shares for gasoline passenger cars, heavy-duty vehicles, diesel light duty vehicles, diesel passenger cars and gasoline light duty vehicles were 39, 26, 19, 13 and 2 %, respectively (Figure 3.21).

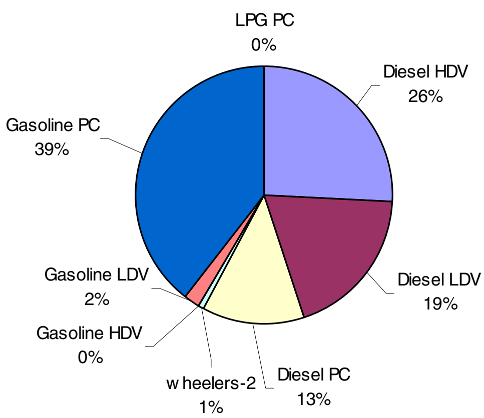


Figure 3.21 Fuel consumption share (PJ) pr vehicle type for road transport in 2007.

Other mobile sources

It must be noted that the fuel consumption figures behind the Danish inventory for mobile equipment in the agriculture, forestry, industry, household and gardening (residential), and inland waterways (part of navigation) sectors, are less certain than for other mobile sectors. For these types of machinery, the DEA statistical figures do not directly provide fuel consumption information, and fuel consumption totals are subsequently estimated from activity data and fuel consumption factors. For 2007 no new stock information has been gathered for gasoline fuelled working machinery, and thus the 2006 total stock information is repeated for this year. For recreational craft the latest historical year is 2004.

As seen in Figure 3.22, classified according to CRF the most important sectors are Agriculture/forestry/fisheries (1A4c), Industry-other (mobile machinery part of 1A2f) and Navigation (1A3d). Minor fuel consuming sectors are Civil Aviation (1A3a), Railways (1A3c), Other (military mobile fuel consumption: 1A5) and Residential (1A4b).

The 1990-2007 time-series are shown pr fuel type in Figures 3.23-3.26 for diesel, gasoline and jet fuel, respectively.

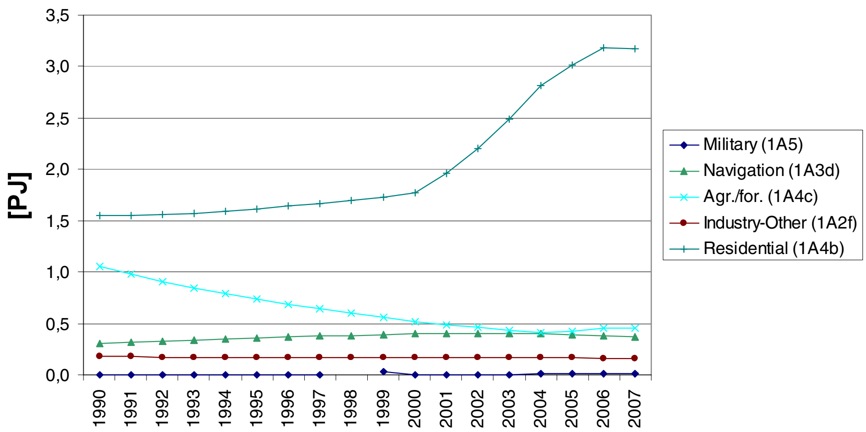


Figure 3.22 Total fuel consumption in CRF sectors for other mobile sources 1990-2007.

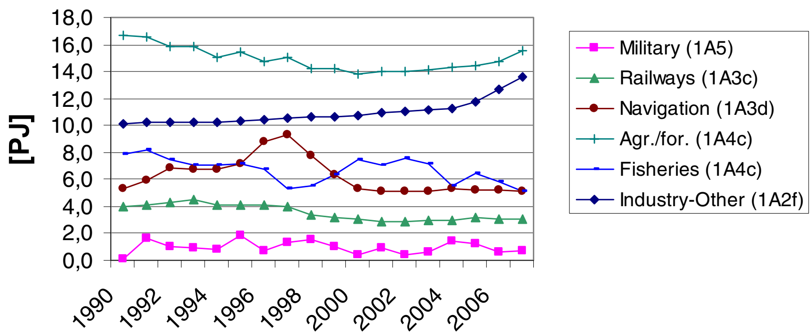


Figure 3.23 Diesel fuel consumption in CRF sectors for other mobile sources 1990-2007.

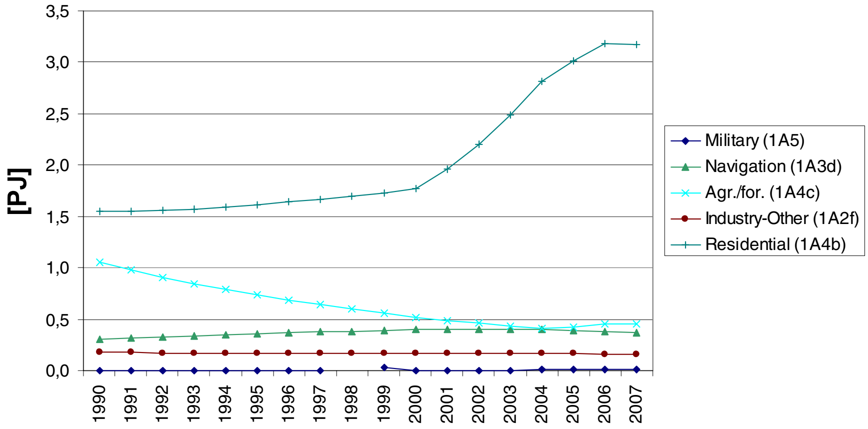


Figure 3.24 Gasoline fuel consumption in CRF sectors for other mobile source 1990-2007.

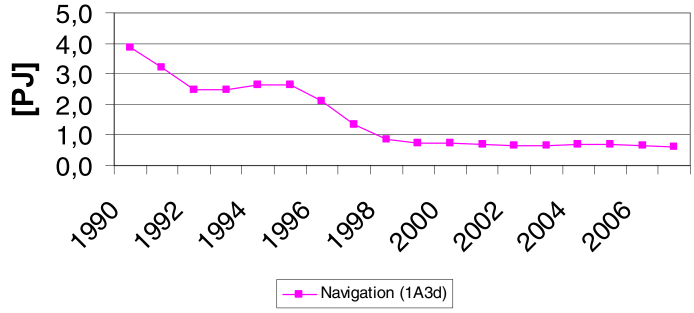


Figure 3.25 Residual oil fuel consumption in CRF sectors for other mobile sources 1990-2007.

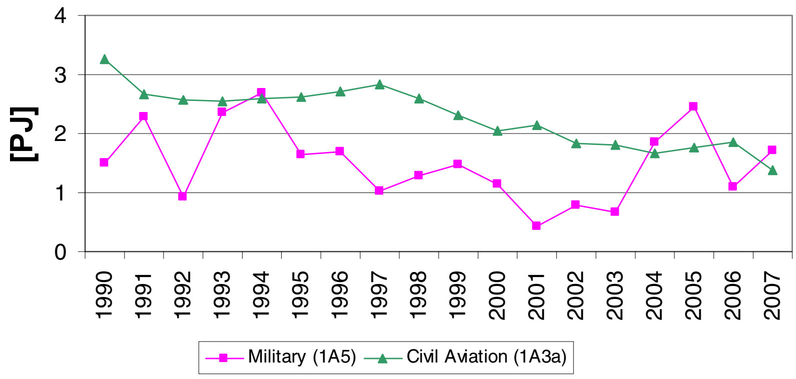


Figure 3.26 Jet fuel consumption in CRF sectors for other mobile sources 1990-2007.

In terms of diesel, the fuel consumption decreases for agricultural machines until 2000, due to fewer numbers of tractors and harvesters. After that, the increase in the engine sizes of new sold machines has more than outbalanced the trend towards smaller total stock numbers. The fuel consumption for industry has increased from the beginning of the 1990's, due to an increase in the activities for construction machinery. The fuel consumption increase has been very pronounced in 2005-2007. For fisheries, the development in fuel consumption reflects the activities in this sector.

The Navigation sector comprises national sea transport (fuel consumption between two Danish ports) and recreational craft. For the latter category, fuel consumption has increased significantly from 1990 to 2004 due to the rising number diesel-fuelled private boats. For national sea transport, the diesel fuel consumption curve reflects the combination of traffic and ferries in use for regional ferries. From 1998 to 2000, a significant decline in fuel consumption is apparent. The most important explanation here is the closing of ferry service routes in connection with the opening of the Great Belt Bridge in 1997. For railways, the gradual shift towards electrification explains the lowering trend in diesel fuel consumption and the emissions for this transport sector. The fuel consumed (and associated emissions) to produce electricity is accounted for in the stationary source part of the Danish inventories.

The largest gasoline fuel use is found for household and gardening machinery in the Residential (1A4b) sector. Especially from 2001-2006, a significant fuel consumption increase is apparent due to considerable growth in the machinery stock. The decline in gasoline fuel consumption for Agriculture/forestry/fisheries (1A4c) is due to the gradual phasing out of gasoline-fuelled agricultural tractors.

In terms of residual oil there has been a substantial decrease in the fuel consumption for regional ferries. The fuel consumption decline is most significant from 1990-1992 and from 1997-1999.

The considerable variations from one year to another in military jet fuel consumption are due to planning and budgetary reasons, and the passing demand for flying activities. Consequently, for some years, a certain amount of jet fuel stock-building might disturb the real picture of aircraft fuel consumption. Civil aviation has decreased since the building of the Great Belt Bridge, both in terms of number of flights and total jet fuel consumption.

Bunkers

The residual oil and diesel oil fuel consumption fluctuations reflect the quantity of fuel sold in Denmark to international ferries, international warships, other ships with foreign destinations, transport to Greenland and the Faroe Islands, tank vessels and foreign fishing boats. For jet petrol, the sudden fuel consumption drop in 2002 is explained by the recession in the air traffic sector due to the events of September 11, 2001 and structural changes in the aviation business.

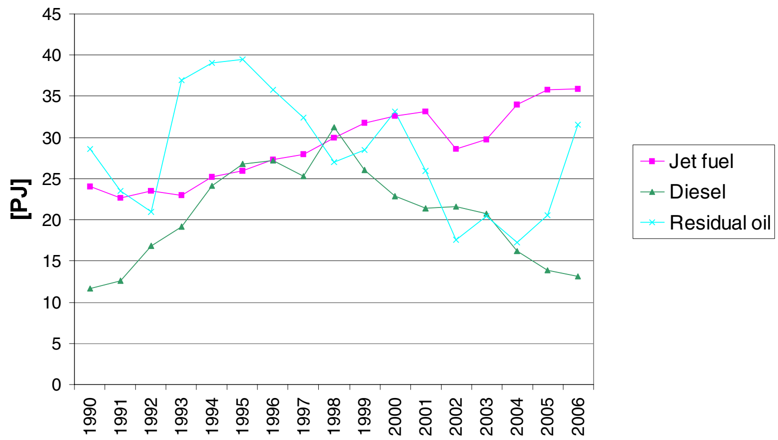


Figure 3.27 Bunker fuel consumption 1990-2006.

Emissions of CO_2, CH_4 and N_2O

In Table 3.19 the CO_2, CH_4 and N_2O emissions for road transport and other mobile sources are shown for 2007 in CRF sectors. The emission figures in time-series 1990-2007 are given in Annex 3:B.13 (CRF format) and are shown for 1990 and 2007 in Annex 3.B.14 (CollectER format).

From 1990 to 2007 the road transport emissions of CO_2 and N_2O have increased by 42 and 31 %, respectively, whereas the emissions of CH_4 have decreased by 55 % (from Figures 3.28-3.30). From 1990 to 2007 the other mobile CO_2 emissions have decreased by 9 %, (from Figures 3.32-3.34).

Table 3.19 Emissions of CO_2, CH_4 and N_2O in 2007 for road transport and other mobile sources.

CRF Sector	CH_4 [tonnes]	CO_2 [ktonnes]	N_2O [tonnes]
Industry-Other (1A2f)	43	1 088	46
Civil Aviation (1A3a)	5	107	7
Railways (1A3c)	9	228	6
Navigation (1A3d)	32	454	26
Residential (1A4b)	235	232	4
Ag./for./fish. (1A4c)	91	1 565	74
Military (1A5)	8	175	6
Total other mobile	423	3 847	168
Road (1A3b)	1 185	13 198	409
Total mobile	1 608	17 045	576

Road transport

CO_2 emissions are directly fuel-use dependent and, in this way, the development in the emission reflects the trend in fuel consumption. As shown in Figure 3.28, the most important emission source for road transport is passenger cars, followed by heavy-duty vehicles, light-duty vehicles and 2-wheelers in decreasing order. In 2007, the respective emission shares were 52, 26, 21 and 1 %, respectively (Figure 3.31).

The majority of CH_4 emissions from road transport come from gasoline passenger cars (Figure 3.29). The emission drop from 1992 onwards is explained by the penetration of catalyst cars into the Danish fleet. The 2007 emission shares for CH_4 were 49, 28, 16 and 7 % for passenger cars, heavy-duty vehicles, 2-wheelers and light-duty vehicles, respectively (Figure 3.31).

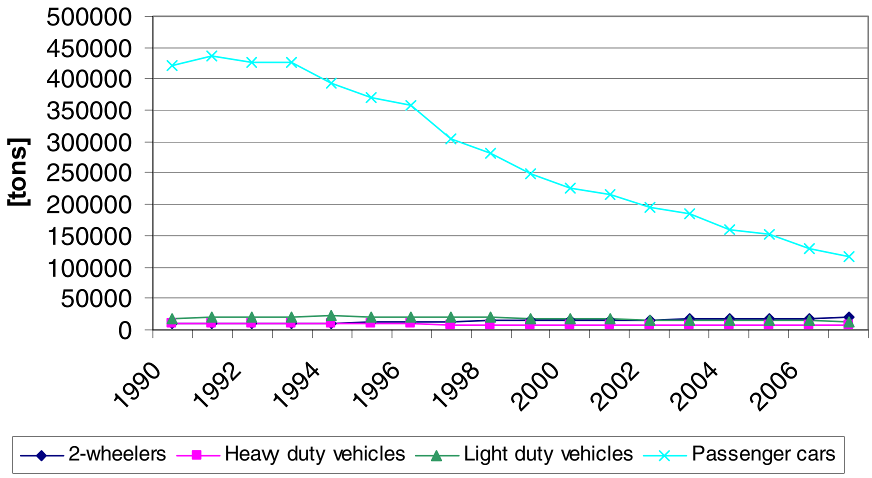


Figure 3.28 CO_2 emissions (k-tonnes) pr vehicle type for road transport 1990-2007.

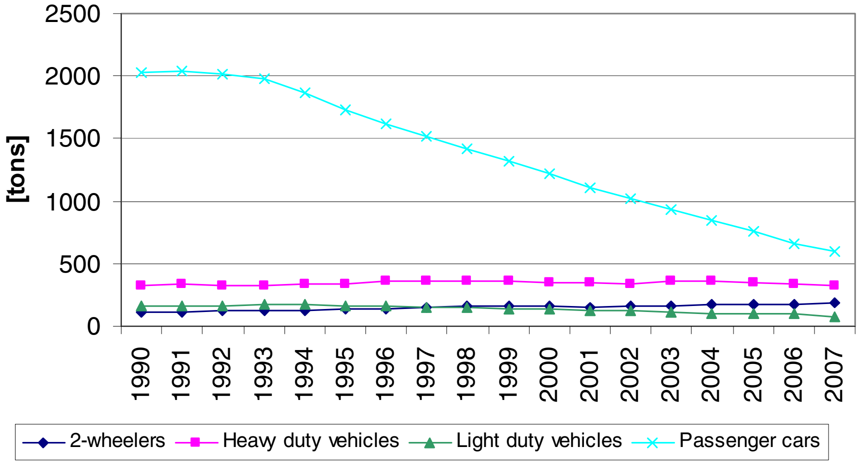


Figure 3.29 CH_4 emissions (tonnes) pr vehicle type for road transport 1990-2007.

An undesirable environmental side effect of the introduction of catalyst cars is the increase in the emissions of N_2O from the first generation of catalyst cars (Euro 1) compared to conventional cars. The emission factors for later catalytic converter technologies are considerably lower than the ones for Euro 1, thus causing the emissions to decrease from 1998 onwards (Figure 3.30). In 2007, emission shares for passenger cars, light and heavy-duty vehicles were 46, 35 and 18 %, of the total road transport N_2O, respectively (Figure 3.31).

Referring to the third IPCC assessment report, 1 g CH_4 and 1 g N_2O has the greenhouse effect of 21 and 310 g CO_2, respectively. In spite of the relatively large CH_4 and N_2O global warming potentials, the largest contribution to the total CO_2 emission equivalents for road transport comes from CO_2, and the CO_2 emission equivalent shares pr vehicle category are almost the same as the CO_2 shares.

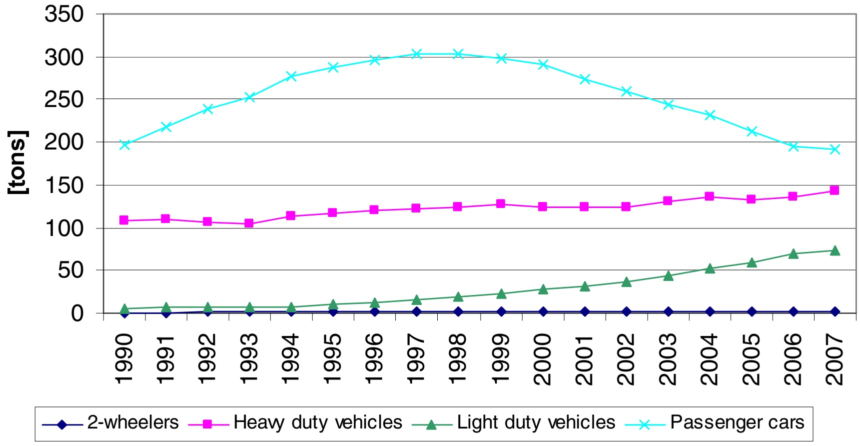


Figure 3.30 N_2O emissions (tonnes) pr vehicle type for road transport 1990-2007.

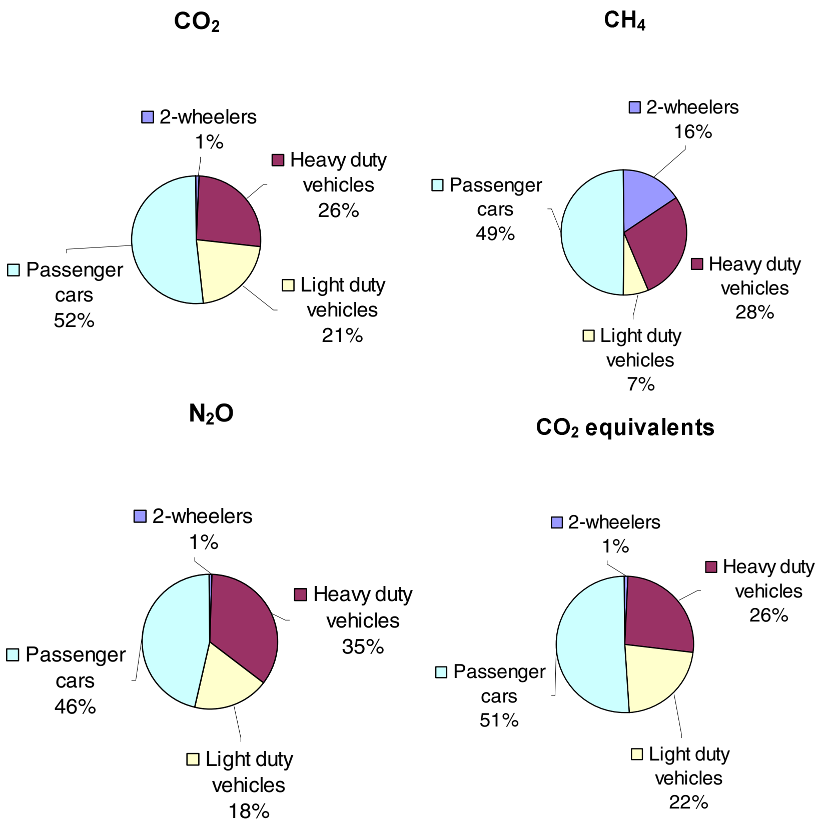


Figure 3.31 CO_2, CH_4 and N_2O emission shares and GHG equivalent emission distribution for road transport in 2007.

Other mobile sources

For other mobile sources, the highest CO_2 emissions in 2007 come from Agriculture/forestry/fisheries (1A4c), Industry-other (1A2f), Navigation (1A3d), with shares of 40, 28 and 12 %, respectively (Figure 3.35). The 1990-2007 emission trend is directly related to the fuel-use development in the same time-period. Minor CO_2 emission contributors are sectors such as Residential (1A4b), Railways (1A3c), Military (1A5) and Civil Aviation (1A3a). In 2007, the CO_2 emission shares for these sectors were 6, 6, 5 and 3 %, respectively (Figure 3.35).

For CH_4, far the most important sector is Residential (1A4b), see Figure 3.35. The emission share of 56 % in 2006 is due to relatively large gasoline fuel consumption for gardening machinery. The 2006 emission shares for Agriculture/forestry/fisheries (1A4c), Industry (1A2f) and

Navigation (1A3d) are 21, 10 and 8 %, respectively, whereas the remaining sectors have emission shares of 2 % or less.

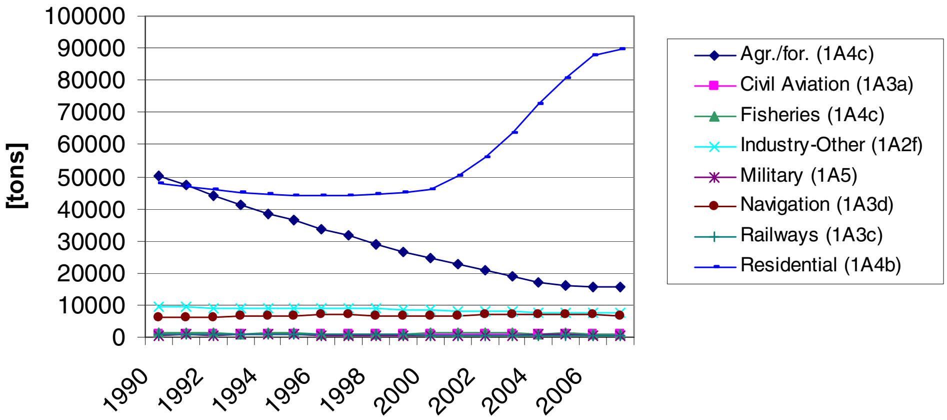


Figure 3.32 CO_2 emissions (k-tonnes) in CRF sectors for other mobile sources 1990-2007.

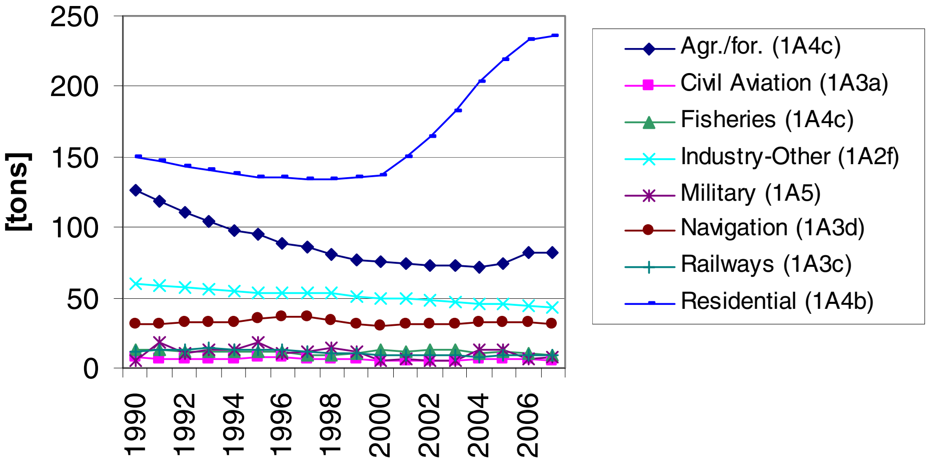


Figure 3.33 CH_4 emissions (tonnes) in CRF sectors for other mobile sources 1990-2007.

For N_2O, the emission trend in sub-sectors is the same as for fuel consumption and CO_2 emissions (Figure 3.34).

As for road transport, CO_2 alone contributes with by far the most CO_2 emission equivalents in the case of other mobile sources, and pr sector the CO_2 emission equivalent shares are almost the same as those for CO_2, itself (Figure 3.35).

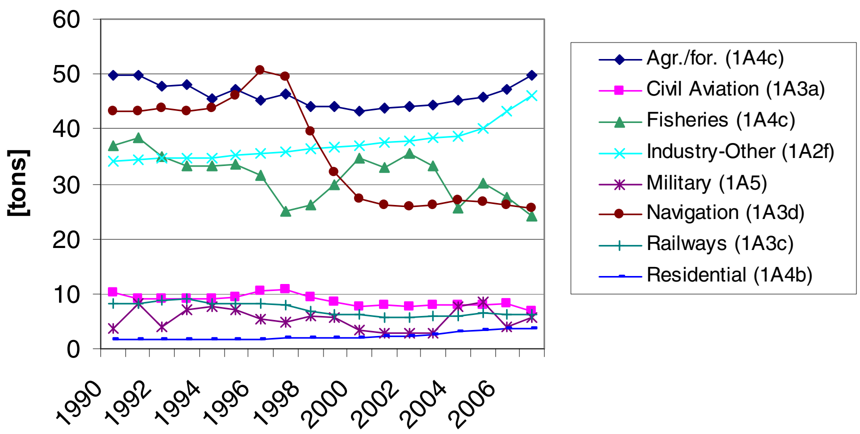


Figure 3.34 N_2O emissions (tonnes) in CRF sectors for other mobile sources 1990-2007.

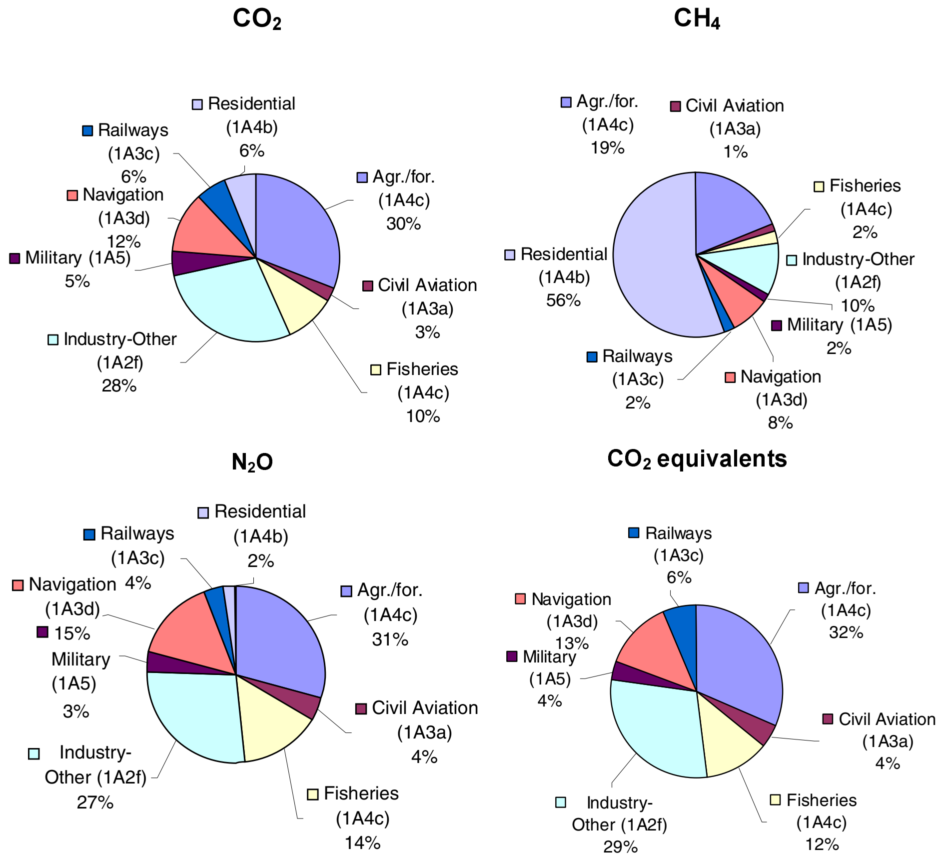


Figure 3.35 CO_2, CH_4 and N_2O emission shares and GHG equivalent emission distribution for other mobile sources in 2007.

Emissions of SO_2, NO_X, NMVOC and CO

In Table 3.20 the SO_2, NO_X, NMVOC and CO emissions for road transport and other mobile sources are shown for 2007 in CRF sectors. The emission figures in the time-series 1990-2007 are given in Annex 3.B.15 (CRF format) and are shown for 1990 and 2007 in Annex 3.B.14 (CollectER format).

From 1990 to 2007, the road transport emissions of NMVOC, CO and NO_X emissions have decreased by 75, 66 and 39 %, respectively (Figures 3.37-3.39).

For other mobile sources, the emissions of NO_X decreased by 22 % from 1990 to 2007 and for SO_2 the emission drop is as much as 84 %. In the same period, the emissions of NMVOC have declined by 8 %, whereas the CO emissions have increased by 4 % (Figures 3.41-3.44).

Table 3.20 Emissions of SO_2, NO_X, NMVOC and CO in 2007 for road transport and other mobile sources.

CRF ID	SO_2 [tonnes]	NO_X [tonnes]	NMVOC [tonnes]	CO [tonnes]
Industry-Other (1A2f)	32	10 654	1 497	7 378
Civil Aviation (1A3a)	34	498	153	870
Railways (1A3c)	1	3 555	231	629
Navigation (1A3d)	838	5 929	1 087	6 573
Residential (1A4b)	1	288	8 101	89 398
Ag./for./fish. (1A4c)	518	18 180	2 407	16 677
Military (1A5)	40	771	73	546
Total other mobile	1 465	39 875	13 548	122 071
Road (1A3b)	83	64 485	20 364	155 084
Total mobile	1 548	104 360	33 912	277 155

Road transport

The step-wise lowering of the sulphur content in diesel fuel has given rise to a substantial decrease in the road transport emissions of SO_2 (Figure 3.36). In 1999, the sulphur content was reduced from 500 ppm to 50 ppm (reaching gasoline levels), and for both gasoline and diesel the sulphur content was reduced to 10 ppm in 2005. Since Danish diesel and gasoline fuels have the same sulphur percentages, at present, the 2007 shares for SO_2 emissions and fuel consumption for passenger cars, heavy-duty vehicles, light-duty vehicles and 2-wheelers are the same in each case: 52, 26, 21 and 1 %, respectively (Figure 3.40).

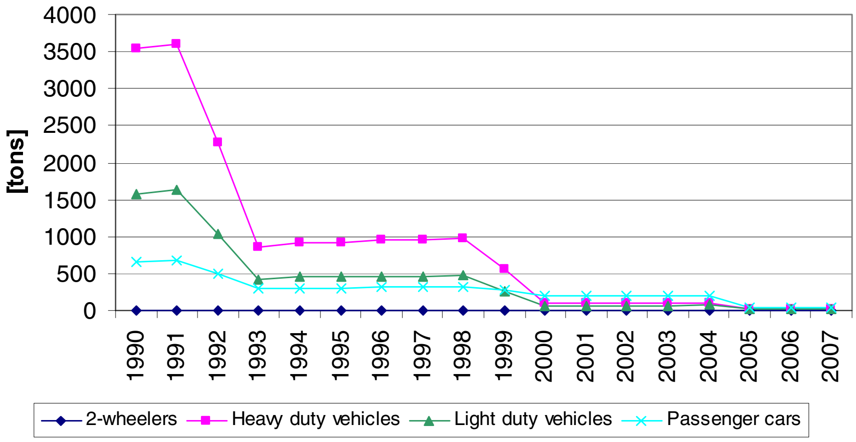


Figure 3.36 SO_2 emissions (tonnes) pr vehicle type for road transport 1990-2007.

Historically, the emission totals of NMVOC and CO have been very dominated by the contributions coming from private cars, as shown in Figures 3.38-3.39. However, the NMVOC and CO (and NO_x) emissions from this vehicle type have shown a steady decreasing tendency since the introduction of private catalyst cars in 1990 (EURO I) and the introduction of even more emission-efficient EURO II, III and IV private cars (introduced in 1997, 2001 and 2006, respectively).

In the case of NO_x, the real traffic emissions for heavy duty vehicles do not decline follow the reductions as intended by the EU emission legislation. This is due to the so-called engine cycle-beating effect. Outside the legislative test cycle stationary measurement points, the electronic engine control for heavy duty Euro II and III engines switches to a fuel efficient engine running mode, thus leading to increasing NO_x emissions.

The 2007 emission shares for heavy-duty vehicles, passenger cars, light-duty vehicles and 2-wheelers for NO_x (53, 30, 17 and 0 %), NMVOC (7, 67, 9 and 17 %), CO (5, 76, 7, 12 %), PM (30, 41, 27 and 2 %) and NH_3 (1, 96, 3 and 0 %), are also shown in Figure 3.40.

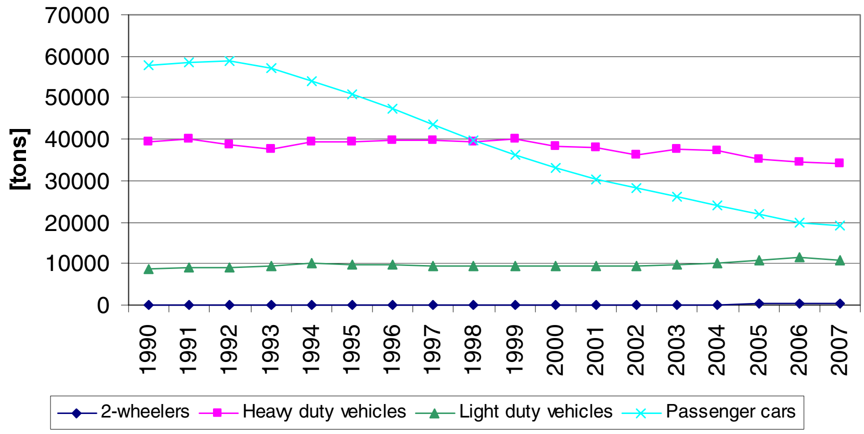


Figure 3.37 NO_X emissions (tonnes) pr vehicle type for road transport 1990-2007.

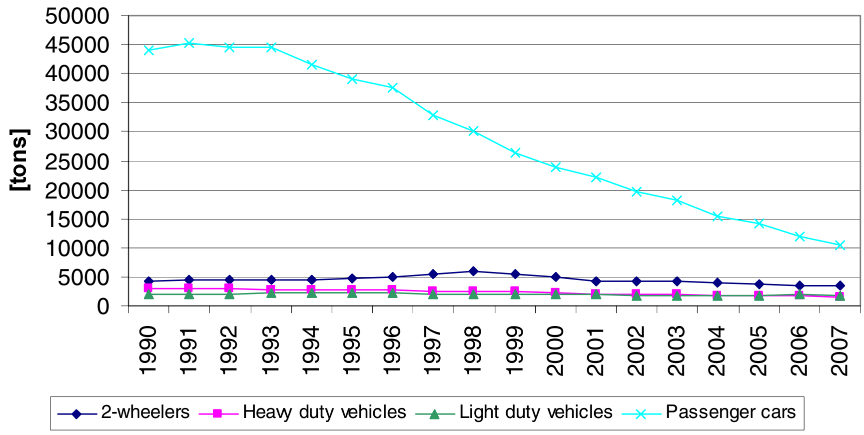


Figure 3.38 NMVOC emissions (tonnes) pr vehicle type for road transport 1990-2007

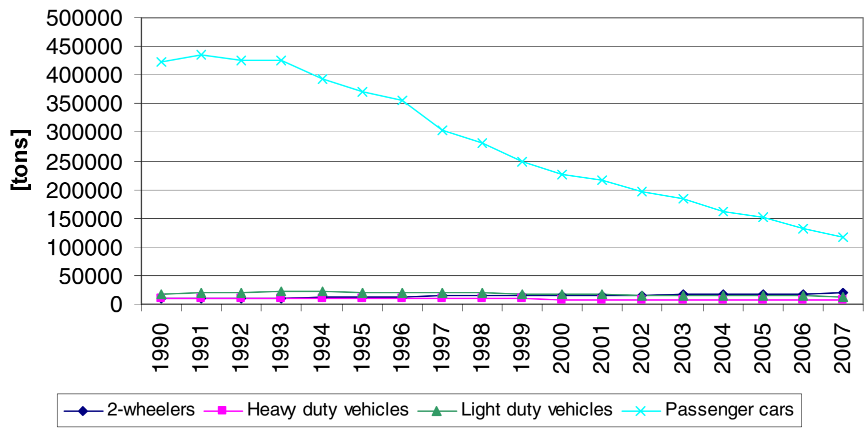


Figure 3.39 CO emissions (tonnes) pr vehicle type for road transport 1990-2007.

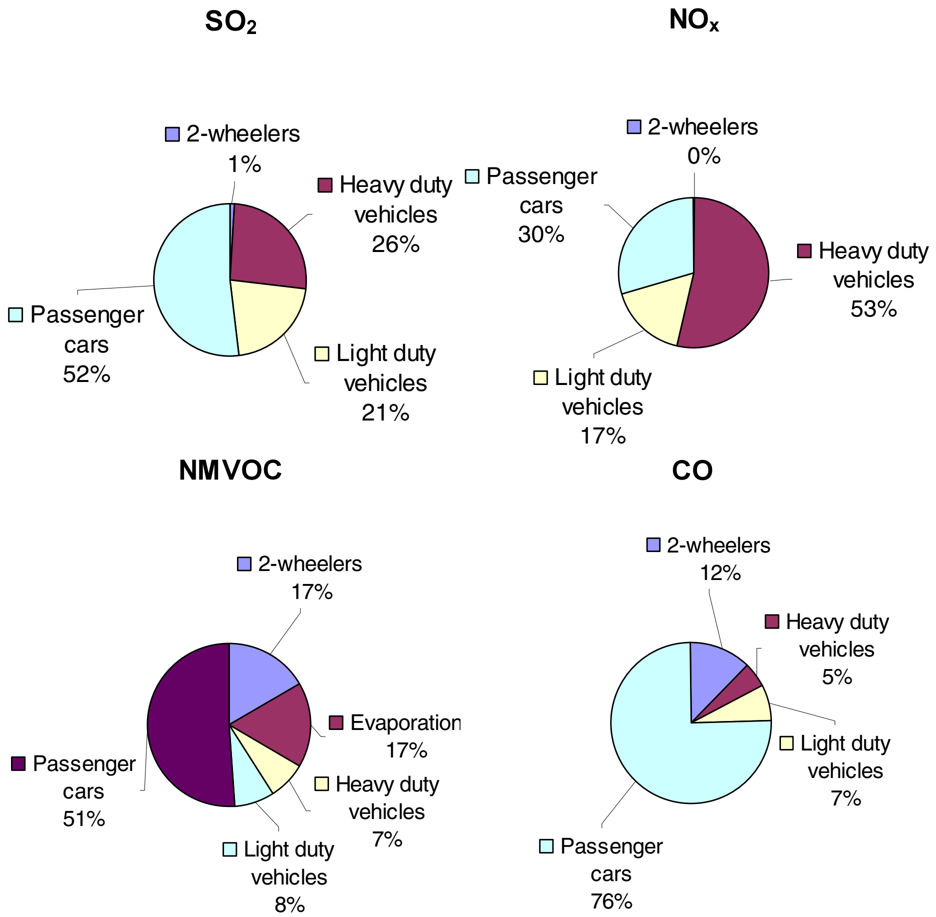


Figure 3.40 SO_2, NO_X, NMVOC and CO emission shares pr vehicle type for road transport in 2007.

Other mobile sources

For SO_2 the trends in the Navigation (1A3d) emissions shown in Figure 3.41 mainly follow the development of the heavy fuel consumption (Figure 3.25). Though, from 1993 to 1995 relatively higher contents of sulphur in the fuel (estimated from sales) cause a significant increase in the emissions of SO_2. The SO_2 emissions for Fisheries (1A4c) correspond with the development in the consumption of marine gas oil. The main explanation for the development of the SO_2 emission curves for Railways (1A3c) and non-road machinery in Agriculture/forestry (1A4c) and Industry (1A2f), are the stepwise sulphur content reductions for diesel used by machinery in these sectors.

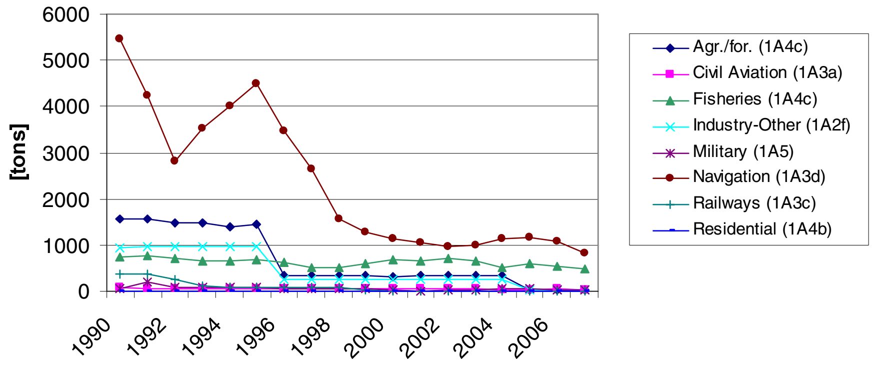


Figure 3.41 SO_2 emissions (tonnes) in CRF sectors for other mobile sources 1990-2007

In general, the emissions of NO_X, NMVOC and CO from diesel-fuelled working equipment and machinery in agriculture, forestry and industry have decreased slightly since the end of the 1990s due to gradually strengthened emission standards given by the EU emission legislation directives.

NO_X emissions mainly come from diesel machinery, and the most important sources are Agriculture/forestry/fisheries (1A4c), Industry (1A2f), Navigation (1A3d) and Railways (1A3c), as shown in Figure 3.42. The 2006 emission shares are 45, 27, 15 and 9 %, respectively (Figure 3.45). Minor emissions come from the sectors, Civil Aviation (1A3a), Military (1A5) and Residential (1A4b).

The NO_X emission trend for Navigation, Fisheries and Agriculture is determined by fuel consumption fluctuations for these sectors, and the development of emission factors. For ship engines the emission factors tend to increase for new engines until mid 1990s. After that, the emission factors gradually reduce until 2000, bringing them to a level comparable with the emission limits for new engines in this year. For agricultural machines, there have been somewhat higher NO_X emission factors for 1991-stage I machinery, and an improved emission performance for stage I and II machinery since the late 1990s.

The emission development for industry NO_X is the product of a slight fuel-use increase from 1990 to 2007 and a development in emission factors as explained for agricultural machinery. For railways, the gradual shift towards electrification explains the declining trend in diesel fuel consumption and NO_X emissions for this transport sector until 2001.

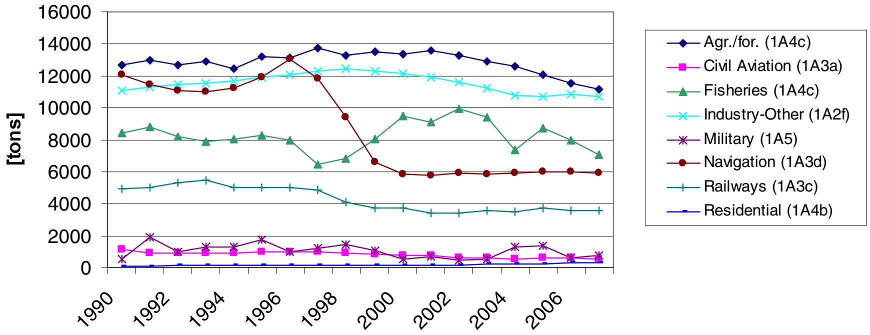


Figure 3.42 NO_X emissions (tonnes) in CRF sectors for other mobile sources 1990-2007.

The 1990-2007 time-series of NMVOC and CO emissions are shown in Figures 3.43 and 3.44 for other mobile sources. The 2007 sector emission shares are shown in Figure 3.45. For NMVOC, the most important sectors are Residential (1A4b), Agriculture/forestry/fisheries (1A4c), Industry (1A2f) and Navigation (1A3d), with 2007 emission shares of 59, 18, 11 and 8 %, respectively. The same four sectors also contribute with most of the CO emissions in the same consecutive order; the emission shares are 73, 14, 6 and 5 %, respectively. Minor NMVOC and CO emissions come from Railways (1A3c), Civil Aviation (1A3a) and Military (1A5).

For NMVOC and CO, the significant emission increases for the residential sector after 2000 are due to the increased number of gasoline working machines. Improved NMVOC emission factors for diesel machinery in agriculture and gasoline equipment in forestry (chain saws) are the most important explanations for the NMVOC emission decline in the Agriculture/forestry/fisheries sector. This explanation also applies for the industrial sector, which is dominated by diesel-fuelled machinery. From 1997 onwards, the NMVOC emissions from Navigation decrease due to the gradually phase-out of the 2-stroke engine technology for recreational craft. The main reason for the significant 1990-2006 CO emission decrease for Agriculture/forestry/fisheries is the phasing out of gasoline tractors.

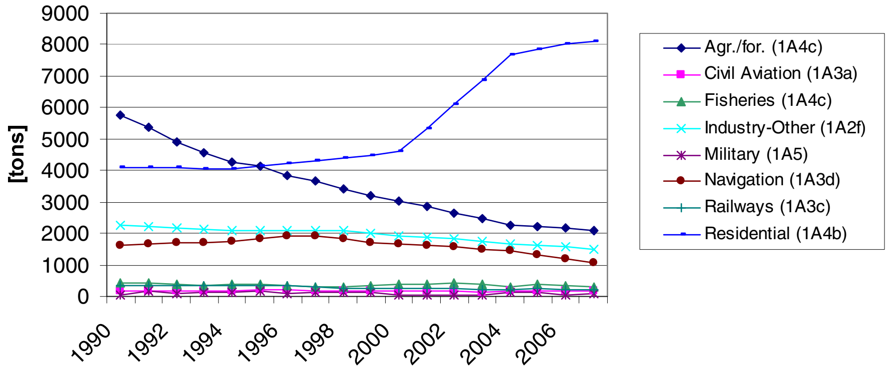


Figure 3.43 NMVOC emissions (tonnes) in CRF sectors for other mobile sources 1990-2007.

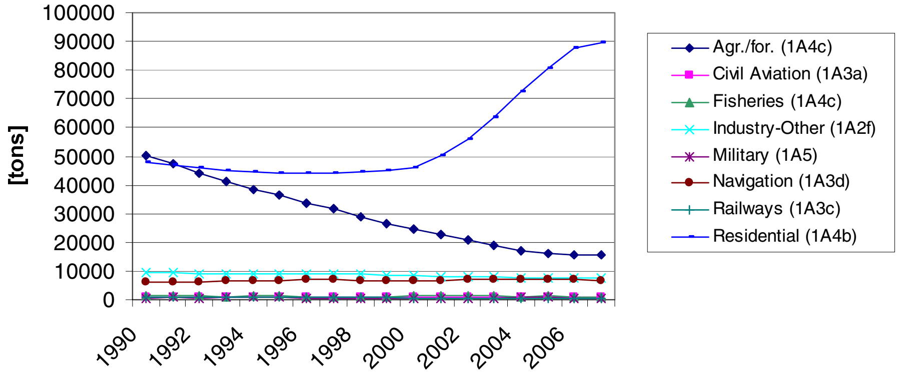


Figure 3.44 CO emissions (tonnes) in CRF sectors for other mobile sources 1990-2007.

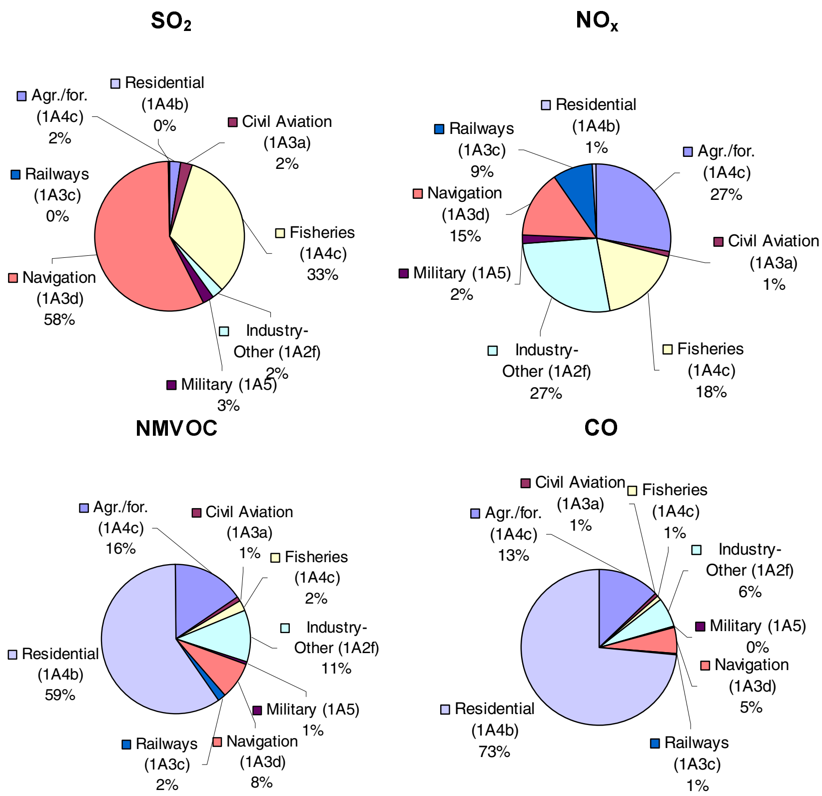


Figure 3.45 SO_2, NO_X, NMVOC and CO emission shares pr vehicle type for other mobile sources in 2007.

Bunkers

The most important emissions from bunker fuel consumption (fuel consumption for international transport) are SO_2, NO_X and CO_2 (and TSP, not shown). However, compared with the Danish national emission total (all sources), the greenhouse gas emissions from bunkers are small. The bunker emission totals are shown in Figure 3.21 for 2007, split into sea transport and civil aviation. All emission figures in the 1990-2007 time-series are given in Annex 3.B.15 (CRF format). In Annex 3.B.14, the emissions are also given in CollectER format for the years 1990 and 2007.

Table 3.21 Emissions in 2007 for international transport and national totals.

CRF sector	SO_2 [tonnes]	NO_X [tonnes]	NMVOC [tonnes]	CH_4 [tonnes]	CO [tonnes]	CO_2 [k-tonnes]	N_2O [tonnes]
Navigation int. (1A3d)	26876	89720	2767	86	9129	3559	224
Civil Aviation int. (1A3a)	863	11606	516	55	1964	2701	93
International total	27739	101327	3283	140	11093	6260	316

The differences in emissions between navigation and civil aviation are much larger than the differences in fuel consumption (and derived CO_2 emissions), and display a poor emission performance for international sea transport. In broad terms, the emission trends shown in Figure 3.46 are similar to the fuel-use development.

However, for navigation minor differences occur for the emissions of SO_2, NO_X and CO_2 due to varying amounts of marine gas oil and residual oil, and for SO_2 and NO_X the development in the emission factors also have an impact on the emission trends. For civil aviation, apart from the annual consumption of jet fuel, the development of the NO_X emissions is also due to yearly variations in LTO/aircraft type (earlier than 2001) and city-pair statistics (2001 onwards).

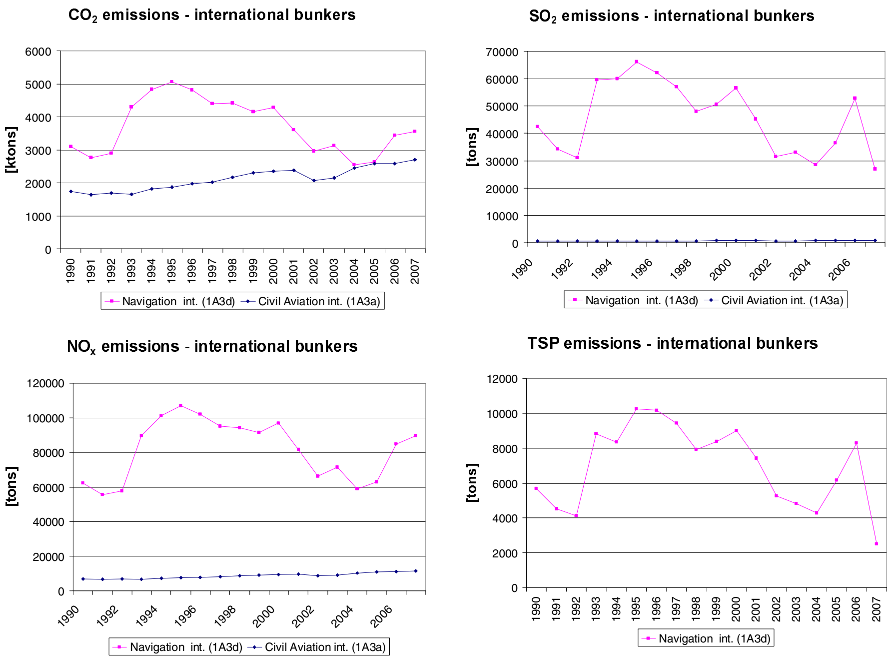


Figure 3.46 CO_2, SO_2, NO_X and TSP emissions for international transport 1990-2007.

3.3.2 Methodological issues

The description of methodologies and references for the transport part of the Danish inventory is given in two sections: one for road transport and one for the other mobile sources.

Methodology and references for Road Transport

For road transport, the detailed methodology is used to make annual estimates of the Danish emissions, as described in the EMEP/CORINAIR Emission Inventory Guidebook (EMEP/CORINAIR, 2007). The actual calculations are made with a model developed by NERI, using the European COPERT III model methodology, and updated fuel consumption and emission factors from the latest version of COPERT - COPERT IV. The latter model approach is explained in (EMEP/CORINAIR, 2007). In COPERT, fuel consumption and emission simulations can be made for operationally hot engines, taking into account gradually stricter emission standards and emission degradation due to catalyst wear. Furthermore, the emission effects of cold-start and evaporation are simulated.

Vehicle fleet and mileage data

Corresponding to the COPERT III fleet classification, all present and future vehicles in the Danish fleet are grouped into vehicle classes, sub-classes and layers. The layer classification is a further division of vehicle sub-classes into groups of vehicles with the same average fuel consumption and emission behaviour, according to EU emission legislation levels. Table 3.22 gives an overview of the different model classes and sub-classes, and the layer level with implementation years are shown in Annex 3.B.1.

Table 3.22 Model vehicle classes and sub-classes, trip speeds and mileage split.

			Trip speed [km pr h]			Mileage split [%]		
Vehicle classes	Fuel type	Engine size/weight	Urban	Rural	Highway	Urban	Rural	Highway
PC	Gasoline	< 1.4 l.	40	70	100	35	46	19
PC	Gasoline	1.4 – 2 l.	40	70	100	35	46	19
PC	Gasoline	> 2 l.	40	70	100	35	46	19
PC	Diesel	< 2 l.	40	70	100	35	46	19
PC	Diesel	> 2 l.	40	70	100	35	46	19
PC	LPG		40	70	100	35	46	19
PC	2-stroke		40	70	100	35	46	19
LDV	Gasoline		40	65	80	35	50	15
LDV	Diesel		40	65	80	35	50	15
Trucks	Gasoline		35	60	80	32	47	21
Trucks	Diesel	3.5 – 7.5 tonnes	35	60	80	32	47	21
Trucks	Diesel	7.5 – 16 tonnes	35	60	80	32	47	21
Trucks	Diesel	16 – 32 tonnes	35	60	80	19	45	36
Trucks	Diesel	> 32 tonnes	35	60	80	19	45	36
Urban buses	Diesel		30	50	70	51	41	8
Coaches	Diesel		35	60	80	32	47	21
Mopeds	Gasoline		30	30	-	81	19	0
Motorcycles	Gasoline	2 stroke	40	70	100	47	39	14
Motorcycles	Gasoline	< 250 cc.	40	70	100	47	39	14
Motorcycles	Gasoline	250 – 750 cc.	40	70	100	47	39	14
Motorcycles	Gasoline	> 750 cc.	40	70	100	47	39	14

New total mileage data for passenger cars, light duty trucks, heavy duty trucks and buses produced by the Danish vehicle inspection programme is used for the years 1990-2004. For 2005, total mileage data is provided by the Danish Road Directorate in a format similar to the 1990-2004 format (Foldager, 2007). To compute total mileage figures for 2006 and 2007, the information for 2005 is used in combination with the overall 2005-2007 development of the vehicle fleet, due to lack of data.

The new Danish mileage data is distributed into annual mileage pr first registration year for the different vehicle categories in the inventory, by using the baseline vehicle stock and annual mileage information obtained from the Danish Road Directorate (Ekman, 2005). Fleet numbers in total vehicle categories for 2007 has been obtained from Statistics Denmark (2008), and data are split into vehicle categories-first registration years, by using the 2004 distribution matrix.

The data set from Ekman (2005) which underpinned the Danish 2004 emission inventory, covers data for the number of vehicles and annual mileage pr first registration year for all vehicle sub-classes, and mileage split between urban, rural and highway driving, and the respective average speeds. Additional data for the moped fleet and motorcycle fleet disaggregation information is given by The National Motorcycle Association (Markamp, 2008).

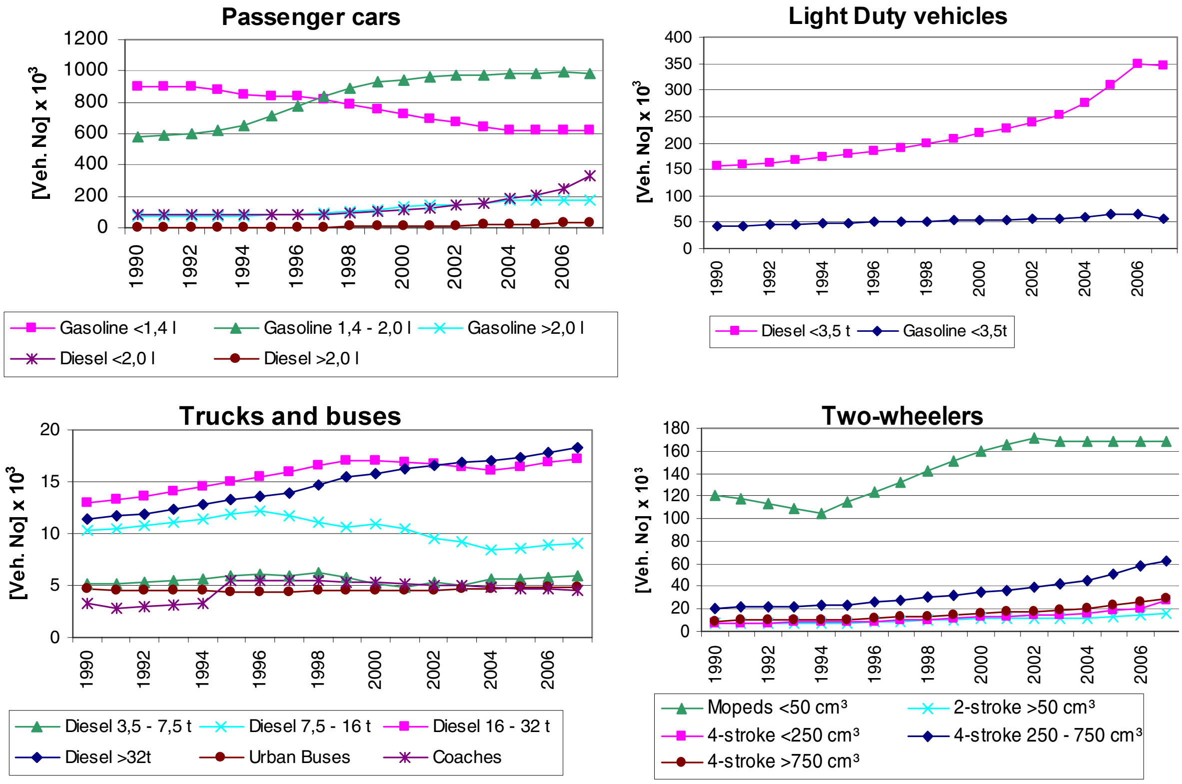


Figure 3.47 Number of vehicles in sub-classes in 1990-2007.

The vehicle numbers pr sub-class are shown in Figure 3.47. It must be noted that for 2005-2007, the 2004 stock shares are used to distribute the fleet into the different vehicle sub-categories for passenger cars and heavy duty trucks. Consequently, it gives less meaning to explain the fleet curves beyond 2004 for these vehicle types.

For passenger cars, the engine size differentiation is associated with some uncertainty. The increase in the total number of passenger cars is mostly due to a growth in the number of gasoline cars with engine sizes between 1.4 and 2 litres (from 1990-2002) and an increase in the number of gasoline cars (>2 litres) and diesel cars (< 2 litres). In the later years, there has been a decrease in the number of cars with an engine size smaller than 1.4 litres.

There has been a considerable growth in the number of diesel light-duty vehicles from 1990 to 2006. The two largest truck sizes have also increased in numbers during the 1990s. From 2000 onwards, this growth has continued for trucks larger than 32 tonnes, whereas the number of trucks with gross vehicle weights between 16 and 32 tonnes has decreased slightly.

The number of urban buses has been almost constant between 1990 and 2006. The sudden change in the level of coach numbers from 1994 to 1995 is due to uncertain fleet data.

The reason for the significant growth in the number of mopeds from 1994 to 2002 is the introduction of the so-called Moped 45 vehicle type. For motorcycles, the number of vehicles has grown in general throughout the entire 1990-2007 period. The increase is, however, most visible from the mid-1990s and onwards.

The vehicle numbers are summed up in EU emission layers for each year (Figure 3.48) by using the correspondence between layers and first year of registration:

$$N_{j,y} = \sum_{i=FYear(j)}^{LYear(j)} N_{i,y} \quad (1)$$

Where N = number of vehicles, j = layer, y = year, i = first year of registration.

Weighted annual mileages pr layer are calculated as the sum of all mileage driven pr first registration year divided by the total number of vehicles in the specific layer.

$$M_{j,y} = \frac{\sum_{i=FYear(j)}^{LYear(j)} N_{i,y} \cdot M_{i,y}}{\sum_{i=FYear(j)}^{LYear(j)} N_{i,y}} \quad (2)$$

For heavy duty trucks, there is a slight deviation from the strict correspondence between EU emission layers and first registration year. In this case, specific information from the Danish Car Importers Association (Danske Bilimportører, DBI, 2008) of the Euro level for the trucks sold in Denmark between 2001 and 2007 is used to estimate a percentage new sales/Euro level matrix for truck engines for these inventory years. A full new sales matrix covering all relevant inventory years is subsequently made, based on a broader view of the 2001-2007 DBI data, and taking into account the actual starting dates for Euro 0-6 engines, see Annex 3.B.16.

Vehicle numbers and weighted annual mileages pr layer are shown in Annex 3.B.1 and 3.B.2 for 1990-2007. The trends in vehicle numbers pr layer are also shown in Figure 3.48. The latter figure shows how vehicles complying with the gradually stricter EU emission levels (EURO I, II, III etc.) have been introduced into the Danish motor fleet.

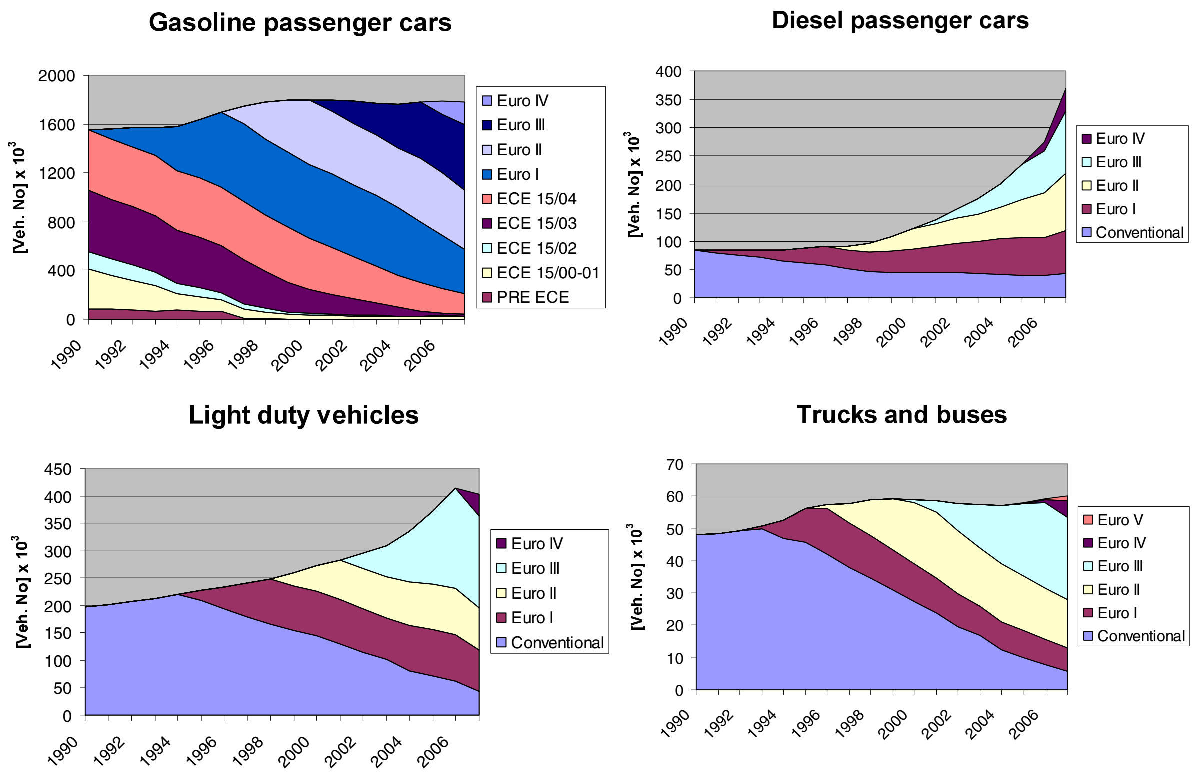


Figure 3.48 Layer distribution of vehicle numbers pr vehicle type in 1990-2007.

Emission legislation

No specific emission legislation exists for CO_2. The current EU strategy for reducing CO_2 emissions from cars is based on voluntary commitments by the car industry, consumer information (car labelling) and fiscal measures to encourage purchases of more fuel-efficient cars. Under the voluntary commitments, European manufacturers have said they will reduce average emissions from their new cars to 140g CO_2 pr km by 2008, while the Japanese and Korean industries will do so by 2009.

However, the strategy has brought only limited progress towards achieving the target of 120g CO_2 pr km by 2012; from 1995 to 2004 average emissions from new cars sold in the EU-15 fell from 186g CO_2 pr km to 163g CO_2 pr km.

The EU Commission's review of the strategy has concluded that the voluntary commitments have not succeeded and that the 120g target will not be met on time without further measures.

The main measures it is proposing in the revised strategy are as follows:

- A legislative framework to reduce CO_2 emissions from new cars and vans will be proposed by the EU Commission by the end of this year or at the latest by mid 2008. This will provide the car industry with sufficient lead time and regulatory certainty.
- Average emissions from new cars sold in the EU-27 would be required to reach the 120g CO_2 pr km target by 2012. Improvements in vehicle technology would have to reduce average emissions to no more than 130g pr km, while complementary measures would contribute a further emissions cut of up to 10g pr km, thus reducing overall emissions to 120g pr km. These complementary measures in-

clude efficiency improvements for car components with the highest impact on fuel consumption, such as tyres and air conditioning systems, and a gradual reduction in the carbon content of road fuels, notably through greater use of biofuels. Efficiency requirements will be introduced for these car components.

- For vans, the fleet average emission targets would be 175g by 2012 and 160g by 2015, compared with 201g in 2002.
- Support for research efforts aimed at further reducing emissions from new cars to an average of 95g CO_2 pr km by 2020.
- Measures to promote the purchase of fuel-efficient vehicles, notably through improved labelling and by encouraging Member States that levy car taxes to base them on cars' CO_2 emissions.
- An EU code of good practice on car marketing and advertising to promote more sustainable consumption patterns. The Commission is inviting car manufacturers to sign up to this by mid-2007.

For Euro 1-4 passenger cars and light duty trucks, the chassis dynamometer test cycle used in the EU for measuring fuel is the NEDC (New European Driving Cycle), see Nørgaard and Hansen (2004). The test cycle is also used also for emissions testing. The NEDC cycle consists of two parts, the first part being a 4-time repetition (driving length: 4 km) of the ECE test cycle. The latter test cycle is the so-called urban driving cycle4 (average speed: 19 km pr h). The second part of the test is the run-through of the EUDC (Extra Urban Driving Cycle) test driving segment, simulating the fuel consumption under rural and highway driving conditions. The driving length of EUDC is seven km at an average speed of 63 km pr h. More information regarding the fuel measurement procedure can be found in the EU-directive 80/1268/EØF.

For NO_X, VOC (NMVOC + CH_4), CO and PM, the emissions from road transport vehicles have to comply with the different EU directives listed in Table 3.23. The emission directives distinguish between three vehicle classes according to vehicle reference mass[5]: Passenger cars and light duty trucks (<1305 kg), light duty trucks (1305-1760 kg) and light duty trucks (>1760 kg).The specific emission limits are shown in Annex 3.B.3.

[4] For Euro 3 and on, the emission approval test procedure was slightly changed. The 40 s engine warm up phase before start of the urban driving cycle was removed.

[5] Reference mass: net vehicle weight + mass of fuel and other liquids + 100 kg.

Table 3.23 Overview of the existing EU emission directives for road transport vehicles.

Vehicle category	Emission layer	EU directive	First reg. date
Passenger cars (gasoline)	PRE ECE		0
	ECE 15/00-01	70/220 - 74/290	1972[a]
	ECE 15/02	77/102	1981[b]
	ECE 15/03	78/665	1982[c]
	ECE 15/04	83/351	1987[d]
	Euro I	91/441	1.10.1990[e]
	Euro II	94/12	1.1.1997
	Euro III	98/69	1.1.2001
	Euro IV	98/69	1.1.2006
	Euro V	715/2007	1.1.2011
	Euro VI	715/2007	1.9.2015
Passenger cars (diesel and LPG)		Conventional	0
	ECE 15/04	83/351	1987[d]
	Euro I	91/441	1.10.1990[e]
	Euro II	94/12	1.1.1997
	Euro III	98/69	1.1.2001
	Euro IV	98/69	1.1.2006
	Euro V	715/2007	1.1.2011
	Euro VI	715/2007	1.9.2015
Light duty trucks (gasoline and diesel)		Conventional	0
	ECE 15/00-01	70/220 - 74/290	1972[a]
	ECE 15/02	77/102	1981[b]
	ECE 15/03	78/665	1982[c]
	ECE 15/04	83/351	1987[d]
	Euro I	93/59	1.10.1994
	Euro II	96/69	1.10.1998
	Euro III	98/69	1.1.2002
	Euro IV	98/69	1.1.2007
	Euro V	715/2007	1.1.2012
	Euro VI	715/2007	1.9.2016
Heavy duty vehicles		Conventional	0
	Euro 0	88/77	1.10.1990
	Euro I	91/542	1.10.1993
	Euro II	91/542	1.10.1996
	Euro III	1999/96	1.10.2001
	Euro IV	1999/96	1.10.2006
	Euro V	1999/96	1.10.2009
Mopeds		Conventional	1.10.2014
	Euro I	97/24	0
	Euro II	2002/51	2000
Motor cycles		Conventional	2004
	Euro I	97/24	0
	Euro II	2002/51	2000
	Euro III	2002/51	2004

a,b,c,d: Expert judgement suggest that Danish vehicles enter into the traffic before EU directive first registration dates. The effective inventory starting years are a: 1970; b: 1979; c: 1981; d: 1986.

e: The directive came into force in Denmark in 1991 (EU starting year: 1993).

In practice, the emissions from vehicles in traffic are different from the legislation limit values and, therefore, the latter figures are considered to be too inaccurate for total emission calculations. A major constraint is that the emission approval test conditions reflect only to a small degree the large variety of emission influencing factors in the real traffic situation, such as cumulated mileage driven, engine and exhaust after treatment maintenance levels and driving behaviour.

Therefore, in order to represent the Danish fleet and to support average national emission estimates, emission factors must be chosen which derive from numerous emissions measurements, using a broad range of real world driving patterns and a sufficient number of test vehicles. It is similar important to have separate fuel consumption and emission data for cold-start emission calculations and gasoline evaporation (hydrocarbons).

For heavy-duty vehicles (trucks and buses), the emission limits are given in g pr kWh and the measurements are carried out for engines in a test bench, using the EU ESC (European Stationary Cycle) and ETC (European Transient Cycle) test cycles, depending on the Euro norm and exhaust gas after-treatment system installed. A description of the test cycles is given by Nørgaard and Hansen, 2004). Measurement results in g pr kWh from emission approval tests cannot be directly used for inventory work. Instead, emission factors used for national estimates must be transformed into g pr km, and derived from a sufficient number of measurements which represent the different vehicle size classes, Euro engine levels and real world variations in driving behaviour.

Fuel consumption and emission factors

Trip-speed dependent basis factors for fuel consumption and emissions are taken from the COPERT model using trip speeds as shown in Table 3.22. The factors are listed in Annex 3.B.4. For EU emission levels not represented by actual data, the emission factors are scaled according to the reduction factors given in Annex 3.B.5.

The fuel consumption and emission factors used in the Danish inventory come from the COPERT IV model. The scientific basis for COPERT IV is fuel consumption and emission information from the European 5th framework research projects ARTEMIS and Particulates. In cases where no updates are made for vehicle categories and fuel consumption/emission components, COPERT IV still uses COPERT III data; the source for these data are various European measurement programmes. In general the COPERT data are transformed into trip-speed dependent fuel consumption and emission factors for all vehicle categories and layers.

For passenger cars, real measurement results are behind the emission factors for Euro 1-4 vehicles (updated figures), and those earlier (COPERT III data). For light duty trucks the measurements represent Euro 1 and prior vehicle technologies from COPERT III. For mopeds and motorcycles, updated fuel consumption and emission figures are behind the conventional and Euro 1-3 technologies.

The experimental basis for heavy-duty trucks and buses is updated computer simulated emission factors for Euro 0-V engines. In COPERT

IV the number of heavy duty vehicle categories has increased substantially, and from the traffic data side it is not possible to support all these new vehicle categories with consistent fleet and mileage data. Thus, the COPERT III vehicle size classification still remains as the Danish inventory basis for heavy duty vehicles.

However, in order to use the new COPERT IV fuel consumption and emission information, the decision is to calculate average fuel consumption and emission factors pr technology level (Euro O-V) from COPERT IV. The average factors comprise the specific COPERT IV size categories in overlap with a given COPERT III size category. Next, these average COPERT IV factors are scaled with the ratio of fuel consumption factors between COPERT III and "average COPERT IV" in order to end up with vehicle sizes corresponding to COPERT III weight classes.

For all vehicle categories/technology levels not represented by measurements, the emission factors are produced by using reduction factors. The latter factors are determined by assessing the EU emission limits and the relevant emission approval test conditions, for each vehicle type and Euro class.

Deterioration factors

For three-way catalyst cars the emissions of NO_X, NMVOC and CO gradually increase due to catalyst wear and are, therefore, modified as a function of total mileage by the so-called deterioration factors. Even though the emission curves may be serrated for the individual vehicles, on average, the emissions from catalyst cars stabilise after a given cut-off mileage is reached due to OBD (On Board Diagnostics) and the Danish inspection and maintenance programme.

For each forecast year, the deterioration factors are calculated pr first registration year by using deterioration coefficients and cut-off mileages, as given in EMEP/CORINAIR (2007), for the corresponding layer. The deterioration coefficients are given for the two driving cycles: ”Urban Driving Cycle” (UDF) and ”Extra Urban Driving Cycle” (EUDF: urban and rural), with trip speeds of 19 and 63 km pr h, respectively.

Firstly, the deterioration factors are calculated for the corresponding trip speeds of 19 and 63 km pr h in each case determined by the total cumulated mileage less than or exceeding the cut-off mileage. The Formulas 3 and 4 show the calculations for the ”Urban Driving Cycle”:

$$UDF = U_A \cdot MTC + U_B \text{ , MTC < } U_{MAX} \quad (3)$$

$$UDF = U_A \cdot U_{MAX} + U_B \text{ , MTC >= } U_{MAX} \quad (4)$$

where UDF is the urban deterioration factor, U_A and U_B the urban deterioration coefficients, MTC = total cumulated mileage and U_{MAX} urban cut-off mileage.

In the case of trip speeds below 19 km pr h the deterioration factor, DF, equals UDF, whereas for trip speeds exceeding 63 km pr h, DF=EUDF. For trip speeds between 19 and 63 km pr h the deterioration factor, DF, is found as an interpolation between UDF and EUDF. Secondly, the deterioration factors, one for each of the three road types, are aggregated into layers by taking into account vehicle numbers and annual mileage levels pr first registration year:

$$DF_{j,y} = \frac{\sum_{i=FYear(j)}^{LYear(j)} DF_{i,y} \cdot N_{i,y} \cdot M_{i,y}}{\sum_{i=FYear(j)}^{LYear(j)} DF_{i,y} \cdot N_{i,y}} \quad (5)$$

where DF is the deterioration factor.

For N_2O and NH_3, COPERT IV takes into account deterioration as a linear function of mileage for gasoline fuelled EURO 1-4 passenger cars and light duty vehicles. The level of emission deterioration also relies on the content of sulphur in the fuel. The deterioration coefficients are given in EMEP/CORINAIR (2007), for the corresponding layer. A cut-off mileage of 120 000 km (pers. comm. Ntziachristos, 2007) is behind the calculation of the modified emission factors, and for the Danish situation the low sulphur level interval is assumed to be most representative.

Emissions and fuel consumption for hot engines

Emissions and fuel-use results for operationally hot engines are calculated for each year and for layer and road type. The procedure is to combine fuel consumption and emission factors (and deterioration factors for catalyst vehicles), number of vehicles, annual mileage levels and the relevant road-type shares given in Table 3.23. For non-catalyst vehicles this yields:

$$E_{j,k,y} = EF_{j,k,y} \cdot S_k \cdot N_{j,y} \cdot M_{j,y} \quad (6)$$

Here E = fuel consumption/emission, EF = fuel consumption/emission factor, S = road type share and k = road type.

For catalyst vehicles the calculation becomes:

$$E_{j,k,y} = DF_{j,k,y} \cdot EF_{j,k,y} \cdot S_k \cdot N_{j,y} \cdot M_{j,y} \quad (7)$$

Extra emissions and fuel consumption for cold engines

Extra emissions of NO_X, VOC, CH_4, CO, PM, N_2O, NH_3 and fuel consumption from cold start are simulated separately. For SO_2 and CO_2, the extra emissions are derived from the cold start fuel consumption results.

In terms of cold start data for NO_X, VOC, CO, PM and fuel consumption no updates are made to the COPERT IV methodology, and the calculation approach is the same as in COPERT III. Each trip is associated with a certain cold-start emission level and is assumed to take place under urban driving conditions. The number of trips is distributed evenly across the months. First, cold emission factors are calculated as the hot emission factor times the cold:hot emission ratio. Secondly, the extra emission factor during cold start is found by subtracting the hot emission factor from the cold emission factor. Finally, this extra factor is applied on the fraction of the total mileage driven with a cold engine (the β-factor) for all vehicles in the specific layer.

The cold:hot ratios depend on the average trip length and the monthly ambient temperature distribution. The Danish temperatures for 2006, 2005 and 2004 are given in Cappelen et al. (2007, 2006, 2005). For 2000-2003, 1990-1999 and 1980-1989 the temperature data are from Cappelen (2004, 2000 and 2003). The cold:hot ratios are equivalent for gasoline fuelled conventional passenger cars and vans and for diesel passenger cars and vans, respectively, see Ntziachristos et al. (2000). For conventional gasoline and all diesel vehicles the extra emissions become:

$$CE_{j,y} = \beta \cdot N_{j,y} \cdot M_{j,y} \cdot EF_{U,j,y} \cdot (CEr - 1) \quad (8)$$

Where CE is the cold extra emissions, β = cold driven fraction, CEr = Cold:Hot ratio.

For catalyst cars, the cold:hot ratio is also trip speed dependent. The ratio is, however, unaffected by catalyst wear. The Euro I cold:hot ratio is used for all future catalyst technologies. However, in order to comply with gradually stricter emission standards, the catalyst light-off temperature must be reached in even shorter periods of time for future EURO standards. Correspondingly, the β-factor for gasoline vehicles is reduced step-wise for Euro II vehicles and their successors.

For catalyst vehicles the cold extra emissions are found from:

$$CE_{j,y} = \beta_{red} \cdot \beta_{EUROI} \cdot N_{j,y} \cdot M_{j,y} \cdot EF_{U,j,y} \cdot (CEr_{EUROI} - 1) \quad (9)$$

where β_{red} = the β reduction factor.

For CH_4, specific emission factors for cold driven vehicles are included in COPERT IV. The β and β_{red} factors for VOC is used to calculate the cold driven fraction for each relevant vehicle layer. The NMVOC emissions during cold start are found as the difference between the calculated results for VOC and CH_4.

For N_2O and NH_3, specific cold start emission factors are also proposed by COPERT IV. For catalyst vehicles, however, just like in the case of hot emission factors, the emission factors for cold start are functions of cumulated mileage (emission deterioration). The level of emission deterioration also relies on the content of sulphur in the fuel. The deterioration coefficients are given in EMEP/CORINAIR (2007), for the corresponding layer. For cold start, the cut-off mileage and sulphur level interval for hot engines are used, as described in the deterioration factors paragraph.

Evaporative emissions from gasoline vehicles

For each year, evaporative emissions of hydrocarbons are simulated in the forecast model as hot and warm running losses, hot and warm soak loss and diurnal emissions. For evaporation, no updates are made to the COPERT IV methodology, and the calculation approach is the same as in COPERT III. All emission types depend on RVP (Reid Vapour Pressure) and ambient temperature. The emission factors are shown in Ntziachristos et al. (2000).

Running loss emissions originate from vapour generated in the fuel tank while the vehicle is running. The distinction between hot and warm running loss emissions depends on engine temperature. In the model, hot and warm running losses occur for hot and cold engines, respectively. The emissions are calculated as annual mileage (broken down into cold and hot mileage totals using the β-factor) times the respective emission factors. For vehicles equipped with evaporation control (catalyst cars), the emission factors are only one tenth of the uncontrolled factors used for conventional gasoline vehicles.

$$R_{j,y} = N_{j,y} \cdot M_{j,y} \cdot ((1-\beta) \cdot HR + \beta \cdot WR) \quad (10)$$

where R is running loss emissions and HR and WR are the hot and warm running loss emission factors, respectively.

In the model, hot and warm soak emissions for carburettor vehicles also occur for hot and cold engines, respectively. These emissions are calculated as number of trips (broken down into cold and hot trip numbers using the β-factor) times respective emission factors:

$$S_{j,y}{}^{C} = N_{j,y} \cdot \frac{M_{j,y}}{l_{trip}} \cdot ((1-\beta) \cdot HS + \beta \cdot WS) \quad (11)$$

where S^C is the soak emission, l_{trip} = the average trip length, and HS and WS are the hot and warm soak emission factors, respectively. Since all catalyst vehicles are assumed to be carbon canister controlled, no soak emissions are estimated for this vehicle type. Average maximum and minimum temperatures pr month are used in combination with diurnal emission factors to estimate the diurnal emissions from uncontrolled vehicles $E^d(U)$:

$$E_{j,y}{}^{d}(U) = 365 \cdot N_{j,y} \cdot e^{d}(U) \quad (12)$$

Each year's total is the sum of each layer's running loss, soak loss and diurnal emissions.

Fuel consumption balance

The calculated fuel consumption in COPERT III must equal the statistical fuel sale totals according to the UNFCCC and UNECE emissions reporting format. The statistical fuel sales for road transport are derived from the Danish Energy Authority data (see DEA, 2008). The DEA data are further processed for gasoline in order to account for e.g. non road and recreational craft fuel consumption, which are not directly stated in the statistics, please refer to paragraph 1.1.4 for further information regarding the transformation of DEA fuel data.

The standard approach to achieve a fuel balance in annual emission inventories is to multiply the annual mileage with a fuel balance factor derived as the ratio between simulated and statistical fuel figures for gasoline and diesel, respectively. This method is also used in the present model.

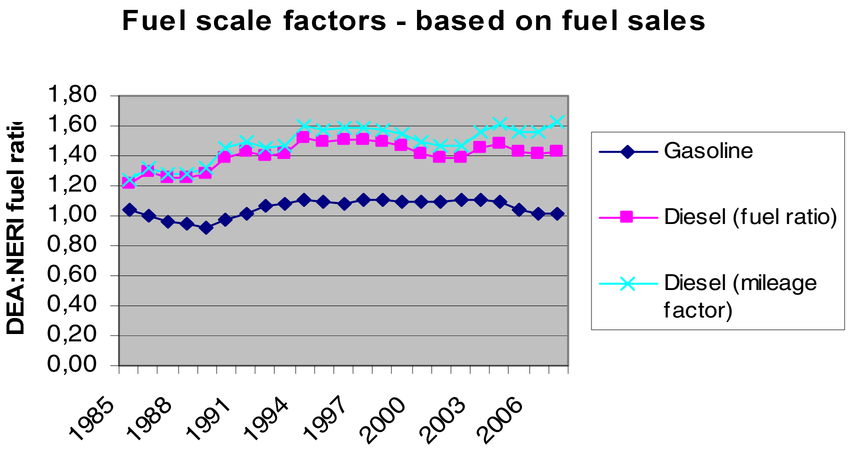


Figure 3.49 DEA:NERI Fuel ratios and diesel mileage adjustment factor based on DEA fuel sales data and NERI fuel consumption estimates.

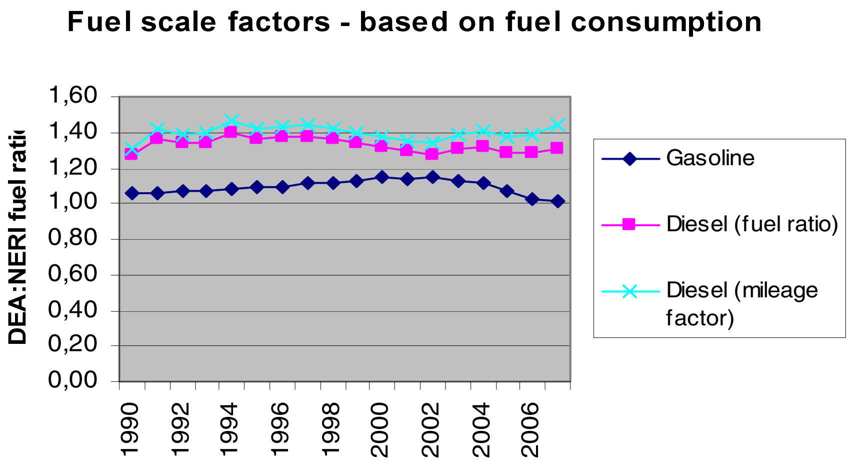


Figure 3.50 DEA:NERI Fuel ratios and diesel mileage adjustment factor based on DEA fuel consumption data and NERI fuel consumption estimates.

In Figure 3.49 and Figure 3.50 the COPERT IV:DEA gasoline and diesel fuel consumption ratios are shown for fuel sales and fuel consumption from 1990-2007. The data behind the figures are also listed in Annex 3.B.8. The fuel consumption figures are related to the traffic on Danish roads.

For gasoline vehicles all mileage numbers are equally scaled in order to obtain gasoline fuel equilibrium, and hence the gasoline mileage factor used is the reciprocal value of the COPERT IV:DEA gasoline fuel consumption ratio.

For diesel the fuel balance is made by adjusting the mileage for light and heavy-duty vehicles and buses, given that the mileage and fuel consumption factors for these vehicles are regarded as the most uncertain parameters in the diesel engine emission simulations. Consequently, the diesel mileage factor used is slightly higher than the reciprocal value of the COPERT IV:DEA diesel fuel consumption ratio.

From the Figures 3.49 and 3.50 it appears that the inventory fuel balances for gasoline and diesel would be improved, if the DEA statistical figures for fuel consumption were used instead of fuel sale numbers. The fuel difference for diesel is, however, still significant. The reasons for this inaccuracy are a combination of the uncertainties related to COPERT IV fuel consumption factors, allocation of vehicle numbers in subcategories, annual mileage, trip speeds and mileage splits for urban, rural and highway driving conditions.

For future inventories it is intended to use improved fleet and mileage data and improved data for trip speed and mileage split for urban, rural and highway driving. The update of road traffic fleet and mileage data will be made as soon as this information is provided from the Danish Ministry of Transport and Energy in a COPERT IV model input format.

The final fuel consumption and emission factors pr vehicle type are shown in Annex 3.B.6 for 1990-2007. The total fuel consumption and emissions are shown in Annex 3.B.7, pr vehicle category and as grand totals, for 1990-2007 (and CRF format in Annex 3.B.15). In Annex 3.B.14, fuel-use and emission factors as well as total emissions are given in CollectER format for 1990 and 2007.

In the following Figures 3.51-3.54, the fuel related emission factors for CH_4 and N_2O are shown pr vehicle type for the Danish road transport (from 1990-2007). For CO_2 the emission factors are country specific values, and come from the DEA. From 2006, bio ethanol has become available from a limited number of gas filling stations in Denmark. Following the IPCC guideline definitions, bio ethanol is regarded as CO_2 neutral for the transport sector as such. The sulphur content for bioethanol is zero, and hence, the aggregated CO_2 (and SO_2) factors for gasoline have been adjusted, on the basis of the energy content of pure gasoline and bio ethanol. In Denmark, only E5 gasoline-ethanol blends is sold at the gas stations in negligible amounts. Currently no consistent sets of emission factor changes are available to modify the emission factors for the neat gasoline case. However, a literature review in a Danish research project (REBECA) currently carried out seeks to sort out these emission changes. If this study, and research studies made by other researchers points out significant emission changes from using E5 blends compared to neat gasoline, these emission changes will be incorporated in the basis emission factors used to calculate the Danish road transport emissions, and subsequently reflected in the implied emission factors for this sector.

The CO_2 factors are shown pr fuel type in Table 3.24.

Table 3.24 Fuel-specific emission factors for CO_2 (kg pr GJ) for road transport in Denmark.

Fuel type	1990-2005	2006	2007
Gasoline	73	72.9	72.8
Diesel	74	74	74
LPG	65	65	65

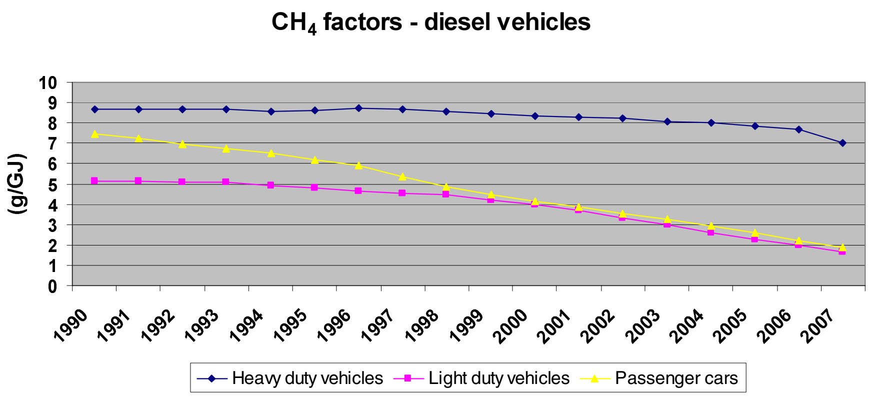


Figure 3.51 Fuel related CH_4 emission factors (diesel) pr vehicle type for Danish road transport (1990-2007).

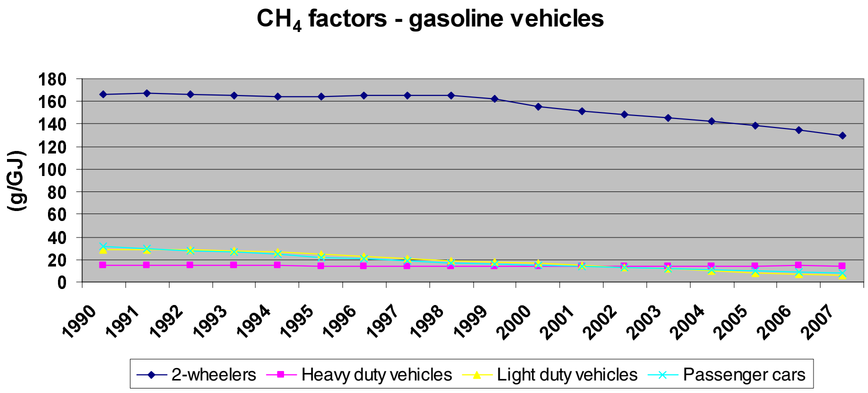


Figure 3.52 Fuel related CH_4 emission factors (gasoline) pr vehicle type for Danish road transport (1990-2007).

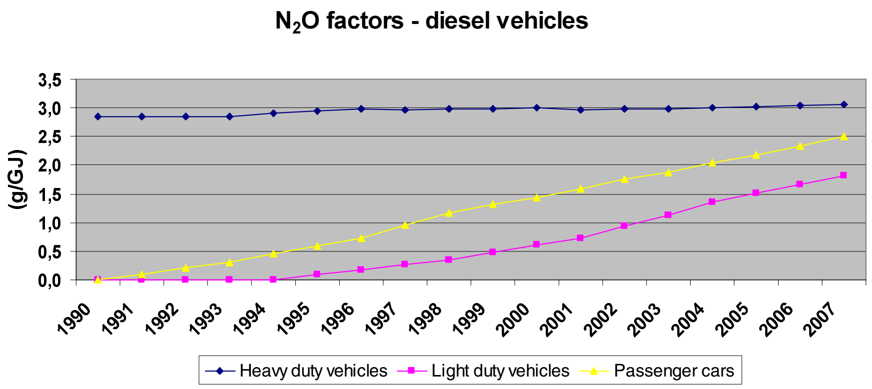


Figure 3.53 Fuel related N_2O emission factors (diesel) pr vehicle type for Danish road transport (1990-2006).

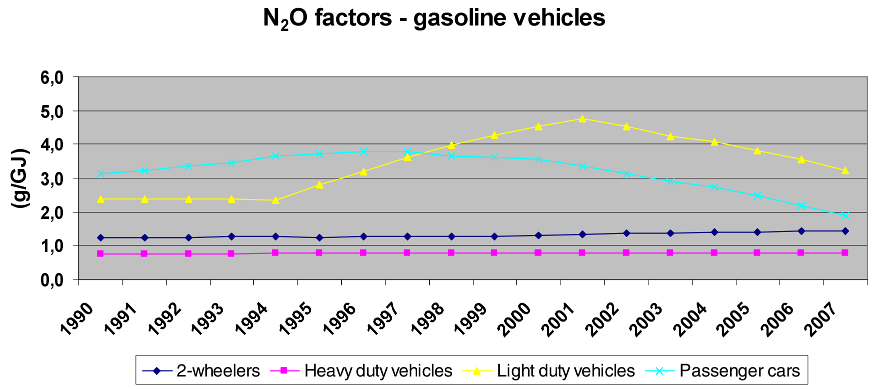


Figure 3.54 Fuel related N_2O emission factors (gasoline) pr vehicle type for Danish road transport (1990-2006).

Methodologies and references for other mobile sources

Other mobile sources are divided into several sub-sectors: sea transport, fishery, air traffic, railways, military, and working machinery and equipment in the sectors agriculture, forestry, industry and residential. The emission calculations are made using the detailed method as described in the EMEP/CORINAIR Emission Inventory Guidebook (EMEP/CORINAIR, 2007) for air traffic, off-road working machinery and equipment, and ferries, while for the remaining sectors the simple method is used.

3.3.3 Activity data

Air traffic

The activity data for air traffic consists of air traffic statistics provided by the Danish Civil Aviation Agency (CAA-DK) and Copenhagen Airport. Fuel statistics for jet fuel use and aviation gasoline are obtained from the Danish energy statistics (DEA, 2008).

For 2001 onwards, pr flight records are provided by CAA-DK as data codes for aircraft type, and origin and destination airports (city-pairs).

Subsequently the aircraft types are separated by NERI into larger aircraft using jet fuel (jet engines, turbo props, helicopters) and small aircraft types with piston engines using aviation gasoline. This is done by using different aircraft dictionaries, internet look-ups and by communication with the CAA-DK. Each of the larger aircraft type is then matched with a representative type for which fuel consumption and emission data are available from the EMEP/CORINAIR databank. Relevant for this selection is aircraft maximum take off mass, engine types, and number of engines. A more thorough explanation is given in Winther (2001a, b).

The ideal flying distance (great circle distance) between the city-pairs is calculated by NERI in a separate database. The calculation algorithm uses a global latitude/altitude coordinate table for airports. In cases when airport coordinates are not present in the NERI database, these are looked up on the internet and entered into the database accordingly.

For inventory years prior to 2001, detailed LTO/aircraft type statistics are obtained from Copenhagen Airport (for this airport only), while information of total take-off numbers for other Danish airports is provided by CAA-DK. The assignment of representative aircraft types for Copenhagen Airport is done as described above. For the remaining Danish airports representative aircraft types are not directly assigned. Instead appropriate average assumptions are made relating to the fuel consumption and emission data part.

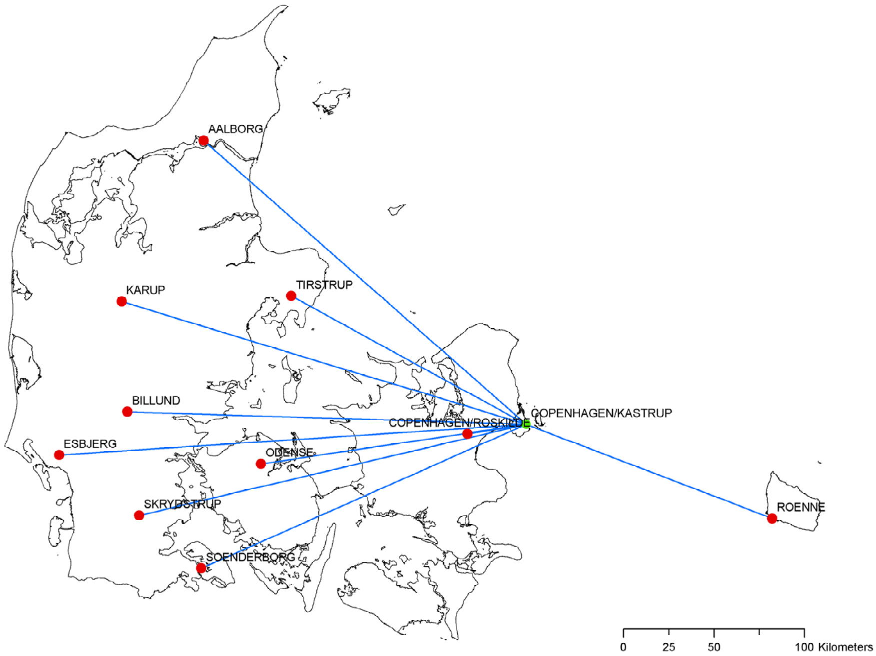


Figure 3.55 Most frequent domestic flying routes for large aircraft in Denmark.

Copenhagen Airport is the starting or end point for most of the domestic aviation made by large aircraft in Denmark (Figure 3.55). Even though many domestic flights not touching Copenhagen Airport are also reported in the flight statistics kept by CAA-DK, these flights, however, are predominantly made with small piston engine aircraft using aviation gasoline. Hence, the consumption of jet fuel by flights not using Copenhagen is merely marginal.

Non-road working machinery and equipment

Non-road working machinery and equipment are used in agriculture, forestry and industry, for household/gardening purposes and in inland waterways (recreational craft). Information on the number of different types of machines, their respective load factors, engine sizes and annual working hours has been provided by Winther et al. (2006). The stock development from 1990-2007 for the most important types of machinery are shown in Figures 3.52-3.59. The stock data are also listed in Annex 3.B.10, together with figures for load factors, engine sizes and annual working hours. As regards stock data for the remaining machinery types, please refer to (Winther et al., 2006).

For agriculture, the total number of agricultural tractors and harvesters pr yr are shown in the Figures 3.56-3.57, respectively. The figures clearly show a decrease in the number of small machines, these being replaced by machines in the large engine-size ranges.

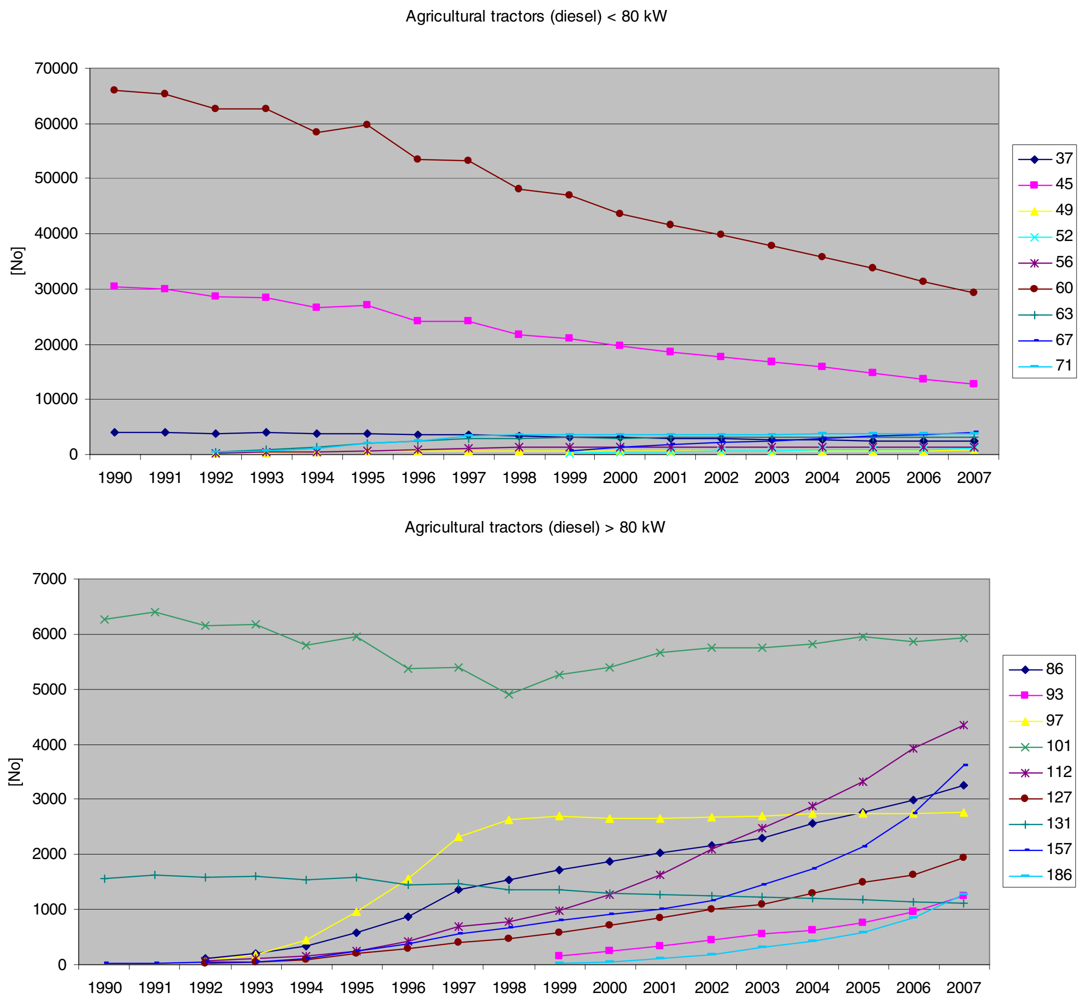


Figure 3.36 Total numbers in kW classes for tractors from 1990 to 2007.

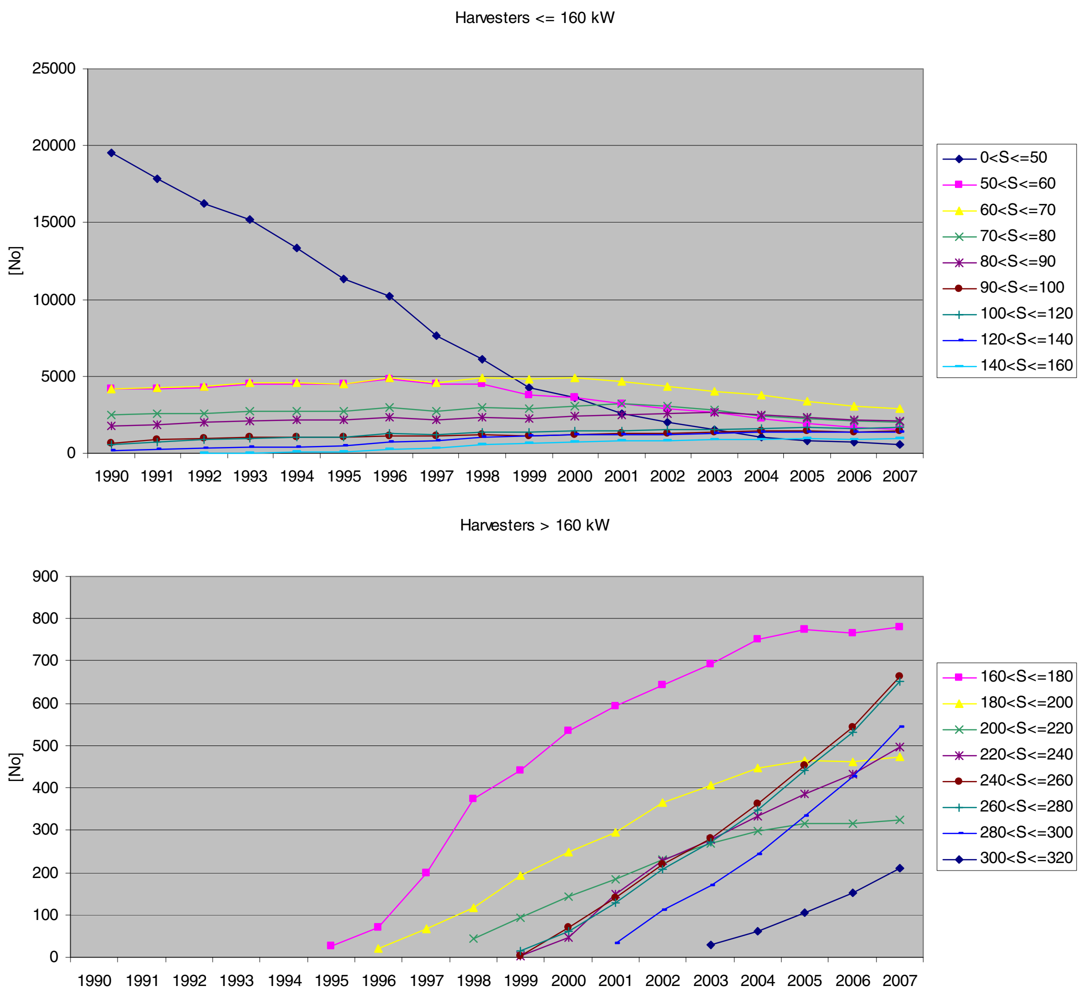


Figure 3.57 Total numbers in kW classes for harvesters from 1990 to 2007.

The tractor and harvester developments towards fewer vehicles and larger engines, shown in Figure 3.58, are very clear. From 1990 to 2007, tractor and harvester numbers decrease by around 22 % and 45 %, respectively, whereas the average increase in engine size for tractors is 22 %, and more than 109 % for harvesters, in the same time period.

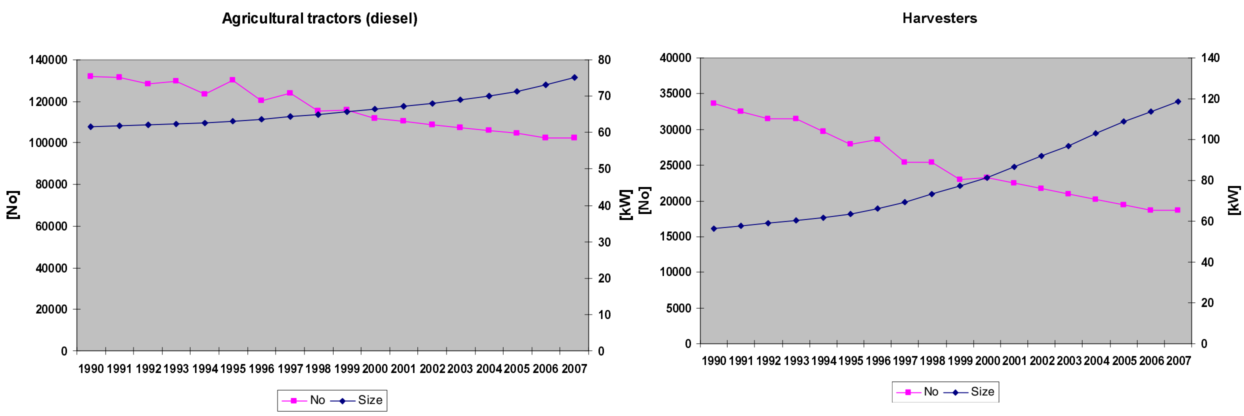
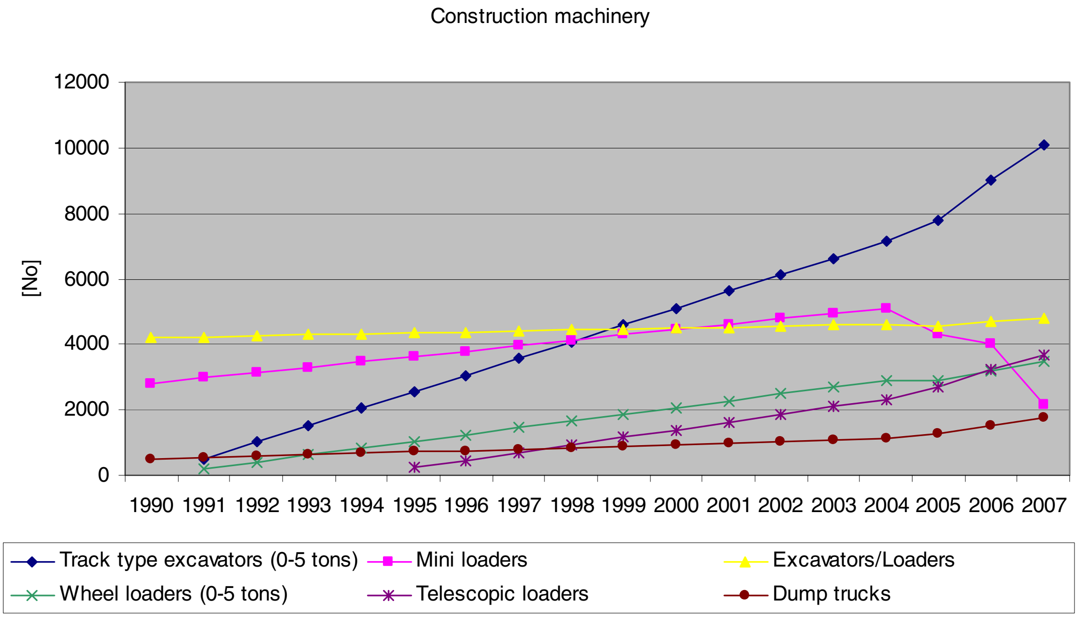


Figure 3.58 Total numbers and average engine size for tractors and harvesters (1990 to 2007).

The most important machinery types for industrial use are different types of construction machinery and fork lifts. The Figures 3.59 and 3.60 show the 1990-2007 stock development for specific types of construction machinery and diesel fork lifts. For most of the machinery types there is an increase in machinery numbers from 1990 onwards, due to increased construction activities. It is assumed that track type excavators/wheel type loaders (0-5 tonnes), and telescopic loaders first enter into use in 1991 and 1995, respectively.



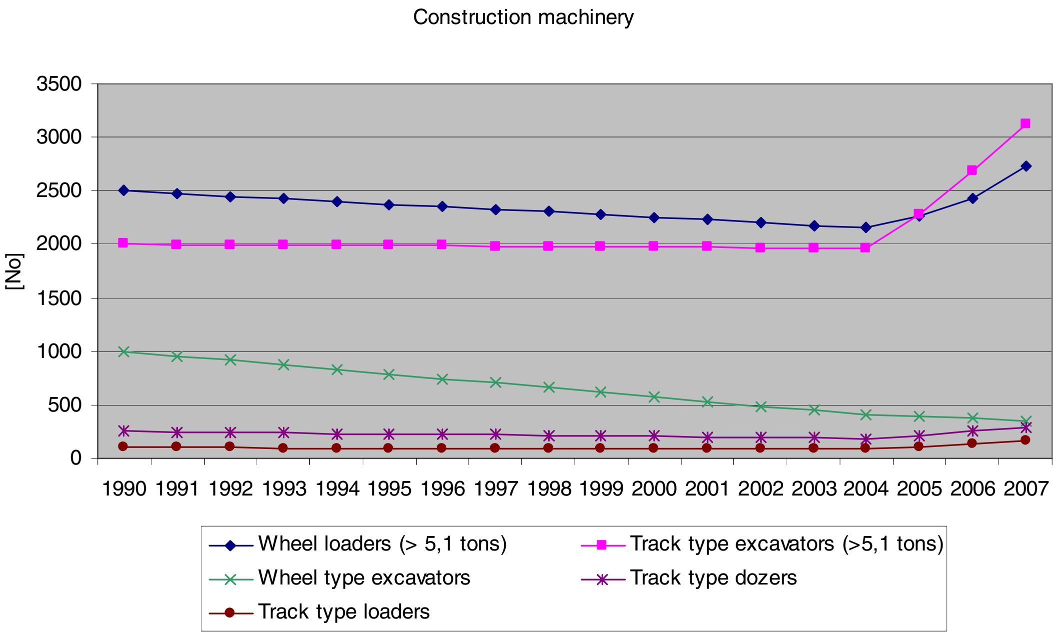


Figure 3.59 1990-2007 stock development for specific types of construction machinery.

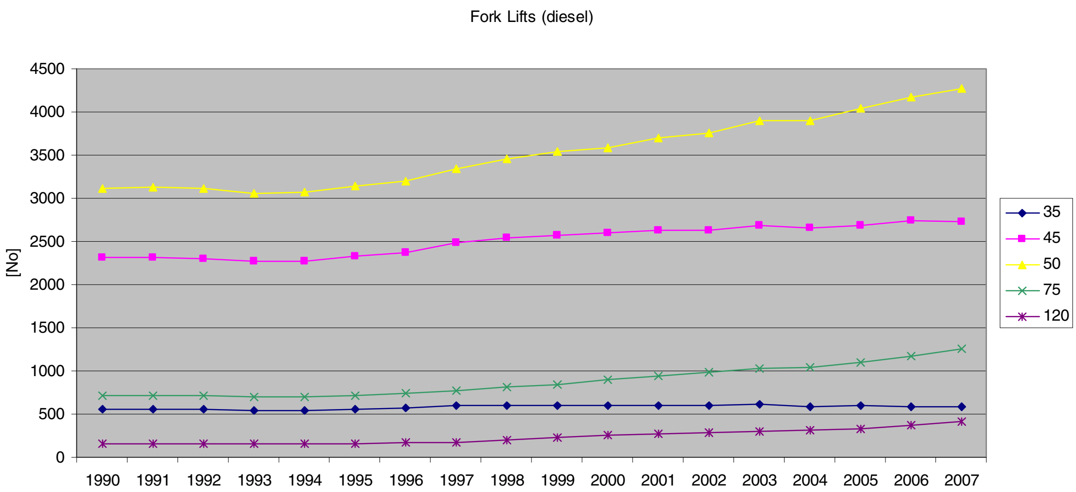


Figure3.60 Total numbers of diesel fork lifts in kW classes from 1990 to 2007.

The emission level shares for tractors, harvesters, construction machinery and diesel fork lifts are shown in Figure 3.61, and present an overview of the penetration of the different pre-Euro engine classes, and engine stages complying with the gradually stricter EU stage I and II emission limits. The average lifetimes of 30, 25, 20 and 10 years for tractors, harvesters, fork lifts and construction machinery, respectively, influence the individual engine technology turn-over speeds.

The EU emission directive Stage I and II implementation years relate to engine size, and for all four machinery groups the emission level shares for the specific size segments will differ slightly from the picture shown in Figure 3.61. Due to scarce data for construction machinery, the emission level penetration rates are assumed to be linear and the general technology turnover pattern is as shown in Figure 3.61.

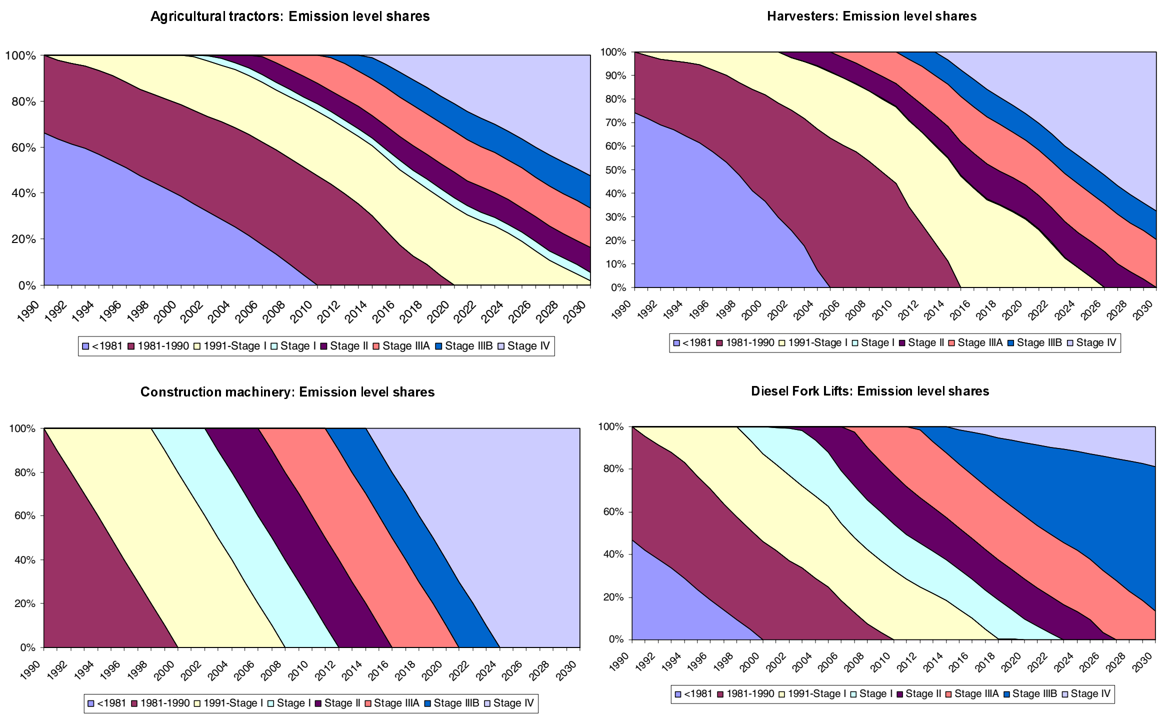


Figure 3.61 Emission level shares for tractors, harvesters, construction machinery and diesel fork lifts (1990 to 2007).

The 1990-2007 stock development for the most important household and gardening machinery types is shown in Figure 3.62. . The 2006 stock data for these machinery types are repeated for 2007, since no new stock information has been obtained.

For lawn movers and cultivators, the machinery stock remains approximately the same for all years. The stock figures for chain saws, shrub clearers, trimmers and hedge cutters increase from 1990 until 2004, and for riders this increase continues also after 2004. The yearly stock increases, in most cases, become larger after 2000. The lifetimes for gasoline machinery are short and, therefore, there new emission levels (not shown) penetrate rapidly.

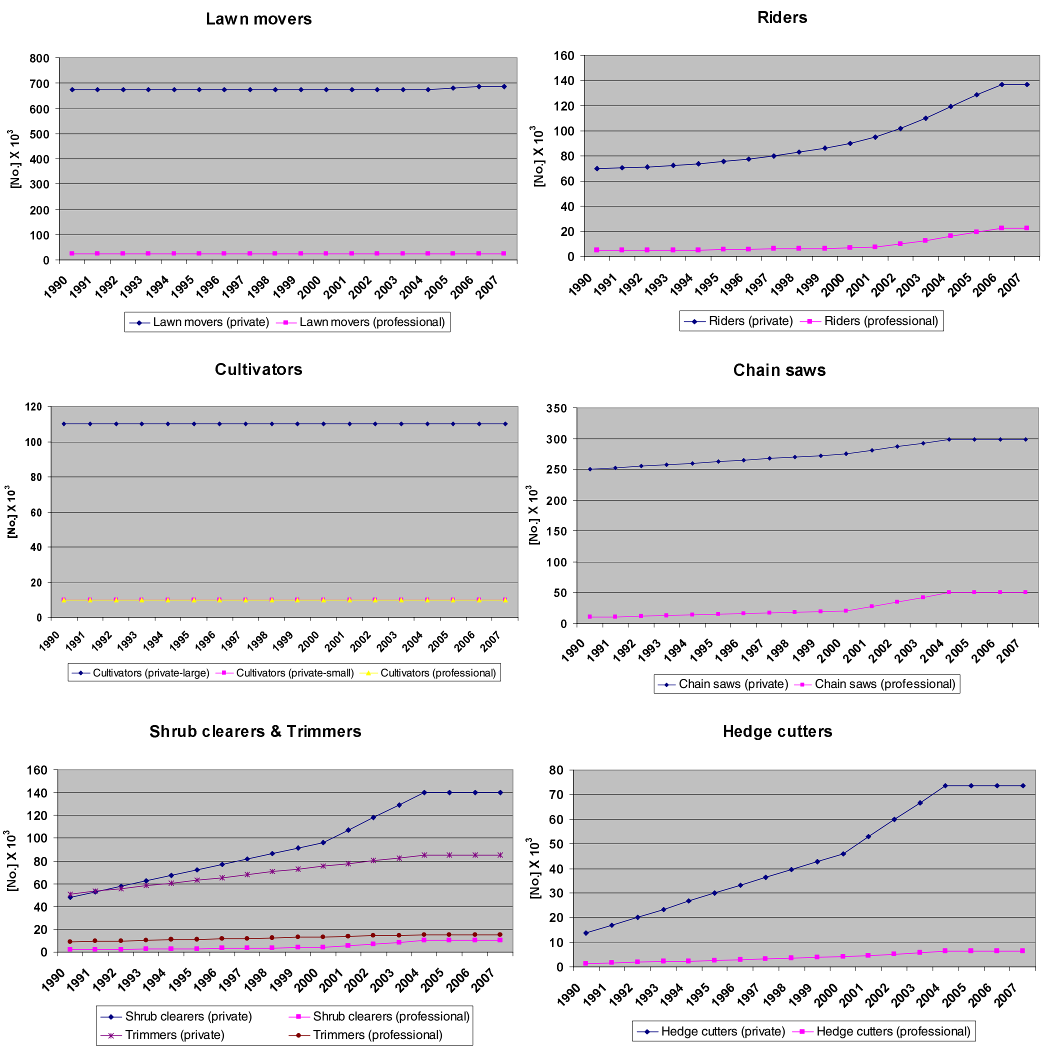


Figure 3.62 Stock development 1990-2007 for the most important household and gardening machinery types.

Figure 3.63 shows the development in numbers of different recreational craft from 1990-2007. The 2004 stock data for recreational craft are repeated for 2005-2007, since no new fleet information has been obtained.

For diesel boats, increases in stock and engine size are expected during the whole period, except for the number of motor boats (< 27 ft.) and the engine sizes for sailing boats (<26 ft.), where the figures remain unchanged. A decrease in the total stock of sailing boats (<26 ft.) by 21 % and increases in the total stock of yawls/cabin boats and other boats (<20 ft.) by around 25 % are expected. Due to a lack of information specific to Denmark, the shifting rate from 2-stroke to 4-stroke gasoline engines is based on a German non-road study (IFEU, 2004).

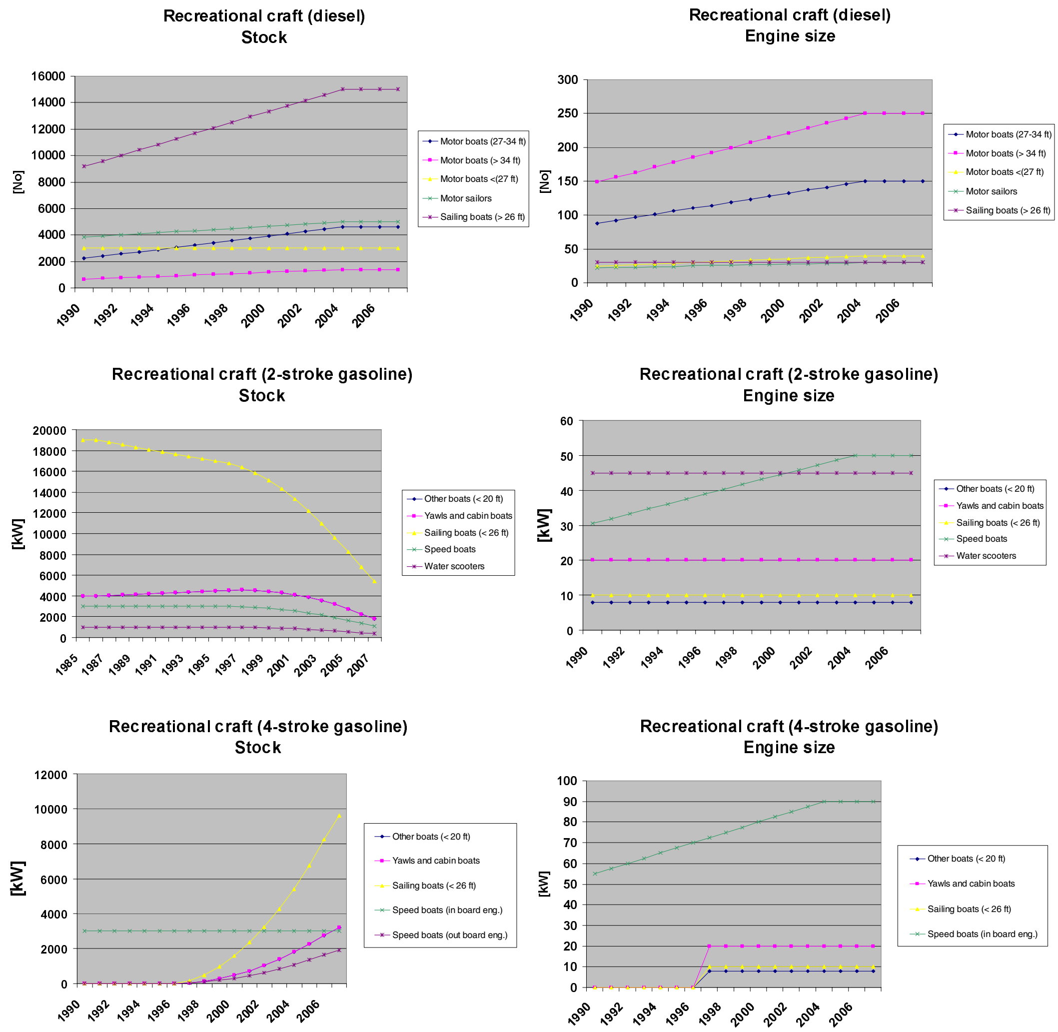


Figure 3.63 1990-2007 Stock and engine size development for recreational craft.

National sea transport

A new methodology is used to estimate the fuel consumption figures for national sea transport, based on fleet activity estimates for regional ferries, local ferries and other national sea transport (Winther, 2008a).

Table 3.25 lists the most important domestic ferry routes in Denmark in the period 1990-2007. For these ferry routes and the years 1990-2005, the following detailed traffic and technical data have been gathered by Winther (2008a): Ferry name, year of service, engine size (MCR), engine type, fuel type, average load factor, auxiliary engine size and sailing time (single trip).

For 2006 and 2007, traffic data for specific ferries have been provided by Kristensen (2008) in the case of Mols-Linien (Sjællands Odde-Ebeltoft, Sjællands Odde-Århus, Kalundborg-Århus) and by Hjortberg (2008) for Bornholmstrafikken (Køge-Rønne).

Table 3.25 Ferry routes comprised in the Danish inventory.

Ferry service	Service period
Halsskov-Knudshoved	1990-1999
Hundested-Grenaa	1990-1996
Kalundborg-Juelsminde	1990-1996
Kalundborg-Samsø	1990-
Kalundborg-Århus	1990-
Korsør-Nyborg, DSB	1990-1997
Korsør-Nyborg, Vognmandsruten	1990-1999
København-Rønne	1990-2004
Køge-Rønne	2004-
Sjællands Odde-Ebeltoft	1990-
Sjællands Odde-Århus	1999-
Tårs-Spodsbjerg	1990-

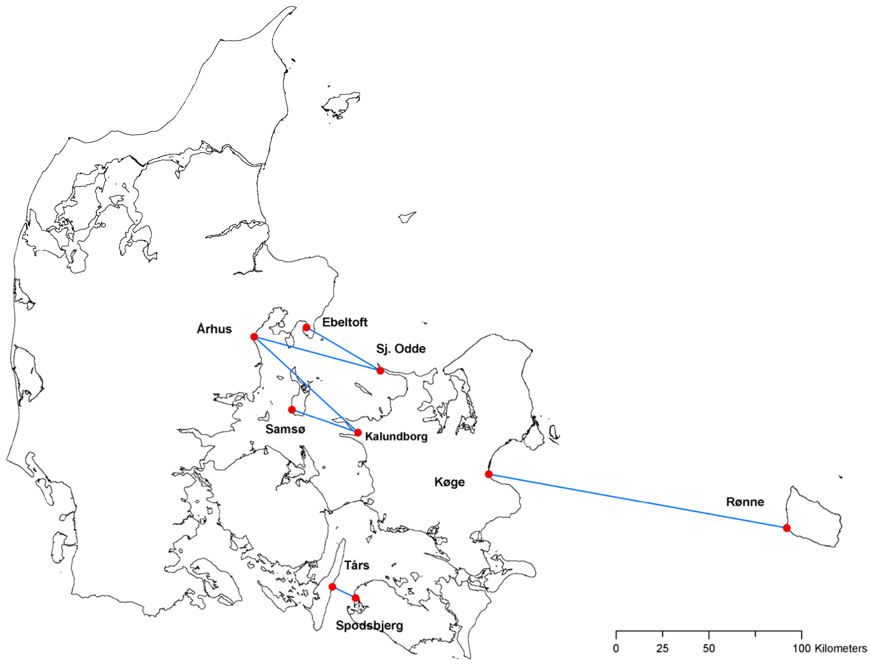


Figure 3.64 Domestic regional ferry routes in Denmark (2007).

The number of round trips pr ferry route is shown in Figure 3.64. The traffic data are also listed in Annex 3.B.11, together with different ferry specific technical and operational data.

For each ferry, Annex 3.B.12 lists the relevant information as regards ferry route, name, year of service, engine size (MCR), engine type, fuel type, average load factor, auxiliary engine size and sailing time (single trip).

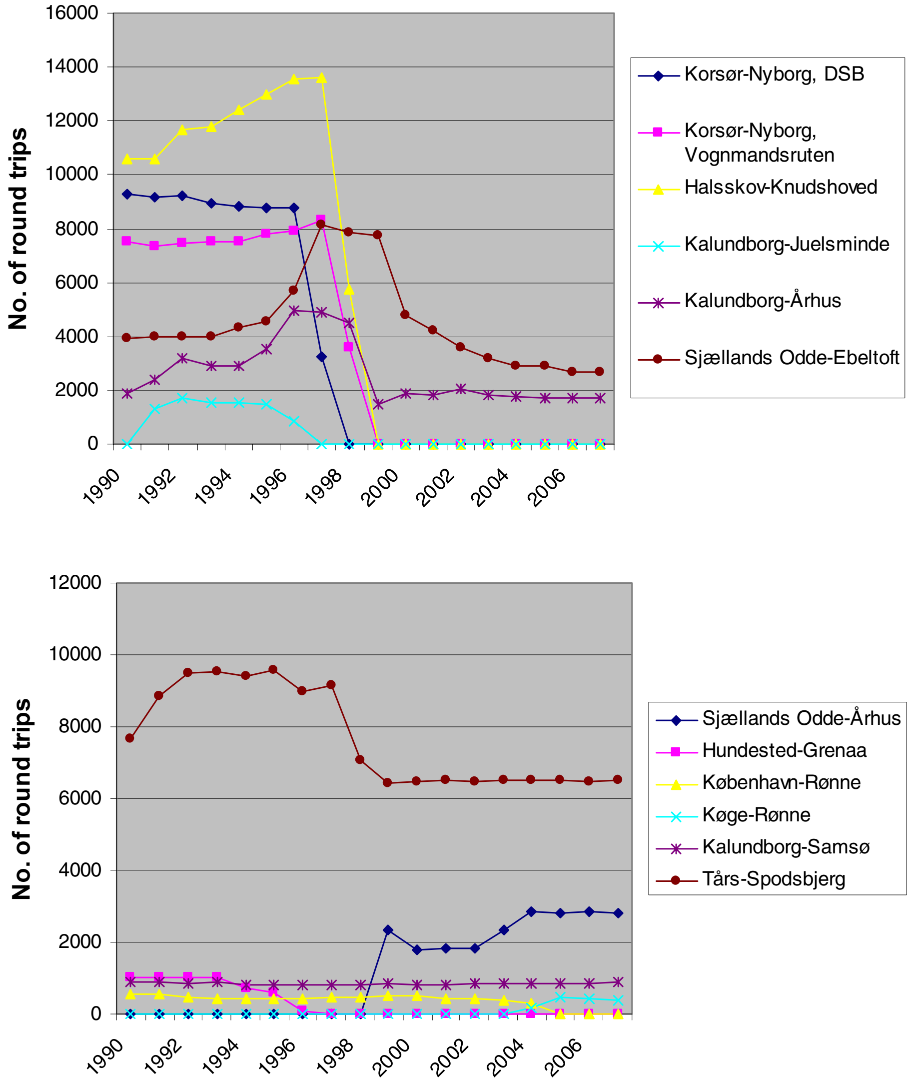


Figure 3.65 No. of round trips for the most important ferry routes in Denmark 1990-2007.

It is seen from Table 3.25(and Figure 3.65) that several ferry routes were closed in the time period from 1996-1998, mainly due to the opening of the Great Belt Bridge (connecting Zealand and Funen) in 1997. Hundested-Grenaa and Kalundborg-Juelsminde was closed in 1996, Korsør-Nyborg (DSB) closed in 1997, and Halsskov-Knudshoved and Korsør-Nyborg (Vognmandsruten) was closed in 1998. The ferry line København-Rønne was replaced by Køge-Rønne in 2004 and from 1999 a new ferry connection was opened between Sjællands Odde and Århus.

For the local ferries, a bottom-up estimate of fuel consumption for 1996 has been taken from the Danish work in Wismann (2001). The latter project calculated fuel consumption and emissions for all sea transport in Danish waters in 1995/1996 and 1999/2000. In order to cover the entire 1990-2006 inventory period, the fuel figure for 1996 has been adjusted according to the developments in local ferry route traffic shown in Annex 3.B.11.

For the remaining part of the traffic between two Danish ports, other national sea transport, new bottom-up estimates for fuel consumption have been calculated for the years 1995 and 1999 by Wismann (2007). The calculations use the database set up for Denmark in the Wismann (2001) study, with actual traffic data from the Lloyd's LMIS database (not including ferries). The database was split into three vessel types: bulk carriers, container ships, and general cargo ships; and five size classes: 0-1000, 1000-3000, 3000-10000, 10000-20000 and >20000 DTW. The calculations assume that bulk carriers and container ships use heavy fuel oil, and that general cargo ships use gas oil. For further information regarding activity data for local ferries and other national sea transport, please refer to Winther (2008a).

The fleet activity data for regional ferries, and the fleet activity based fuel consumption estimates for local ferries and other national sea transport provided by Winther (2008a) replace the previous fuel based activity data which originated directly from the DEA statistics.

Other sectors

The activity data for military, railways, international sea transport and fishery consists of fuel consumption information from DEA (2007). For international sea transport, the basis is fuel sold in Danish ports for vessels with a foreign destination, as prescribed by the IPCC guidelines.

For fisheries, the calculation methodology described by Winther (2008a) remains fuel based. However, the input fuel data differ from the fuel sales figures previously used. The changes are the result of further data processing of the DEA reported gas oil sales for national sea transport and fisheries, prior to inventory input. For years when the fleet activity estimates of fuel consumption for national sea transport are smaller than reported fuel sold, fuel is added to fisheries in the inventory. Conversely, lower fuel sales in relation to bottom-up estimates for national sea transport means that fuel is being subtracted from the original fisheries fuel sales figure in order to make up the final fuel consumption input for fisheries.

The updated fuel consumption time-series for national sea transport lead, in turn, to changes in the energy statistics for fisheries (gas oil) and industry (heavy fuel oil), so the national energy balance can remain unchanged.

For all sectors, fuel consumption figures are given in Annex 3.B.14 for the years 1990 and 2006 in CollectER format.

Emission legislation

For the engines used by other mobile sources, no legislative limits exist for specific fuel consumption. And no legislative limits exist for the emissions of CO_2 which are directly fuel dependent. The engines, however, do have to comply with the emission legislation limits agreed by the EU and, except for ships, the VOC emission limits influence the emissions of CH_4, these forming part of total VOC.

For non-road working machinery and equipment, and recreational craft and railway locomotives/motor cars, the emission directives list specific emission limit values (g pr kWh) for CO, VOC, NO_x (or VOC + NO_x) and TSP, depending on engine size (kW for diesel, ccm for gasoline) and date of implementation (referring to engine market date).

For diesel, the directives 97/68 and 2004/26 relate to non-road machinery other than agricultural and forestry tractors, and the directives have different implementation dates for machinery operating under transient and constant loads. The latter directive also comprises emission limits for railway machinery. For tractors the relevant directives are 2000/25 and 2005/13. For gasoline, the directive 2002/88 distinguishes between hand-held (SH) and not hand-held (NS) types of machinery.

For engine type approval, the emissions (and fuel consumption) are measured using various test cycles (ISO 8178). Each test cycle consists of a number of measurement points for specific engine loads during constant operation. The specific test cycle used depends on the machinery type in question and the test cycles are described in more details in the directives.

Table 3.26 Overview of EU emission directives relevant for diesel fuelled non-road machinery.

Stage/Engine size [kW]	CO	VOC	NO_X	$VOC+NO_X$	PM	Diesel machinery			Tractors	
							Implement. date		EU	Implement.
	[g pr kWh]					EU Directive	Transient	Constant	directive	date
Stage I										
37<=P<75	6.5	1.3	9.2	-	0.85	97/68	1/4 1999	-	2000/25	1/7 2001
Stage II										
130<=P<560	3.5	1	6	-	0.2	97/68	1/1 2002	1/1 2007	2000/25	1/7 2002
75<=P<130	5	1	6	-	0.3		1/1 2003	1/1 2007		1/7 2003
37<=P<75	5	1.3	7	-	0.4		1/1 2004	1/1 2007		1/1 2004
18<=P<37	5.5	1.5	8	-	0.8		1/1 2001	1/1 2007		1/1 2002
Stage IIIA										
130<=P<560	3.5	-	-	4	0.2	2004/26	1/1 2006	1/1 2011	2005/13	1/1 2006
75<=P<130	5	-	-	4	0.3		1/1 2007	1/1 2011		1/1 2007
37<=P<75	5	-	-	4.7	0.4		1/1 2008	1/1 2012		1/1 2008
19<=P<37	5.5	-	-	7.5	0.6		1/1 2007	1/1 2011		1/1 2007
Stage IIIB										
130<=P<560	3.5	0.19	2	-	0.025	2004/26	1/1 2011	-	2005/13	1/1 2011
75<=P<130	5	0.19	3.3	-	0.025		1/1 2012	-		1/1 2012
56<=P<75	5	0.19	3.3	-	0.025		1/1 2012	-		1/1 2012
37<=P<56	5	-	-	4.7	0.025		1/1 2013	-		1/1 2013
Stage IV										
130<=P<560	3.5	0.19	0.4	-	0.025	2004/26	1/1 2014		2005/13	1/1 2014
56<=P<130	5	0.19	0.4	-	0.025		1/10 2014			1/10 2014

Table 3.27 Overview of the EU Emission Directive 2002/88 for gasoline fuelled non-road machinery.

	Category	Engine size [ccm]	CO [g pr kWh]	HC [g pr kWh]	NO_X [g pr kWh]	HC+NO_X [g pr kWh]	Implementation date
	Stage I						
Hand held	SH1	S<20	805	295	5.36	-	1/2 2005
	SH2	20=<S<50	805	241	5.36	-	1/2 2005
	SH3	50=<S	603	161	5.36	-	1/2 2005
Not hand held	SN3	100=<S<225	519	-	-	16.1	1/2 2005
	SN4	225=<S	519	-	-	13.4	1/2 2005
	Stage II						
Hand held	SH1	S<20	805	-	-	50	1/2 2008
	SH2	20=<S<50	805	-	-	50	1/2 2008
	SH3	50=<S	603	-	-	72	1/2 2009
Not hand held	SN1	S<66	610	-	-	50	1/2 2005
	SN2	66=<S<100	610	-	-	40	1/2 2005
	SN3	100=<S<225	610	-	-	16.1	1/2 2008
	SN4	225=<S	610	-	-	12.1	1/2 2007

For recreational craft, Directive 2003/44 comprises the emission legislation limits for diesel engines, and for 2-stroke and 4-stroke gasoline engines, respectively. The CO and VOC emission limits depend on engine size (kW) and the inserted parameters presented in the calculation formulas in Table 3.28. For NO_X, a constant limit value is given for each of the three engine types. For TSP, the constant emission limit regards diesel engines only.

Table 3.28 Overview of the EU Emission Directive 2003/44 for recreational craft.

Engine type	Impl. date	CO=A+B/P^n			HC=A+B/P^n			NO_X	TSP
		A	B	n	A	B	n		
2-stroke gasoline	1/1 2007	150.0	600.0	1.0	30.0	100.0	0.75	10.0	-
4-stroke gasoline	1/1 2006	150.0	600.0	1.0	6.0	50.0	0.75	15.0	-
Diesel	1/1 2006	5.0	0.0	0	1.5	2.0	0.5	9.8	1.0

Table 3.29 Overview of the EU Emission Directive 2004/26 for railway locomotives and motorcars.

	Engine size [kW]		CO [g pr kWh]	HC [g pr kWh]	NO_x [g pr kWh]	HC+NOX [g pr kWh]	PM [g pr kWh]	Implement. date
Locomotives	Stage IIIA							
	130<=P<560	RL A	3.5	-	-	4	0.2	1/1 2007
	560<P	RH A	3.5	0.5	6	-	0.2	1/1 2009
	2000<=P and piston displacement >= 5 l/cyl.	RH A	3.5	0.4	7.4	-	0.2	1/1 2009
	Stage IIIB	RB	3.5	-	-	4	0.025	1/1 2012
Motor cars	Stage IIIA							
	130<P	RC A	3.5	-	-	4	0.2	1/1 2006
	Stage IIIB							
	130<P	RC B	3.5	0.19	2	-	0.025	1/1 2012

Aircraft engine emissions of NO_x, CO, VOC and smoke are regulated by ICAO (International Civil Aviation Organization). The engine emission certification standards are contained in Annex 16 — Environmental Protection, Volume II — Aircraft Engine Emissions to the Convention on International Civil Aviation (ICAO Annex 16, 1993). The emission standards relate to the total emissions (in grams) from the so-called LTO (Landing and Take Off) cycle divided by the rated engine thrust (kN). The ICAO LTO cycle contains the idealised aircraft movements below 3000 ft (915 m) during approach, landing, airport taxiing, take off and climb out.

For smoke all aircraft engines manufactured from 1 January 1983 have to meet the emission limits agreed by ICAO. For NO_x, CO, VOC The emission legislation is relevant for aircraft engines with a rated engine thrust larger than 26.7 kN. In the case of CO and VOC, the ICAO regulations apply for engines manufactured from from 1 January 1983.

For NO_x, the emission regulations fall in four categories

a) For engines of a type or model for which the date of manufacture of the first individual production model is on or before 31 December 1995, and for which the production date of the individual engine is on or before 31 December 1999.
b) For engines of a type or model for which the date of manufacture of the first individual production model is after 31 December 1995, or for individual engines with a production date after 31 December 1999.
c) For engines of a type or model for which the date of manufacture of the first individual production model is after 31 December 2003.
d) For engines of a type or model for which the date of manufacture of the first individual production model is after 31 December 2007.

The regulations published by ICAO are given in the form of the total quantity of pollutants (D_p) emitted in the LTO cycle divided by the maximum sea level thrust (F_{oo}) and plotted against engine pressure ratio at maximum sea level thrust.

The limit values for NO_x are given by the formular in Table 3.30.

Table 3.30 Current certification limits for NO_x for turbo jet and turbo fan engines.

	Engines first produced before 31.12.1995 & for engines manufactured up to 31.12.1999	Engines first produced after 31.12.1995 & for engines manufactured after 31.12.1999	Engines for which the date of manufacture of the first individual production model was after 31 December 2003	Engines for which the date of manufacture of the first individual production model was after 31 December 2007
Applies to engines >26.7 kN	$Dp/F_{oo} = 40 + 2\pi_{oo}$	$Dp/F_{oo} = 32 + 1.6\pi_{oo}$		
Engines of pressure ratio less than 30				
Thrust more than 89 kN			$Dp/F_{oo} = 19 + 1.6\pi_{oo}$	$Dp/F_{oo} = 16.72 + 1.4080\pi_{oo}$
Thrust between 26.7 kN and not more than 89 kN			$Dp/F_{oo} = 37.572 + 1.6\pi_{oo} - 0.208F_{oo}$	$Dp/F_{oo} = 38.54862 + (1.6823\pi_{oo}) – (0.2453F_{oo}) – (0.00308\pi_{oo}F_{oo})$
Engines of pressure ratio more than 30 and less than 62.5				
Thrust more than 89 kN			$Dp/F_{oo} = 7+2.0\pi_{oo}$	$Dp/F_{oo} = -1.04+ (2.0*\pi_{oo})$
Thrust between 26.7 kN and not more than 89 kN			$Dp/F_{oo} = 42.71 +1.4286\pi_{oo} -0.4013F_{oo} +0.00642\pi_{oo}F_{oo}$	$Dp/F_{oo} = 46.1600 + (1.4286\pi_{oo}) – (0.5303F_{oo}) – (0.00642\pi_{oo}F_{oo})$
Engines with pressure ratio 82.6 or more			$Dp/F_{oo} = 32+1.6\pi_{oo}$	$Dp/F_{oo} = 32+1.6\pi_{oo}$

Source: International Standards and Recommended Practices, Environmental Protection, ICAO Annex 16 Volume II Part III Paragraph 2.3.2, 2nd edition July 1993, plus amendments: Amendment 3 (20 March 1997),Amendment 4 (4 November 1999),Amendment 5 (24 November 2005).

where:

D_p = the sum of emissions in the LTO cycle in g

F_{oo} = thrust at sea level take-off (100 %)

π_{oo} = pressure ratio at sea level take-off thrust point (100 %)

The equivalent limits for HC and CO are D_p/F_{oo} = 19.6 for HC and D_p/F_{oo} = 118 for CO (ICAO Annex 16 Vol. II paragraph 2.2.2). Smoke is limited to a regulatory smoke number = 83 $(F_{oo})^{-0.274}$ or a value of 50, whichever is the lower.

A further description of the technical definitions in relation to engine certification as well as actual engine exhaust emission measurement data can be found in the ICAO Engine Exhaust Emission Database. The latter database is accessible from http://www.caa.co.uk, hosted by the UK Civil Aviation Authority.

For seagoing vessels, NO_x emissions are regulated as explained in Marpol 73/78 Annex VI, formulated by IMO (International Maritime Organisation). The legislation is relevant for diesel engines with a power output higher than 130 kW, which are installed on a ship constructed on or after 1 January 2000 and diesel engines with a power output higher than 130 kW which undergo major conversion on or after 1 January 2000.

The NO_x emission limits for ship engines in relation to their rated engine speed (n) given in RPM (Revolutions Per Minute) are the following:

- 17 g pr kWh, n < 130 RPM
- 45 x n-0.2 g pr kWh, 130 ≤ n < 2000 RPM
- 9,8 g pr kWh, n ≥ 2000 RPM

Further, the Marine Environment Protection Committee (MEPC) of IMO has approved proposed amendments to MARPOL Annex VI to be agreed by IMO in October 2008 in order to strengthen the emission standards for NO_x and the sulphur contents of heavy fuel oil used by ship engines.

For NO_x emission regulations, a three tiered approach is considered, which comprises the following:

- Tier I: Diesel engines (> 130 kW) installed on a ship constructed on or after 1 January 2000 and prior to 1 January 2011.
- Tier II: Diesel engines (> 130 kW) installed on a ship constructed on or after 1 January 2011.
- Tier III[6]: Diesel engines (> 130 kW) installed on a ship constructed on or after 1 January 2016.

As for the existing NO_x emission limits, the new Tier I-III NO_x legislation values rely on the rated engine speeds. The emission limit equations are shown in Table 3.31.

Table 3.31 Tier I-III NOx emission limits for ship engines (amendments to MARPOL Annex VI).

	NO_x limit	RPM (n)
Tier I	17 g pr kWh	n < 130
	45 x n-0.2 g pr kWh	130 ≤ n < 2000
	9,8 g pr kWh	n ≥ 2000
Tier II	14.4 g pr kWh	n < 130
	44 x n-0.23 g pr kWh	130 ≤ n < 2000
	7.7 g pr kWh	n ≥ 2000
Tier III	3.4 g pr kWh	n < 130
	9 x n-0.2 g pr kWh	130 ≤ n < 2000
	2 g pr kWh	n ≥ 2000

The Tier I emission limits are identical with the existing emission limits from MARPOL Annex VI.

Also to be agreed by IMO in October 2008, the NO_x Tier I limits are to be applied for existing engines with a power output higher than 5000 kW and a displacement pr cylinder at or above 90 litres, installed on a ship constructed on or after 1 January 1990 but prior to 1 January 2000.

In relation to the sulphur content in heavy fuel and marine gas oil used by ship engines, Table 3.32 shows the current legislation in force, and the amendment of MARPOL Annex VI to be agreed by IMO in October 2008.

[6] For ships operating in a designated Emission Control Area. Outside a designated Emission Control Area, Tier II limits apply.

Table 3.32 Current legislation in relation to marine fuel quality.

Legislation		Heavy fuel oil		Gas oil	
		S-%	Impl. date	S-%	Impl. date
EU-directive 93/12		None		0.2[1]	1.10.1994
EU-directive 1999/32		None		0.2	1.1.2000
EU-directive 2005/33	SECA - Baltic sea	1.5	11.08.2006	0.1	1.1.2008
	SECA - North sea	1.5	11.08.2007	0.1	1.1.2008
	Outside SECA's	None		0.1	1.1.2008
MARPOL Annex VI	SECA – Baltic sea	1.5	19.05.2006		
	SECA – North sea	1.5	21.11.2007		
	Outside SECA	4.5	19.05.2006		
MARPOL Annex VI amendments	SECA's	1	01.03.2010		
	SECA's	0.1	01.01.2015		
	Outside SECA's	0.5	01.01.2020[2]		

[1] Sulphur content limit for fuel sold inside EU.

[2] Subject to a feasibility review to be completed no later than 2018. If the conclusion of such a review becomes negative the effective date would default 1 January 2025.

For non road machinery, the EU directive 2003/17/EC gives a limit value of 50 ppm sulphur in diesel (from 2005).

Emission factors

The CO_2 emission factors are country-specific and come from the DEA. The N_2O emission factors are taken from the EMEP/CORINAIR guidebook (EMEP/CORINAIR, 2007).

For military ground material, aggregated CH_4 emission factors for gasoline and diesel are derived from the road traffic emission simulations. The CH_4 emission factors for railways are derived from specific Danish VOC measurements from the Danish State Railways (Næraa, 2007) and a NMVOC/CH_4 split, based on own judgment.

For agriculture, forestry, industry, household gardening and inland waterways, the VOC emission factors are derived from various European measurement programmes and the current EU emission legislation; see IFEU (2004) and Winther et al. (2006). The NMVOC/CH_4 split is taken from USEPA (2004). The baseline emission factors are shown in Annex 3.B.9.

For national sea transport and fisheries, the VOC emission factors come from Trafikministeriet (2000), for the ferries used by Mols Linjen, however, new VOC emission factors are provided by Kristensen (2008). The latter data originate from measurement results by Hansen et al. (2004), Wismann (1999) and PHP (1996).

For ship engines VOC/CH_4 splits are taken from EMEP/CORINAIR (2007), and all emission factors are shown in Annex 3.B.12.

The CH_4 emission factors for domestic aviation come from the EMEP/CORINAIR (2007).

For all sectors, emission factors for the years 1990 and 2006 are given in CollectER format in Annex 3.B.14.

Table 3.31 shows the aggregated emission factors for CO_2, CH_4 and N_2O in 2006 used to calculate the emissions from other mobile sources in Denmark.

Factors for deterioration, transient loads and gasoline evaporation for non road machinery

The emission effects of engine wear are taken into account for diesel and gasoline engines by using the so-called deterioration factors. For diesel engines alone, transient factors are used in the calculations, to account for the emission changes caused by varying engine loads. The evaporative emissions of NMVOC are estimated for gasoline fuelling and tank evaporation. The factors for deterioration, transient loads and gasoline evaporation are taken from IFEU (2004), and are shown in Annex 3.B.9. For more details regarding the use of these factors, please refer to paragraph 3.1.4 or Winther et al. (2006).

Table 3.33 Fuel-specific emission factors for CO_2, CH_4 and N_2O for other mobile sources in Denmark.

SNAP ID	CRF ID	Category	Fuel type	Mode	Emission factors[7]		
					CH_4 [g pr GJ]	CO_2 [kg pr GJ]	N_2O [g pr GJ]
801	1A5	Military	Diesel		6.44	74	5.66
801	1A5	Military	Jet fuel	< 3000 ft	2.65	72	2.30
801	1A5	Military	Jet fuel	> 3000 ft	2.65	72	2.30
801	1A5	Military	Gasoline		22.26	73	11.50
801	1A5	Military	Aviation gasoline		21.90	73	2.00
802	1A3c	Railways	Diesel		2.88	74	2.04
803	1A3d	Inland waterways	Diesel		2.76	74	2.97
803	1A3d	Inland waterways	Gasoline		55.94	73	1.13
80402	1A3d	National sea traffic	Residual oil		2.01	78	4.89
80402	1A3d	National sea traffic	Diesel		1.55	74	4.68
80402	1A3d	National sea traffic	Kerosene		7.00	72	0.00
80402	1A3d	National sea traffic	LPG		20.26	65	0.00
80403	1A4c	Fishing	Residual oil		1.76	78	4.90
80403	1A4c	Fishing	Diesel		1.73	74	4.68
80403	1A4c	Fishing	Kerosene		7.00	72	0.00
80403	1A4c	Fishing	Gasoline		108.10	73	0.52
80403	1A4c	Fishing	LPG		20.26	65	0.00
80404	Memo item	International sea traffic	Residual oil		1.86	78	4.89
80404	Memo item	International sea traffic	Diesel		1.70	74	4.68
80501	1A3a	Air traffic, other airports	Jet fuel	Dom. < 3000 ft	3.36	72	18.05
80501	1A3a	Air traffic, other airports	Aviation gasoline		21.90	73	2.00
80502	Memo item	Air traffic, other airports	Jet fuel	Int. < 3000 ft	1.79	72	8.48
80502	Memo item	Air traffic, other airports	Aviation gasoline		21.90	73	2.00
80503	1A3a	Air traffic, other airports	Jet fuel	Dom. > 3000 ft	2.62	72	2.30
80504	Memo item	Air traffic, other airports	Jet fuel	Int. > 3000 ft	0.71	72	2.30
806	1A4c	Agriculture	Diesel		1.50	74	3.13
806	1A4c	Agriculture	Gasoline		132.74	73	1.57
807	1A4c	Forestry	Diesel		0.94	74	3.21
807	1A4c	Forestry	Gasoline		54.12	73	0.42
808	1A2f	Industry	Diesel		1.69	74	3.08
808	1A2f	Industry	Gasoline		103.02	73	1.41
808	1A2f	Industry	LPG		7.69	65	3.50
809	1A4b	Household and gardening	Gasoline		71.57	73	1.17
80501	1A3a	Air traffic, Copenhagen airport	Jet fuel	Dom. < 3000 ft	4.65	72	9.84
80501	1A3a	Air traffic, Copenhagen airport	Aviation gasoline		21.90	73	2.00
80502	Memo item	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	4.18	72	4.07
80502	Memo item	Air traffic, Copenhagen airport	Aviation gasoline		21.90	73	2.00
80503	1A3a	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	2.30	72	2.30
80504	Memo item	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	1.15	72	2.30

3.3.4 Calculation method

Air traffic

For aviation, the domestic and international estimates are made separately for landing and take-off (LTOs < 3000 ft), and cruising (> 3000 ft).

[7] References. CO_2: Country-specific. N_2O: EMEP/CORINAIR. CH_4: Railways: DSB/NERI; Agriculture/Forestry/Industry/Household-Gardening: IFEU/USEPA; National sea traffic/Fishing/International sea traffic: Trafikministeriet/EMEP-CORINAIR; domestic and international aviation: EMEP/CORINAIR.

The fuel consumption for one LTO cycle is calculated according to the following sum formula:

$$FC^{a}_{LTO} = \sum_{m=1}^{4} t_m \cdot ff_{a,m} \quad (13)$$

Where FC = fuel consumption (kg), m = LTO mode (approach/landing, taxiing, take off, climb out), t = times in mode (s), ff = fuel flow (kg pr s), a = representative aircraft type.

The emissions for one LTO cycle are estimated as follows:

$$E^{a}_{LTO} = \sum_{m=1}^{4} FC_{a,m} \cdot EI_{a,m} \quad (14)$$

Due to lack of specific airport data, for approach/descent, take off and climb out, standardised times-in-modes of 4, 0.7 and 2.2 mins are used as defined by ICAO (ICAO, 1995), whereas for taxiing the appropriate time interval is 13 mins in Copenhagen Airport and 5 mins in other airports present in the Danish inventory.

To estimate cruise results, fuel consumption and emissions for standard flying distances from EMEP/CORINAIR (2007) are interpolated or extrapolated – in each case determined by the great circle distance between the origin and the destination airports.

If the great circle distance, y, is smaller than the maximum distance for which fuel consumption and emission data are given in the EMEP/CORINAIR data bank the fuel consumption or emission E (y) becomes:

$$E(y) = E_{x_i} + \frac{(y - x_i)}{x_{i+1} - x_i} \cdot (E_{x_{i+1}} - E_{x_i}) \quad y < x_{max},\ i = 0,1,2\ldots max\text{-}1 \quad (15)$$

In (5.3) x_i and x_{max} denominate the separate distances and the maximum distance, respectively, with known fuel use and emissions. If the flight distance y exceeds x_{max} the maximum figures for fuel use and emissions must be extrapolated and the equation then becomes:

$$E(y) = E_{x_{max}} + \frac{(y - x_{max})}{x_{max} - x_{max-1}} \cdot (E_{x_{max}} - E_{x_{max-1}}) \quad y > x_{max} \quad (16)$$

Total results are summed up and categorised according to each flight's airport and country codes.

The overall fuel precision in the model is around 0.8, derived as the fuel ratio between model estimates and statistical sales. The fuel difference is accounted for by adjusting cruising fuel use and emissions in the model according to domestic and international cruising fuel shares.

Prior to 2001, the calculation procedure was first to estimate each year's fuel use and emissions for LTO. Secondly, total cruising fuel use was found year by year as the statistical fuel use total minus the calculated fuel use for LTO. Lastly, the cruising fuel use was split into a domestic and international part by using the results from a Danish city-pair emission inventory in 1998 (Winther, 2001a). For more details of this latter fuel allocation procedure, see Winther (2001b).

Non-road working machinery and recreational craft

Prior to adjustments for deterioration effects and transient engine operations, the fuel use and emissions in year X, for a given machinery type, engine size and engine age, are calculated as:

$$E_{Basis}(X)_{i,j,k} = N_{i,j,k} \cdot HRS_{i,j,k} \cdot P \cdot LF_i \cdot EF_{y,z} \quad (17)$$

where E_{Basis} = fuel use/emissions in the basic situation, N = number of engines, HRS = annual working hours, P = average rated engine size in kW, LF = load factor, EF = fuel use/emission factor in g pr kWh, i = machinery type, j = engine size, k = engine age, y = engine-size class and z = emission level. The basic fuel use and emission factors are shown in Annex 2.B.9.

The deterioration factor for a given machinery type, engine size and engine age in year X depends on the engine-size class (only for gasoline), y, and the emission level, z. The deterioration factors for diesel and gasoline 2-stroke engines are found from:

$$DF_{i,j,k}(X) = \frac{K_{i,j,k}}{LT_i} \cdot DF_{y,z} \quad (18)$$

where DF = deterioration factor, K = engine age, LT = lifetime, i = machinery type, j = engine size, k = engine age, y = engine-size class and z = emission level.

For gasoline 4-stroke engines the deterioration factors are calculated as:

$$DF_{i,j,k}(X) = \sqrt{\frac{K_{i,j,k}}{LT_i}} \cdot DF_{y,z} \quad (19)$$

The deterioration factors inserted in (18) and (19) are shown in Annex 2.B.9. No deterioration is assumed for fuel use (all fuel types) or for LPG engine emissions and, hence, DF = 1 in these situations.

The transient factor for a given machinery type, engine size and engine age in year X, relies only on emission level and load factor, and is denominated as:

$$TF_{i,j,k}(X) = TF_z \quad (20)$$

Where i = machinery type, j = engine size, k = engine age and z = emission level.

The transient factors inserted in (20) are shown in Annex 2.B.9. No transient corrections are made for gasoline and LPG engines and, hence, TF_z = 1 for these fuel types.

The final calculation of fuel use and emissions in year X for a given machinery type, engine size and engine age, is the product of the expressions 17-20:

$$E(X)_{i,j,k} = E_{Basis}(X)_{i,j,k} \cdot TF(X)_{i,j,k} \cdot (1 + DF(X)_{i,j,k}) \quad (21)$$

The evaporative hydrocarbon emissions from fuelling are calculated as:

$$E_{Evap,fueling,i} = FC_i \cdot EF_{Evap,fueling} \quad (22)$$

Where $E_{Evap,fueling}$, = hydrocarbon emissions from fuelling, i = machinery type, FC = fuel consumption in kg, $EF_{Evap,fueling}$ = emission factor in g NMVOC pr kg fuel.

For tank evaporation, the hydrocarbon emissions are found from:

$$E_{Evap,\tan k,i} = N_i \cdot EF_{Evap,\tan k,i} \quad (23)$$

Where $E_{Evap,tank,i}$ = hydrocarbon emissions from tank evaporation, N = number of engines, i = machinery type and $EF_{Evap,fueling}$ = emission factor in g NMVOC pr year.

Ferries, other national sea transport and fisheries

The fuel use and emissions in year X, for regional ferries are calculated as:

$$E(X) = \sum_i N_i \cdot T_i \cdot S_{i,j} \cdot P_i \cdot LF_j \cdot EF_{k,l,y} \quad (24)$$

Where E = fuel use/emissions, N = number of round trips, T = sailing time pr round trip in hours, S = ferry share of ferry service round trips, P = engine size in kW, LF = engine load factor, EF = fuel use/emission factor in g pr kWh, i = ferry service, j = ferry, k = fuel type, l = engine type, y = engine year.

For the remaining navigation categories, the emissions are calculated using a simplified approach:

$$E(X) = \sum_i EC_{i,k} EF_{k,l,y} \quad (25)$$

Where E = fuel use/emissions, EC = energy consumption, EF = fuel use/emission factor in g pr kg fuel, i = category (local ferries, other national sea, fishery, international sea), k = fuel type, l = engine type, y = average engine year.

The emission factor inserted in (25) is found as an average of the emission factors representing the engine ages which are comprised by the average lifetime in a given calculation year, X:

$$EF_{k,l,y} = \frac{\sum_{year=X}^{year=X-LT} EF_{k,l}}{LT_{k,l}} \quad (26)$$

Other sectors

For military and railways, the emissions are estimated with the simple method using fuel-related emission factors and fuel use from the DEA:

$$E = FC \cdot EF \quad (27)$$

where E = emission, FC = fuel consumption and EF = emission factor. The calculated emissions for other mobile sources are shown in CollectER format in Annex 3.B.14 for the years 1990 and 2007 and as time-series 1990-2007 in Annex 3.B.15 (CRF format).

Energy balance: DEA statistics and NERI estimates

Following convention rules, the DEA statistical fuel sales figures are behind the full Danish inventory. However, in some cases for mobile sources the DEA statistical sectors do not fully match the inventory sectors. This is the case for non road machinery, where relevant DEA statistical sectors also include fuel consumed by stationary sources.

In other situations, fuel consumption figures estimated by NERI from specific bottom-up calculations are regarded as more reliable than DEA reported sales. This is the case for national sea transport.

In the following the transferral of fuel consumption data from DEA statistics into inventory relevant categories is explained for national sea transport and fisheries, non road machinery and recreational craft, and road transport. A full list of all fuel consumption data, DEA figures as well as intermediate fuel consumption data, and final inventory input figures is shown in Annex 3.B.13.

National sea transport and fisheries

For national sea transport in Denmark, the new fuel consumption estimates obtained by NERI (Winther, 2008a) are regarded as much more accurate than the DEA fuel sales data, since the large fluctuations in reported fuel sales cannot be explained by the actual development in the traffic between different national ports. As a consequence, the new bottom-up estimates replace the previous fuel based figures for national sea transport.

There are different potential reasons for the differences between estimated fuel consumption and reported sales for national sea transport in Denmark. According to the DEA, the latter fuel differences are most likely explained by inaccurate costumer specifications made by the oil suppliers. This inaccuracy can be caused by a sector misallocation in the sales statistics between national sea transport and fisheries for gas oil, and between national sea transport and industry for heavy fuel oil (Peter Dal, DEA, personal communication, 2007).

Following this, for fisheries and industry the updated fuel consumption time-series for national sea transport lead, in turn, to changes in the fuel activity data for fisheries (gas oil) and industry (heavy fuel oil), so the national energy balance can remain unchanged.

For fisheries, fuel investigations made prior to the initiation of the work made by Winther (2008a) have actually pointed out a certain area of inaccuracy in the DEA statistics. No engines installed in fishing vessels use heavy fuel oil, even though a certain amount of heavy fuel oil is listed in the DEA numbers for some statistical years (H. Amdissen, Danish Fishermen's Association, personal communication, 2006). Hence, for fisheries small amounts of fuel oil are transferred to national sea transport, and in addition small amounts of gasoline and diesel are transferred to recreational craft.

Non road machinery and recreational craft

For diesel and LPG, the non-road fuel consumption estimated by NERI is partly covered by the fuel-use amounts in the following DEA sectors: agriculture and forestry, market gardening, and building and construction. The remaining quantity of non-road diesel and LPG is taken from the DEA industry sector.

For gasoline, the DEA residential sector, together with the DEA sectors mentioned for diesel and LPG, contribute to the non-road fuel consumption total. In addition, a certain amount of fuel from road transport is needed to reach the fuel-use goal.

The amount of diesel and LPG in DEA industry not being used by non-road machinery is included in the sectors, "Combustion in manufacturing industry" (0301) and "Non-industrial combustion plants" (0203) in the Danish emission inventory.

For recreational craft, the calculated fuel-use totals for diesel and gasoline are subsequently subtracted from the DEA fishery sector. For gasoline, the DEA reported fuel consumption for fisheries is far too small to fill the fuel gap, and hence the missing fuel amount is taken from the DEA road transport sector.

Bunkers

The distinction between domestic and international emissions from aviation and navigation should be in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. For the national emission inventory, this, in principle, means that fuel sold (and associated emissions) for flights/sea transportation starting from a seaport/airport in the Kingdom of Denmark, with destinations inside or outside the Kingdom of Denmark, are regarded as domestic or international, respectively.

Aviation

For aviation, the emissions associated with flights inside the Kingdom of Denmark are counted as domestic. The flights from Denmark to Greenland and the Faroe Islands are classified as domestic flights in the inventory background data. In Greenland and in the Faroe Islands, the jet fuel sold is treated as domestic. This decision becomes reasonable when considering that almost no fuel is bunkered in Greenland/the Faroe Islands by flights other than those going to Denmark.

Navigation

In DEA statistics, the domestic fuel total consists of fuel sold to Danish ferries and other ships sailing between two Danish ports. The DEA international fuel total consists of the fuel sold in Denmark to international ferries, international warships, other ships with foreign destinations, transport to Greenland and the Faroe Islands, tank vessels and foreign fishing boats.

In Greenland, all marine fuel sales are treated as domestic. In the Faroe Islands, the fuel sold in Faroese ports for Faroese fishing vessels and other Faroese ships is treated as domestic. The fuel sold to Faroese ships bunkering outside Faroese waters and the fuel sold to foreign ships in Faroese ports or outside Faroese waters is classified as international (Lastein and Winther, 2003).

To comply with the IPCC classification rules, the fuel consumed by vessels sailing to Greenland and the Faroe Islands should be a part of the domestic total. To improve the fuel data quality for Greenland and the Faroe Islands, the fuel sales should be grouped according to vessel destination and IPCC classification, subsequently.

In conclusion, the domestic/international fuel split (and associated emissions) for navigation is not determined with the same degree of precision as for aviation. It is considered, however, that the potential of incorrectly allocated fuel quantities is only a small part of the total fuel sold for navigational purposes in the Kingdom of Denmark.

3.3.5 Uncertainties and time-series consistency

Uncertainty estimates for greenhouse gases are made for road transport and other mobile sources using the guidelines formulated in the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). For road transport, railways and fisheries, these guidelines provide uncertainty factors for activity data that are used in the Danish situation. For other sectors, the factors reflect specific national knowledge (Winther et al., 2006 and Winther, 2008a). These sectors are (SNAP categories): Inland Waterways (a part of 1A3d: Navigation), Agriculture and Forestry (parts of 1A4c: Agriculture-/forestry/fisheries), Industry (mobile part of (1A2f: Industry-other), Residential (1A4b) and National sea transport (a part of 1A3d: Navigation).

The activity data uncertainty factor for civil aviation is based on own judgement.

The uncertainty estimates should be regarded as preliminary, only, and may be subject to changes in future inventory documentation. The calculations are shown in Annex 3.B.16 for all emission components.

Table 3.34 Uncertainties for activity data, emission factors and total emissions in 2006 and as a trend.

Category	Activity data	CO_2	CH_4	N_2O
	%	%	%	%
Road transport	2	5	40	50
Military	2	5	100	1000
Railways	2	5	100	1000
Navigation (small boats)	21	5	100	1000
Navigation (large vessels)	11	5	100	1000
Fisheries	2	5	100	1000
Agriculture	13	5	100	1000
Forestry	16	5	100	1000
Industry (mobile)	18	5	100	1000
Residential	18	5	100	1000
Civil aviation	10	5	100	1000
Overall uncertainty in 2006		4	34	136
Trend uncertainty		4	6	69

As regards time-series consistency, background flight data cannot be made available on a city-pair level prior to 2000. However, aided by LTO/aircraft statistics for these years and the use of proper assumptions, a sound level of consistency is, in any case, obtained for this part of the transport inventory.

The time-series of emissions for mobile machinery in the agriculture, forestry, industry, household and gardening (residential) and inland waterways (part of navigation) sectors are less certain than time-series for other sectors, since DEA statistical figures do not explicitly provide fuel consumption information for working equipment and machinery.

3.3.6 Quality assurance/quality control (QA/QC)

The intention is to publish every second year a sector report for road transport and other mobile sources. The last sector report prepared concerned the 2006 inventory (Winther, 2008).

The QA/QC descriptions of the Danish emission inventories for transport follow the general QA/QC description for NERI in Section 1.6, based on the prescriptions given in the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000).

An overview diagram of the Danish emission inventory system is presented in Figure 1.2 (Data storage and processing levels), and the exact definitions of Critical Control Points (CCP) and Points of Measurements (PM) are given in Section 1.6. The status for the PMs relevant for the mobile sector are given in the following text and the result of this investigation indicates a need for future QA/QC activities in order to fulfil the QA/QC requirements from the IPCC GPG.

Data storage level 1

Data Storage level 1	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included by setting down the reasoning behind the selection of datasets.

The following external data sources are used in the mobile part of the Danish emission inventories for activity data and supplementary information:

- Danish Energy Authority: Official Danish energy statistics
- Danish Road Directorate: Road traffic vehicle fleet and mileage data
- Civil Aviation Agency of Denmark: Flight statistics
- Non-road machinery: Information from statistical sources, research organisations, different professional organisations and machinery manufacturers.
- Ferries (Statistics Denmark): Data for annual return trips for Danish ferry routes.
- Ferries (Danish Ferry Historical Society): Detailed technical and operational data for specific ferries.
- Danish Meteorological Institute (DMI): Temperature data
- The National Motorcycle Association: 2-wheeler data

The emission factors come from various sources:

- Danish Energy Authority: CO_2 emission factors and lower heating values (all fuel types)
- COPERT IV: Road transport (all exhaust components, except CO_2, SO_2)
- Danish State Railways: Diesel locomotives (NO_X, VOC, CO and TSP)
- EMEP/CORINAIR guidebook: Civil aviation and supplementary
- Non road machinery: References given in NERI reports.
- National sea transport and fisheries: TEMA2000 (NO_X, VOC, CO and TSP) and MAN Diesel (sfc, NO_X)

Table 3.33 to follow contains Id, File/Directory/Report name, Description, Reference and Contacts. As regards File/Directory/Report name, this field refers to a file name for Id when all external data (time-series for the existing inventory) are stored in one file. In other cases, a computer directory name is given when the external data used are stored in several files, e.g. each file contains one inventory year’s external data or each file contains time-series of external data for sub-categories of machinery. A third situation occurs when the external data are published in publicly available reports; here the aim is to obtain electronic copies for internal archiving.

Table 3.33 Overview table of external data for transport.

Id no	File/-Directory/-Report name	Description	Activity data or emission factor	Reference	Contacts	Data agreement
T1	Transport energy[1]	Dataset for all transport energy use	Activity data	The Danish Energy Authority (DEA)	Peter Dal	Yes
T2	Fleet and mileage data[1]	Road transport fleet and mileage data	Activity data	The Danish Road Directorate	Inger Foldager	Yes
T3	Flight statistics[2]	Data records for all flights	Activity data	Civil Aviation Agency of Denmark	Henrik Gravesen	Yes
T4	Non road machinery[2]	Stock and operational data for non-road machinery	Activity data	Non road Documentation report	Morten Winther	No
T5	Emissions from ships[3]	Data for ferry traffic	Activity data	Statistics Denmark	Sonja Merkelsen	No
T6	Emissions from ships[3]	Technical and operational data for Danish ferries	Activity data	Navigation emission documentation report	Hans Otto Kristensen	No
T7	Temperature data[3]	Monthly avg of daily max/min temperatures	Other data	Danish Meteorological Institute	Danish Meteorological Institute	No
T8	Fleet and mileage data[1]	Stock data for mopeds and motorcycles	Activity data	The National Motorcycle Association	Henrik Markamp	No
T9	CO_2 emission factors[1]	DEA CO_2 emission factors (all fuel types)	Emission factor	The Danish Energy Authority (DEA)	Peter Dal	No
T10	COPERT IV emission factors[3]	Road transport emission factors	Emission factor	Laboratory of applied thermodynamics Aristotle University Thessaloniki	Leonidas Ntziachristos	No
T11	Railways emission factors[1]	Emission factors for diesel locomotives	Emission factor	Danish State Railways	Rikke Næraa	Yes
T12	EMEP/CORINAIR guidebook[3]	Emission factors for navigation, civil aviation and supplementary	Emission factor	European Environment Agency	European Environment Agency	No
T13	Non road emission factors[3]	Emission factors for agriculture, forestry, industry and household/gardening	Emission factor	Non road Documentation report	Morten Winther	No
T14	Emissions from ships[3]	Emission factors for national sea transport and fisheries	Emission factor	Navigation emission documentation report	Morten Winther	No

[1)] File name; [2)] Directory in the NERI data library structure; [3)] Reports available on the internet.

Danish Energy Authority (energy statistics)

The official Danish energy statistics are provided by the Danish Energy Authority (DEA) and are regarded as complete on a national level. For most transport sectors, the DEA subsector classifications fit the SNAP classifications used by NERI.

For non-road machinery, this is however not the case, since DEA do not distinguish between mobile and stationary fuel consumption in the sub-sectors relevant for non-road mobile fuel consumption.

Here, NERI calculates a bottom-up non-road fuel consumption estimate and for diesel (land based machinery only) and LPG, the residual fuel quantities are allocated to stationary consumption. For gasoline (land-based machinery) the relevant fuel consumption quantities for the DEA are smaller than the NERI estimates, and the amount of fuel consumption missing is subtracted from the DEA road transport total to account for all fuel sold. For recreational craft, no specific DEA category exists and, in this case, the gasoline and diesel fuel consumption is taken from road transport and fisheries, respectively.

In the case of Danish national sea transport, fuel consumption estimates are obtained by NERI (Winther, 2008a), since they are regarded as much more accurate than the DEA fuel sales data. For the latter source, the large fluctuations in reported fuel sales cannot be explained by the actual development in the traffic between different national ports.

In order to maintain the national energy balance, the updated fuel consumption time-series for national sea transport lead, in turn, to changes in the fuel activity data for fisheries (gas oil) and industry (heavy fuel oil).

The NERI fuel modifications, thus, give DEA-SNAP differences for road transport, national sea transport and fisheries.

A special note must be made for the DEA civil aviation statistical figures. The domestic/international fuel consumption division derives from bottom-up fuel consumption calculations made by NERI.

Danish Road Directorate

Figures for fleet numbers and mileage data are provided by the Danish Road Directorate. Being a sector institution under the Ministry of Transport and Energy, it is a basic task for the Danish Road Directorate to possess comprehensive information on Danish road traffic. The fleet figures are based on data from the Car Register, kept by Statistics Denmark and are, therefore, regarded as very precise. In some cases, stock data are split into vehicle subcategories (COPERT III format), based on expert judgement. Annual mileage information comes from the Danish Vehicle Inspection and Maintenance Programme.

Civil Aviation Agency of Denmark

The Civil Aviation Agency of Denmark (CAA-DK) monitors all aircraft movements in Danish airspace and, in this connection, possesses data records for all take-offs and landings at Danish airports. The dataset from 2001 onwards, among others consisting of aircraft type and origin and destination airports for all flights leaving major Danish airports, are, therefore, regarded as very complete. For inventory years before 2001, the most accurate data contain CAA-DK total movements from major Danish airports and detailed aircraft type distributions for aircraft using Copenhagen Airport, provided by the airport itself.

Non-road machinery (stock and operational data)

A great deal of new stock and operational data for non road machinery was obtained in a research project carried out by Winther et al. (2006) for the 2004 inventory. The source for the agricultural machinery stock of tractors and harvesters is Statistics Denmark. Sales figures for tractors, harvesters and construction machinery, together with operational data and supplementary information, are obtained from The Association of Danish Agricultural Machinery Dealers. IFAG (The Association of Producers and Distributors of Fork Lifts in Denmark) provides fork-lift sale figures, whereas total stock numbers for gasoline equipment are obtained from machinery manufacturers with large Danish market shares, with figures validated through discussions with KVL. Stock information disaggregated into vessel types for recreational craft was obtained from the Danish Sailing Association. A certain part of the operational data comes from previous Danish non-road research projects (Dansk Teknologisk Institut, 1992 and 1993; Bak et al., 2003).

No statistical register exists for non-road machinery types and this affects the accuracy of stock and operational data. For tractors and harvesters, Statistics Denmark provide total stock data based on information from questionnaires and the registers of crop subsidy applications kept by the Ministry of Agriculture. In combination with new sales figures pr engine size from The Association of Danish Agricultural Machinery Dealers, the best available stock data are obtained. In addition, using the sources for construction machinery and fork lift sale figures are regarded as the only realistic approach for consolidated stock information for these machinery types. Use of this source-type also applies in the case of machinery types (gasoline equipment, recreational craft) where data is even scarcer.

To support the 2006 inventory, new 2006 stock data for tractors, harvesters, fork lifts and construction machinery was obtained from the same sources as in Winther et al. (2006). For non-road machinery in general, it is, however, uncertain if data in such a level can be provided annually in the future.

Ferries (Statistics Denmark)

Statistics Denmark provides information of annual return trips for all Danish ferry routes from 1990 onwards. The data are based on monthly reports from passenger and ferry shipping companies in terms of transported vehicles passengers and goods. Thus, the data from Statistics Denmark are regarded as complete. Most likely the data can be provided annually in the future.

Ferries (Danish Ferry Historical Society, DFS)

No central registration of technical and operational data for Danish ferries and ferry routes is available from official statistics. However, one valuable reference to obtain data and facts about construction and operation of Danish ferries, especially in the recent 20 - 30 years is the archives of Danish Ferry Historical Society. Pure technical data has not only been obtained from this society´s archives, but some of the knowledge has been obtained through the personal insight about ferries from some of the members of the society, which have been directly involved in the ferry business for example consultants, naval architects, marine engineers, captains and superintendents. However, until recently no documentation of the detailed DFS knowledge was established in terms of written reports or a central database system.

To make use of all the ferry specific data for the Danish inventories, DSF made a data documentation as a specific task of the research project carried out by Winther (2008a). Unless additional funding can be made available, the DFS data are not going to be updated for the inventory years 2006+.

Danish Meteorological Institute

The monthly average max/min temperature for Denmark comes from DMI. This source is self explanatory in terms of meteorological data. Data are publicly available for each year on the internet.

The National Motorcycle Association

Road transport: 2-wheeler stock information (The National Motorcycle Association). Given that no consistent national data are available for mopeds in terms of fleet numbers and distributions according to new sales pr year, The National Motorcycle Association is considered to be the professional organisation, where most expert knowledge is available. The relevant annual information is given as personal communication, a method which can be repeated in the future.

Danish Energy Authority (CO_2 emission factors and lower heating values)

The CO_2 emission factors and lower heating values (LHV) are fuel-specific constants. The country-specific values from the DEA are used for all inventory years.

COPERT IV

COPERT IV provides factors for fuel consumption and for all exhaust emission components which are included in the national inventory. For several reasons, COPERT IV is regarded as the most appropriate source of road traffic fuel consumption and emission factors. First of all, very few Danish emission measurements exist, so data are too scarce to support emission calculations on a national level. Secondly, most of the fuel-use and emission information behind the COPERT model are derived from the European 5th framework research projects ARTEMIS and Particulates, and the formulation of fuel-use and emission factors for all single vehicle categories has been made by a group of road traffic emission experts. A large degree of internal consistency is, therefore, achieved. Finally, the COPERT model is regularly updated with new experimental findings from European research programmes and, apart from updated fuel-use and emission factors, the use of COPERT IV by many European countries ensures a large degree of cross-national consistency in reported emission results.

Danish State Railways

Aggregated emission factors of NO_x, VOC, CO and TSP for diesel locomotives are provided annually by the Danish State Railways. Taking into account available time resources for subsector emission calculations, the use of data from Danish State Railways is sensible. This operator accounts for around 90 % of all diesel fuel consumed by railway locomotives in Denmark and the remaining diesel fuel is used by various private railways companies. Setting up contacts with the private transport operators is considered to be a rather time consuming experience taking time away from inventory work in areas of greater emission importance.

EMEP/CORINAIR guidebook

Fuel-use and emission data from the EMEP/CORINAIR guidebook is the prime and basic source for the aviation and navigation part of the Danish emission inventories. For aviation, the guidebook contains the most comprehensive list of representative aircraft types available for city-pair fuel consumption and emission calculations. The data have been evaluated specifically for detailed national inventory use by a group of experts representing civil aviation administration, air traffic management, emission modellers and inventory workers.

In addition, the EMEP/CORINAIR guidebook is the source of non-exhaust TSP, PM_{10} and $PM_{2.5}$ emission factors for road transport, and the primary source of emission factors for some emission components – typically N_2O, NH_3, heavy metals and PAH – for other mobile sources.

Non-road machinery (fuel consumption and emission factors)

The references for non-road machinery fuel-use and emission factors are listed in Winther et al. (2006). The fuel-use and emission data is regarded as the most comprehensive data collection on a European level, having been thoroughly evaluated by German emission measurement and non-road experts within the framework of a German non-road inventory project.

National sea transport and fisheries

Emission factors for NO_X, VOC, CO and TSP are taken from the TEMA2000 model developed for the Ministry of Transport. To a large extent the emission factors originate from the exhaust emission measurement programme carried out by Lloyd's (1995). For NO_X, additional information of emission factors in a time-series going back to 1949, and PM_{10} and $PM_{2.5}$ fractions of total TSP was provided by the engine manufacturer MAN Diesel.

The experimental work by Lloyd's is still regarded as the most comprehensive measurement campaign with results publicly available. The additional NO_X and $PM_{10}/PM_{2.5}$ information comes from the world's largest ship engine manufacturer and data from this source is consistent with data from Lloyd's. Consequently the data used in the Danish inventories for national sea transport is regarded as the best available for emission calculations.

Data Storage level 1	1. Accuracy	DS.1.1.1	General level of uncertainty for every dataset, including the reasoning for the specific values

The uncertainty involved in the DEA fuel-use information (except civil aviation) and the CAA-DK flight statistics is negligible, as such, and this is also true for DMI temperature data. For civil aviation, some uncertainty prevails, since the domestic fuel-use figures originate from a division of total jet-fuel sales figures into domestic and international fuel quantities, derived from bottom-up calculations. A part of the fuel-use uncertainties for non-road machines is due to the varying levels of stock and operational data uncertainties, as explained in DS 1.3.1. The road transport fleet totals from the Danish Road Directorate and The National

Motorcycle Association in the main vehicle categories are accurate. Uncertainties, however, are introduced when the stock data are split into vehicle subcategories. The mileage figures from the Danish Road Directorate are generally less certain and uncertainties tend to increase for disaggregated mileage figures on subcategory levels.

As regards emission factors, the CO_2 factors (and LHVs) from the DEA are considered to be very precise, since they relate only to fuel. For the remaining emission factor sources, the SO_2 (based on fuel sulphur content), NO_X, NMVOC, CH_4, CO, TSP, PM_{10} and $PM_{2.5}$ emission factors are less accurate. Though many measurements have been made, the experimental data rely on the individual measurement and combustion conditions. The uncertainties for N_2O and NH_3 emission factors increase even further due to the small number of measurements available. For heavy metals and PAH, experimental data are so scarce that uncertainty becomes very high.

A special note, however, must be made for energy. The uncertainties due to the subsequent treatment of DEA data for road transport, fisheries and the non-road relevant sectors, explained in DS 1.3.1, trigger some uncertainties in the fuel-use figures for these sectors. This point is, though, more relevant for QA/QC description for data processing, Level 1.

Data Storage level 1	1. Accuracy	DS.1.1.2	Quantification of the uncertainty level of every single data value including the reasoning for the specific values.

The general uncertainties of the DEA fuel-use information, DMI temperature data, road transport stock totals and the CAA-DK flight statistics are zero. For domestic aviation fuel consumption, the uncertainty is as prescribed by the IPCC Good Practice Guidance manual. For road transport, it is not possible to quantify the uncertainties (1) of stock distribution into COPERT IV-relevant vehicle subsectors and (2) of the national mileage figures, as such. For non-road machinery stock and operational data, the uncertainty figures are given in Winther et al. (2006).

For emission factors, the uncertainties for mobile sources are determined as suggested in the IPCC and UNECE guidelines. The uncertainty figures are listed in Paragraph 3.1.3 for greenhouse gases, and in Illerup et al. (2005b) and Winther et al. (2006) for the remaining emission components.

Data Storage level 1	2.Comparability	DS.1.2.1	Comparability of the data values with similar data from other countries, which are comparable with Denmark, and evaluation of discrepancy.

Work has been carried out to compare Danish figures with corresponding data from other countries in order to evaluate discrepancies. The comparisons have been made on a CRF level, mostly for implied emission factors (Fauser et al., 2007).

Data Storage level 1	4.Consistency	DS.1.4.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PMs)

It is ensured that the original files from external data sources are archived internally at NERI. Subsequent raw data processing is carried out either in the NERI database models or in spreadsheets (data processing level 1).

Data Storage level 1	6.Robustness	DS.1.6.1	Explicit agreements between the external institution holding the data and NERI about the condition of delivery

For transport, NERI has made formal agreements with regard to external data deliverance with (Table 3.33 external data source Id's in brackets): DEA (T1), CAA-DK (T3), Danish State Railways (T9) and the Danish Road Directorate (T2).

Data Storage level 1	7.Transparency	DS.1.7.1	Summary of each dataset, including the reasoning for selecting the specific dataset

Please refer to DS 1.1.1. In this measurement point, the reason for external data selections in different inventory areas is given.

Data Storage level 1	7.Transparency	DS.1.7.3	References for citation for any external dataset have to be available for any single value in any dataset.

The references for external datasets are provided in the present report.

Data Storage level 1	7.Transparency	DS.1.7.4	Listing of external contacts for every dataset

The following list shows the external data source (source Id in brackets), the responsible person and contact information for each area where formal data deliverance agreements have been made.

- Danish Energy Authority (T1): Peter Dal (pd@ens.dk)
- Danish Road Directorate (T2): Inger Foldager ((ifo@vd.dk)
- Civil Aviation Agency of Denmark (T3): Henrik Gravesen (hgr@slv.dk)
- Danish State Railways (T9): Rikke Næraa (rikken@dsb.dk)

Data Processing Level 1

Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to type of variability. (Distribution as: normal, log normal or other type of variability)

In the mobile part of the Danish emission inventories, uncertainty assessments are made at Data Processing Level 1 for non-road machinery, recreational craft and national sea transport. For these types of mobile machinery, the stock and operational data variations are assumed to be normally distributed (Winther et al., 2006; Winther, 2008a). Tier 1 uncertainty calculations produce final fuel-use uncertainties ready for Data Storage Level 2 (SNAP level 2: Inland waterways, agriculture, forestry, industry and household-gardening).

Data Processing level 1	1. Accuracy	DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals)

For non-road machinery, recreational craft and national sea transport, uncertainty assessments are made by Winther et al. (2006) and Winther (2008a), and the sizes of the variation intervals are given for activity data and emission factors.

Data Processing level 1	1. Accuracy	DP.1.1.3	Evaluation of the methodological approach using international guidelines

An evaluation of the methodological inventory approach has been made, which proves that the emission inventories for transport are made according to the international guidelines (Winther, 2005: Kyoto notat, in Danish). This paper will be translated into English and the conclusions will be implemented in the future national inventory reports.

Data Processing level 1	1. Accuracy	DP.1.1.4	Verification of calculation results using guideline values

It has been checked that the greenhouse gas emission factors used in the Danish inventory are within margin of the IPCC guideline values.

Data Processing level 1	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCCC and IPCC.

See DP 1.1.3.

Data Processing level 1	3.Completeness	DP.1.3.1	Assessment of the most important quantitative knowledge which is lacking.

Data Processing level 1	3.Completeness	DP.1.3.2	Assessment of the most important cases where access is lacking with regard to critical data sources that could improve quantitative knowledge.

The most important area where the accessibility to critical data is lacking is road transport. More accurate national vehicle fleet and mileage data is available from the Danish Vehicle Inspection Programme, and new fuel consumption and emission information is available in a new version of COPERT- COPERT IV. It is, however, not straight forward to combine the new traffic and emission data, due to different formats. Instead the new data are transformed into COPERT III input formats. using different assumptions. Work will be made this year by the Ministry of Transport and Energy to transform the new fleet and mileage traffic data into COPERT IV format.

Data Processing level 1	4.Consistency	DP.1.4.1	In order to keep consistency at a high level, an explicit description of the activities needs to accompany any change in the calculation procedure.

A log will be incorporated in the NERI transport models, explaining the model changes (input data, model principles), whenever they occur. The current explanations are included in Chapter 3.3 of the present report.

Data Processing level 1	5.Correctness	DP.1.5.1	Show at least once, by independent calculation, the correctness of every data manipulation.

During model development it has been checked that all mathematical model relations give exactly the same results as independent calculations. A list of examples with model and independent calculation results, one set for each mathematical model expression, will be made.

Data Processing level 1	5.Correctness	DP.1.5.2	Verification of calculation results using time-series

Data Processing level 1	5.Correctness	DP.1.5.3	Verification of calculation results using other measures

When NERI transport model changes are made relating to fuel consumption, it is checked that the calculated fuel-use sums correspond to the expected fuel-use levels in the time-series. The fuel-use check also includes a time-series comparison with fuel-use totals calculated in the previous model version. The checks are performed on a SNAP level and, if appropriate, detailed checks are made for vehicle/machinery technology splits.

As regards model changes in relation to derived emission factors (and calculated emissions), the time-series of emission factors (and emissions) are compared to previous model figures. A part of this evaluation includes an assessment, if the development corresponds to the underlying assumptions given by detailed input parameters. Among other things, the latter parameters depend on emission legislation, new technology phase-in, deterioration factors, engine operational conditions/driving modes, gasoline evaporation (hydrocarbons) and cold starts. For methodological issues, please refer to Section 3.3.2.

Data Processing level 1	5.Correctness	DP.1.5.4	Show one-to-one correctness between external data sources and the data bases at Data Storage level 2

For road transport, aviation and non-road machinery, whether all external data are correctly put into the NERI transport models is checked. This is facilitated by the use of sum queries which sum up stock data (and mileages for road transport) to input aggregation levels. However, spreadsheet or database manipulations of external data are, in some cases, included in a step prior to this check.

This is carried out in order to produce homogenous input tables for the NERI transport models (road, civil aviation, non-road machinery/recreational craft, navigation/fisheries). The sub-routines perform operations, such as the aggregation/disaggregation of data into first sales year (Examples: Fleet numbers and mileage for road transport, stock numbers for tractors, harvesters, fork lifts) or simple lists of total stock pr yr (per machinery type for e.g. household equipment and for recreational craft). For civil aviation, additional databases control the allocation of representative aircraft to real aircraft types and the cruise distance between airports. A more formal description of the sub-routines will be made.

Regarding fuel data, it is checked for road transport and civil aviation that DEA totals (modified for road) match the input values in the NERI models. For the transport modes military and railways, the DEA fuel-use figures go directly into Data Storage Level 2. This is also the case for the railway emission factors obtained from Danish State Railways and, generally, for the emission factors which are kept constant over the years.

The NERI model simulations of fuel-use and emission factors for road transport, civil aviation and non-road machinery refer to Data Processing Level 1.

Data Processing level 1	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described
Data Processing level 1	7.Transparency	DP.1.7.2	The theoretical reasoning for all methods must be described
Data Processing level 1	7.Transparency	DP.1.7.3	Explicit listing of assumptions behind all methods

The NERI model calculation principles and basic equations are thoroughly described in the present report, together with the theoretical model reasoning and assumptions. Documentation is also given e.g. in Illerup et al. (2005b), Winther (2001, 2007, 2008) and Winther et al. (2006).

Data Processing level 1	7.Transparency	DP.1.7.4	Clear reference to dataset at Data Storage level 1.

In the different documentation reports for transport in the Danish emission inventories, there are explicit references for the different external data used.

Data Processing level 1	7.Transparency	DP.1.7.5	A manual log to collect information about recalculations

Recalculation changes in the emission inventories are described in the NIR and ECE reports as a standard. A manual log table in the NERI transport models to collect information about recalculations based on changes in emission factors and/or activity data will be established.

Data Storage Level 2

Data Storage level 2	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data types at level 2 to data at level 1

In the various documentation reports behind the transport part of the Danish emission inventories there is a thorough documentation of the SNAP aggregated fuel consumption figures and emission factors, based on the original external data derived from external sources.

Data Storage level 2	5.Correctness	DS.2.5.2	Check if a correct data import to level 2 has been made.

At present, a NERI software programme imports data from prepared input data tables (SNAP fuel-use figures and emission factors) into the CollectER database.

Tables for CollectER fuel consumption and emission results are prepared by a special NERI database (NERIrep.mdb). The results relevant for mobile sources are copied into a database containing all the official inventory results for mobile sources (Data2005 NIR-UNECE.mdb). By the use of database queries, the results from this latter database are aggregated into the same formats as being used by the relevant NERI transport models in their results calculation part. The final comparison between CollectER and NERI transport model results are set up in a spreadsheet.

Suggested QA/QC plan for mobile sources

The following points make up the list of QA/QC tasks to be carried out directly in relation to the mobile part of the Danish emission inventories. The time plan for the individual tasks has not yet been prepared.

Data storage level 1

- Storage of external data (temperature distribution), EMEP-CORINAIR guidebook (mobile chapters).
- An elaboration of the PAH and heavy metal part of the inventory for mobile sources. Review of existing emission factors and inclusion of new sources.

Data processing level 1

- A log in the NERI transport models explaining model changes (input data, model principles)
- Inclusion of new Danish mileage data (source: Ministry of Transport and Energy)
- Documentation list of model and independent calculations to test every single mathematical relation in the NERI transport models
- A formal description of sub-routines for external data manipulation

Data storage level 2

- Development of a model that can check the correct data transfer from input tables to CollectER.

Recalculations

The following recalculations and improvements of the emission inventories have been made since the emission reporting in 2007.

Road transport

For heavy duty vehicles new information from the Danish Car Importers Association has enabled a more precise distribution of vehicles into Euro levels. Also, a more realistic development from 2005 to 2006 in the total mileage for passenger cars has been introduced in the calculations. For 2005 and 2006, DEA have made small changes in a downward direction for the annual diesel fuel consumption statistics.

Recalculations have been made from 1985-2006 resulting in minor emission differences between -0.1 and -1.2 % for CH_4 and 0 and -0.1 % for N_2O. For CO_2, the emission change in 2005 is 0.1 %.

National sea transport

Fuel consumption and emission factors directly measured for the ferries used by Mols Linien have now been implemented in the inventory calculations, and small activity changes have been made for two smaller Danish ferry companies.

This has caused the fuel consumption and emissions to change from 1996 onwards. The emission changes for CO_2 and N_2O are between 0.4 and 2.3 %, and 0.4 % and 2.5 %, respectively. For CH_4 the emission change is -0.6 % in 2006. The fuel consumption increases are between 0.4 and 2.4 % in the period.

Fishery

Due to the change in fuel consumption for national sea transport, fuel adjustments are made for gas oil used by fishing vessels, and the emissions for this sector are also affected. Also, an error in the energy statistics for the year 2006 has been corrected by the DEA, thus reducing the gas oil fuel consumption for fisheries by 0.4 PJ.

Fishery is a part of the CRF-NFR code 1A4c consisting of agriculture, forestry and fisheries activities, and hence the fuel consumption and emission impacts are somewhat smaller for the sector as a whole.

From 1996-2005 the fuel consumption and emission changes are between -2.3 and -0.5 % for CO_2, -0.9 and -0.2 % for CH_4, and -3 and -0.6 % for N_2O.

Military

Emission factors derived from the new road transport simulations have caused minor emission changes from 1985-2006. The emission differences are between -0.9 and -0.1 % for CH_4, and between -0.1 and 1.7 % for N_2O. For CO_2 the emissions remain the same.

Residential

No changes have been made.

Railways

No changes have been made.

Aviation

No changes have been made.

Planned improvements

The ongoing aspiration is to fulfil the requirements from UNECE and UNFCCC for good practice in inventory preparation for transport. A study has been completed for transport, reviewing the different issues of choices relating to methods (methods used, emission factors, activity data, completeness, time-series consistency, uncertainty assessment) reporting and documentation, and inventory quality assurance/quality control. This work and the overall priorities of NERI, taking into account emission source importance (from the Danish 2004 key category analysis), background data available and time resources, lay down the following list of improvements to be made in future.

Emission factors

The Danish greenhouse gas emission factors will be compared with the factors suggested by IPCC.

QA/QC

Future improvements regarding this issue are dealt with in Section 3.1.4.

References for Chapter 3.3

Bak, F., Jensen, M.G., Hansen, K.F. 2003: Forurening fra traktorer og ikke-vejgående maskiner i Danmark, Miljøprojekt nr. 779, Danish EPA, Copenhagen (in Danish).

Cappelen, J. 2008: The Climate of Denmark 2007, with Thorshavn, Faroe Islands and Nuuk, Greenland - with English translations, Tecnical report No 08-01, pp. 54, Danish Meteorological Institute.

Cappelen, J., Jørgensen, B.V. 2007: The Climate of Denmark 2006, with Thorshavn, Faroe Islands and Nuuk, Greenland - with English translations, Tecnical report No 07-01, pp. 51, Danish Meteorological Institute.

Cappelen, J., Jørgensen, B.V. 2006: The Climate of Denmark 2005, with Thorshavn, Faroe Islands and Nuuk, Greenland - with English translations, Tecnical report No 06-01, pp. 48, Danish Meteorological Institute.

Cappelen, J., Jørgensen, B.V. 2005: The Climate of Denmark 2004 with the Faroe Islands and Greenland - with Danish translations, Tecnical report No 05-01, pp. 88, Danish Meteorological Institute.

Cappelen, J. 2004: The Climate of Denmark - Key climatic Figures 2000-2003, Tecnical report No 04-05, pp 23, Danish Meteorological Institute.

Cappelen, J. 2003: The Climate of Denmark - Key climatic Figures 1980-1989, Tecnical report No 03-15, pp 47, Danish Meteorological Institute.

Cappelen, J. 2000: The Climate of Denmark - Key climatic Figures 1990-1999, Tecnical report No 00-08, pp 47, Danish Meteorological Institute.

Danish Car Importers Association, 2008: Unpublished data from Tejs L. Jensen.

Danish Energy Authority, 2008: The Danish energy statistics, Available at http://www.ens.dk/sw11654.asp (13-10-2008).

Dansk Teknologisk Institut, 1992: Emission fra Landbrugsmaskiner og Entreprenørmateriel, commissioned by the Danish EPA and made by Miljøsamarbejdet in Århus (in Danish).

Dansk Teknologisk Institut, 1993: Emission fra Motordrevne Arbejdsredskaber og –maskiner, commissioned by the Danish EPA and made by Miljøsamarbejdet in Århus (in Danish).

Ekman, B. 2005: Unpublished data material from the Danish Road Directorate.

EMEP/CORINAIR, 2007: Emission Inventory Guidebook 3rd edition, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections, 2007 update. Available at: http://reports.eea.euro-pa.eu/EMEPCORINAIR5/en/page002.html (29-02-2008)

Fauser, P., Thomsen, M., Nielsen, O.K., Winther, M., Gyldenkærne, S., Hoffmann, L., Lyck, E. & Illerup, J.B. 2007: Verification of the Danish emission inventory data by national and international data comparisons. National Environmental Research Institute, University of Aarhus. - NERI Technical Report 627: 53 pp. (electronic). Available at: http://www2.-dmu.dk/Pub/FR627_Final.pdf.

Foldager, I. 2007: Unpublished data material from the Danish Road Directorate.

Hansen, K.F., Jensen, M.G. 2004: MÅLING AF EMISSIONER FRA FREMDRIVNINGSANLÆG PÅ MADS MOLS. Ruston 20RK270, Sagsnr.: 1076868, Documentation note, 5 pages (in Danish).

Hjortberg, Frank Krohn 2008: Unpublished data material from Bornholmstrafikken.

ICAO Annex 16: "International standards and recommended practices", Volume II "Aircraft Engine Emissions", 2th ed. (1993), plus amendments: Amendment 3 20th March 1997 and amendment 4 4 November 1999.

IFEU 2004: Entwicklung eines Modells zur Berechnung der Luftschadstoffemissionen und des Kraftstoffverbrauchs von Verbrennungsmotoren in mobilen Geräten und Maschinen - Endbericht, UFOPLAN Nr. 299 45 113, pp. 122, Heidelberg.

Illerup, J.B., Birr-Pedersen, K., Mikkelsen, M.H., Winther, M., Gyldenkærne, S., Bruun, H.G. & Fenhann, J. 2002: Projection Models 2010. Danish emissions of SO_2, NO_X, NMVOC and NH_3. National Environmental Research Institute, Denmark. 192 pg - NERI Technical Report No. 414. Available at: http://www2.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR414.pdf

Illerup, J.B., Lyck, E., Nielsen, O.K., Mikkelsen, M.H., Hoffmann, L., Gyldenkærne, S., Nielsen, M., Winther, M., Fauser, P., Thomsen, M., Sørensen, P.B. & Vesterdal, L. 2007a: Denmark's National Inventory Report 2007. Emission Inventories - Submitted under the United Nations Framework Convention on Climate Change, 1990-2005. National Environmental Research Institute, University of Aarhus. - NERI Technical Report 632: 642 pp. Available at: http://www2.dmu.dk/Pub/FR632_Final.pdf

Illerup, J.B., Nielsen, O.K., Winther, M., Mikkelsen, M.H., Hoffmann, L., Nielsen, M., Gyldenkærne, S., Fauser, P., Jensen, M.T. & Bruun, H.G. 2007b: Annual Danish Emission Inventory Report to UNECE. Inventories from the base year of the protocols to year 2005. National Environmental Research Institute, University of Aarhus. - NERI Technical Report 649: 182 pp. Available at http://www2.dmu.dk/Pub/FR649.pdf

IPCC, 2000: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Available at: http://www.ipcc-nggip.iges.or.jp/public/gp/english/ (15-04-2007).

Kristensen, Flemming 2008: Unpublished data material from Mols-Linjen.

Lastein, L. & Winther, M. 2003: Emission of greenhouse gases and long-range transboundary air pollutants in the Faroe Islands 1990-2001. National Environmental Research Institute. - NERI Technical Report 477: 62 pp. (electronic). Available at: http://www.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/FR477.PDF

Markamp 2008: Personal communication, Henrik Markamp, The National Motorcycle Association.

Marpol 73/78 Annex VI: Regulations for the prevention of air pollution from ships, technical and operational implications, DNV, 21 February 2005.

Ministry of Transport 2000: TEMA2000 - et værktøj til at beregne transporters energiforbrug og emissioner i Danmark (TEMA2000 - a calculation tool for transport related fuel use and emissions in Denmark). Technical report. Available at: http://www.trm.dk/sw664.asp

Ntziachristos, L. & Samaras, Z. 2000: COPERT III Computer Programme to Calculate Emissions from Road Transport - Methodology and Emission Factors (Version 2.1). Technical report No 49. European Environment Agency, November 2000, Copenhagen. Available at: http://re-ports.eea.eu.int/Technical_report_No_49/en (June 13, 2003).

Næraa, R. 2008: Unpublished data material from the Danish State Railways.

Nørgaard, T., Hansen, K.F. 2004: Chiptuning af køretøjer - miljømæssig effekt, Miljøprojekt nr. 888, Miljøstyrelsen.

PHP 1996: Research Report – Emission tests at Alpha, Mols 2 and Mols 4, 9L25MC mk6 engines #35031 and #35033, 22-23/10 1995 and 16/1 1996, DOK, PHP Basic Research, October 1996, 20 pages.

Pulles, T., Aardenne J.v., Tooly, L. & Rypdal, K. 2001: Good Practice Guidance for CLRTAP Emission Inventories, Draft chapter for the UNECE CORINAIR Guidebook, 7 November 2001, 42pp.

Statistics Denmark (2008): Data from Statbank Denmark. Available at: www.statbank.dk/statbank5a/default.asp?w=1280

Sørensen, P.B., Illerup, J.B., Nielsen, M., Lyck, E., Bruun, H.G., Winther, M., Mikkelsen, M.H. & Gyldenkærne, S. 2005: Quality manual for the green house gas inventory. Version 1. National Environmental Research Institute. - Research Notes from NERI 224: 25 pp. (electronic). Available

at:
http://www2.dmu.dk/1_viden/2_Publikationer/3_arbrapporter/AR224.pdf

USEPA 2004: Conversion Factors for Hydrocarbon Emission Components. EPA420-P-04-001, US Environmental Protection Agency, 5 pp.

Winther, M. 2001a: 1998 Fuel Use and Emissions for Danish IFR Flights. Environmental Project no. 628, 2001. 112 p. Danish EPA. Prepared by the National Environmental Research Institute, Denmark. Available at: http://www.mst.dk/udgiv/Publications/2001/87-7944-661-2/html/.

Winther, M. 2001b: Improving fuel statistics for Danish aviation. National Environmental Research Institute, Denmark. 56 p. – NERI Technical Report No. 387.

Winther, M. 2005: Kyoto notat - Transport. Internal NERI note (unpublished). 4 p. (in Danish).

Winther, M. & Nielsen, O.K. 2006: Fuel use and emissions from non-road machinery in Denmark from 1985–2004 – and projections from 2005-2030. The Danish Environmental Protection Agency. - Environmental Project 1092: 238 pp. Available at:
http://www.dmu.dk/Udgivelser/-Arbejdsrapporter/Nr.+200-249/

Winther, M. 2007: Danish emission inventories for road transport and other mobile sources. Inventories until year 2004. National Environmental Research Institute. - Research Notes from NERI 236: 244 pp. (electronic). Available at:
http://www2.dmu.dk/1_viden/2_Publikationer/3_arbrapporter/rapporter/AR201.pdf

Winther, M. 2008a: Fuel consumption and emissions from navigation in Denmark from 1990-2005 - and projections from 2006-2030. Technical Report from NERI no. 650. 109 pp. Available at:
http://www2.dm-u.dk/Pub/FR650.pdf

Winther, M. 2008b: Danish emission inventories for road transport and other mobile sources. Inventories until year 2006. National Environmental Research Institute, University of Aarhus. 219 pp. – NERI Technical Report No. 686. Available at: http://www.dmu.dk/Pub/FR686.pdf.

Wismann, T. 1999: MOLS-LINIEN, Mai Mols - Måling af emissioner fra fra hovedturbiner, dk-RAPPORT 14.901, 9 pages (in Danish).

Wismann, T. 2001: Energiforbrug og emissioner fra skibe i farvandene omkring Danmark 1995/1996 og 1999/2000 (Fuel consumption and emissions from ships in Danish coastal waters 1995/1996 and 1999/2000). The Danish Environmental Protection Agency. - Environmental Project 597: 88 pp. Available at:
http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publikationer/2001/87-7944-505-5/html/default.htm.

Wismann, T. 2007: Energiforbrug for skibe i fart mellem danske havne (Fuel consumption by ships sailing between Danish ports), Internal note, September 2007, 3 pp.

3.4 Additional information, CRF sector 1A Fuel combustion

3.4.1 Reference approach, feedstocks and non-energy use of fuels

In addition to the sector-specific CO_2 emission inventories (the national approach), the CO_2 emission is also estimated using the reference approach described in the IPCC Reference Manual (IPCC, 1997). The reference approach is based on data for fuel production, import, export and stock change. The CO_2 emission inventory based on the reference approach is reported to the Climate Convention and used for verification of the official data in the national approach.

Data for import, export and stock change used in the reference approach originate from the annual "basic data" table prepared by the Danish Energy Authority and published on their home page (Danish Energy Authority, 2008b). The fraction of carbon oxidised has been assumed to be 1.00. The carbon emission factors are default factors originating from the IPCC Reference Manual (IPCC, 1997). The country-specific emission factors are not used in the reference approach, the approach being for the purposes of verification.

The Climate Convention reporting tables include a comparison of the national approach and the reference approach estimates. To make results comparable, the CO_2 emission from incineration of the plastic content of municipal waste is added in the reference approach while the fuel consumption is subtracted.

Three fuels are used for non-energy purposes: lube oil, bitumen and white spirit. The total consumption for non-energy purposes is relatively low – 13.2 PJ in 2007.

In 2007 the fuel consumption rates in the two approaches differ by -0.44 % and the CO_2 emission differs by -0.004 %. In the period 1990-2007 both the fuel consumption and the CO_2 emission differ by less than 1.7 %. The differences are below 1 % for all years except 1998 and 2006. According to IPCC Good Practice Guidance (IPCC, 2000) the difference should be within 2 %. A comparison of the national approach and the reference approach is illustrated in Figure 3.61.

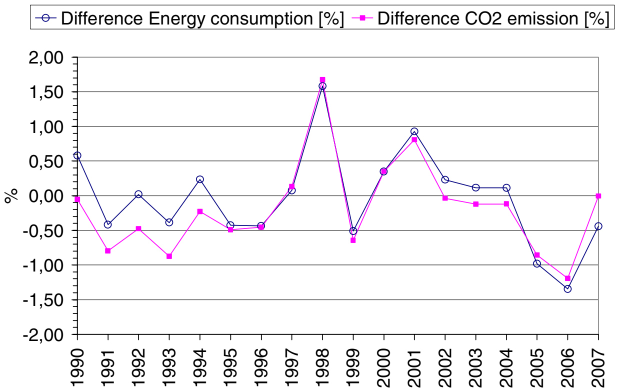


Figure 3.61 Comparison of the reference approach and the national approach.

3.5 Fugitive emissions (CRF sector 1B)

This chapter includes fugitive emissions in the CRF sector 1B.

3.5.1 Source category description

According to the categorization in the reporting format fugitive emissions is a sub-category under the main-category Energy (Sector 1). Fugitive emissions (Sector 1B) is segmented into sub-categories covering emissions from solid fuels (1B1), oil (1B2a), natural gas (1B2b) and from venting and flaring (1B2c). These CRF sub-sectors are shortly described below according to Danish conditions:

- 1B1c Fugitive emission from solid fuels: Emissions from solid fuels are only relevant for the Danish national emission inventories in the case of particle emissions that are not included here. Other components are not occurring, as these emissions should be included in the inventory for the nation housing the coalmines.
- 1B2a Fugitive emissions from oil: The category "Fugitive emissions from oil (1B2a)" includes emissions from offshore activities and refineries.
- 1B2b Fugitive emissions from natural gas, transmission and distribution: The CRF sector 1B2b includes emissions from transmission and distribution of natural gas. Emissions from gas storage are included in transmission.
- 1B2c Flaring of gas: Emissions from flaring include both offshore flaring, flaring in gas storage and treatment plants and in refineries. In Denmark venting of gas is assumed to be negligible because controlled venting enters the gas flare system.

Activity data end emissions are hold in the Danish emission database on SNAP sector categories (Selected Nomenclature for Air Pollution). An overview of the SNAP codes referring to fugitive emissions and the corresponding CRF sectors are shown in Table 3.5.1.

Table 3.5.1 List of CRF sectors relevant for fugitive emissions, and the corresponding SNAP codes and emission sources. Sectors written in grey italic are not occurring in the Danish emission inventories.

CRF sector	SNAP ID	SNAP name	Source
	04	Production processes	
1 B 2 a	*0401*	*Processes in petroleum industries*	*Oil*
1 B 2 a	040101	Petroleum products processing	Oil
1 B 2 a	*040103*	*Other*	*Oil*
	0402	*Processes in iron and steel industries and collieries*	
1 B 1 b	*040201*	*Coke oven (door leakage and extinction)*	*Solid fuel transformation*
1 B 1 c	*040204*	*Solid smokeless fuel*	*Other*
	05	Extraction and distribution of fossil fuels and geothermal energy	
1 B 1 a	0501	Extraction and 1st treatment of solid fossil fuels	Coal mining
1 B 1 a	*050101*	*Open cast mining*	*Coal mining*
1 B 1 a	050103	Storage of solid fuel	Coal mining
1 B 2 a	0502	Extraction, 1st treatment and loading of liquid fossil fuels	Oil
1 B 2 a	050201	Land-based activities	Oil
1 B 2 a	050202	Off-shore activities	Oil
1 B 2 b	0503	Extraction, 1st treatment and loading of gaseous fossil fuels	Natural gas
1 B 2 b	*050301*	*Land-based desulfuration*	*Natural gas*
1 B 2 b	*050302**	*Offshore activities*	*Natural gas*
1 B 2 b	050303	Off-shore activities	Natural gas
1 B 2 a	*0504*	*Liquid fuel distribution (except petrol distribution)*	*Oil*
1 B 2 a	*050401*	*Marine terminals (tankers, handling and storage)*	*Oil*
1 B 2 a	*050402*	*Other handling and storage (including pipeline)*	*Oil*
1 B 2 a	0505	Petrol distribution	Oil
1 B 2 a	*050501*	*Refinery dispatch station*	*Oil*
1 B 2 a	050503	Service stations (including refuelling of cars)	Oil
1 B 2 b	0506	Gas distribution networks	Natural gas
1 B 2 c	050601	Pipelines	Venting and flaring
1 B 2 b	050602	Distribution networks	Natural gas
	09	Waste treatment and disposal	
1 B 2 c	0902	Waste incineration	Venting and flaring
1 B 2 c	090203	Flaring in oil refinery	Venting and flaring
1 B 2 c	090206	Flaring in oil and gas extraction	Venting and flaring

*In the Danish emission inventory emissions from extraction of gas are united under “Extraction, 1st treatment and loading of liquid fossil fuels/off-shore activities” (CRF 1B2a / SNAP 050202).

Table 3.5.2 summarizes the Danish fugitive emissions in 2007. The methodologies, activity data and emission factors used for calculation are described in the following chapters.

Table 3.5.2 Summary of the Danish fugitive emissions 2007. P refers to point source and A to area source.

CRF sector	SNAP code	Source	Pollutant	Emission, tonnes
B2a iv	040101	P	SO_2	0.00
1B2a iv	040101	P	NMVOC	3773.03
1B2a iv	040101	P	CH_4	2115.63
1B2a iv	040103	P	SO_2	609.70
1B2a i	050201	A	NMVOC	5981.00
1B2a i	050201	A	CH_4	1883.00
1B2a i	050202	A	NMVOC	2442.00
1B2a i	050202	A	CH_4	1839.00
1B2a v	050503	A	NMVOC	968.59
1B2b	050601	A	NMVOC	2.26
1B2b	050601	A	CH_4	7.40
1B2b	050601	P	NMVOC	18.00
1B2b	050601	P	CH_4	71.00
1B2b	050603	A	NMVOC	26.78
1B2b	050603	A	CH_4	87.83
1B2c	090203	P	SO_2	525.60
1B2c	090203	P	NO_x	22.39
1B2c	090203	P	NMVOC	28.39
1B2c	090203	P	CH_4	52.71
1B2c	090203	P	CO	4.73
1B2c	090203	P	CO_2	19.60
1B2c	090203	P	N_2O	0.34
1B2c	090206	A	SO_2	1.81
1B2c	090206	A	NO_x	187.08
1B2c	090206	A	NMVOC	14.45
1B2c	090206	A	CH_4	28.89
1B2c	090206	A	CO	144.48
1B2c	090206	A	CO_2	342.58
1B2c	090206	A	N_2O	2.89
1B2c	090206	P	SO_2	0.02
1B2c	090206	P	NO_x	7.65
1B2c	090206	P	NMVOC	7.04
1B2c	090206	P	CH_4	25.07
1B2c	090206	P	CO	15.70
1B2c	090206	P	CO_2	4.46
1B2c	090206	P	N_2O	0.08

3.5.2 Methodological issues

Fugitive emissions from oil (1B2a)

The emissions from oil derive from offshore activities, service stations and refineries. Emissions from offshore activities include emissions from extraction, onshore oil tanks and onshore and offshore loading of ships. In the case of service stations emissions from reloading of tankers and refuelling of vehicles are included. The emissions from refineries derive from petroleum products processing (oil refining). Emissions from flaring in refineries are included under "Flaring".

Offshore activities

Fugitive emissions from oil include emissions from extraction, from onshore oil tanks and from onshore and offshore loading of ships.

The total emission can be expressed as:

$$E_{total} = E_{extraction} + E_{ship} + E_{oil\ tanks} \quad \text{(Eq. 3.5.1)}$$

Fugitive emissions from extraction

According to the EMEP/CORINAIR Guidebook (EEA, 2007) the total fugitive emissions of volatile organic carbon (VOC) from extraction can be estimated by means of equation 3.5.2.

$$E_{extraction,VOC} = 40.2 \cdot N_P + 1.1 \cdot 10^{-2} P_{gas} + 8.5 \cdot 10^{-6} \cdot P_{oil} \quad \text{(Eq. 3.5.2)}$$

where N_P is the number of platforms, P_{gas} is the production of gas, 10^6 Nm^3 and P_{oil} is the production of oil, 10^6 tons.

It is assumed that the VOC contains 75 % methane (CH_4) and 25 % NMVOC and in consequence the total emission of CH_4 and NMVOC for extraction of oil and gas can be calculated as:

$$E_{extraction,CH4} = 0.75(40.2 \cdot N_P + 1.1 \cdot 10^{-2} P_{gas} + 8.5 \cdot 10^{-6} \cdot P_{oil}) \quad \text{(Eq. 3.5.3)}$$

$$E_{extraction,NMVOC} = 0.25(40.2 \cdot N_P + 1.1 \cdot 10^{-2} P_{gas} + 8.5 \cdot 10^{-6} \cdot P_{oil}) \quad \text{(Eq. 3.5.4)}$$

Loading of ships

Fugitive emissions from loading of ships include the transfer of oil from storage tanks or directly from the well into ships. The activity also includes losses during transport. When oil is loaded hydrocarbon vapour will be displaced by oil and new vapour will be formed, both leading to emissions. The emissions from ships are calculated by equation 3.5.5.

$$E_{ships} = EMF_{ships} \cdot L_{oil} \quad \text{(Eq. 3.5.5)}$$

where EMF_{ships} is the emission factor for loading of ships off-shore and on-shore and L_{oil} is the amount of oil loaded.

Oil tanks

The emissions for storage of oil are given in the green accounts from DONG for 2007 (DONG, 2008). An implied emission factor is calculated for use in the CRF tables on basis of the amount of oil transported in pipelines according to equation 3.5.6.

$$IEF_{tanks} = E_{tanks} \div T_{oil} \quad \text{(Eq. 3.5.6)}$$

where IMF_{tanks} is the implied emission factor for storage of raw oil in tanks, E_{tanks} is the emission and T_{oil} is the amount of oil transported in pipelines.

Filling stations

NMVOC emissions from filling stations are estimated as outlined in equation 3.5.7.

$$E_{service\ stations} = \left(EMF_{reloading} \cdot T_{fuel}\right) + \left(EMF_{refuelling} \cdot T_{fuel}\right) \quad \text{(Eq.3.5.7)}$$

where $EMF_{reloading}$ is the emission factor for reloading of tankers to storage tanks at filling stations, $EMF_{refuelling}$ is the emission factor for refuelling of vehicles and T_{fuel} is the amount of gasoline used for road transport.

Oil refining

When oil is processed in the refineries part of the volatile organic carbon hydrides (VOC) are emitted to the atmosphere. The VOC emissions from the petroleum refinery process include non-combustion emissions from handling and storage of feedstock (raw oil), from the petroleum product processing and from handling and storage of products. Emissions from flaring in refineries are included under "Flaring". In cases where only the total VOC emission is given by the refinery the emission of CH_4 and NMVOC is estimated due to the assumption that 1 % of VOC is CH_4 and the remaining 99 % is NMVOC.

Both the non-combustion processes including product processing and sulphur recovery plants emit SO_2. The SO_2 emissions are calculated by the refineries and implemented in the emission inventory without further calculation.

Transmission and distribution of gas

The fugitive emission from transmission, storage and distribution is based on information from the gas companies. The only calculation added to the delivered data is estimation of NMVOC due to the gas quality measured by Energinet.dk.

Flaring

Emissions from flaring are estimated from the amount of gas flared offshore and in gas treatment/storage plants and from the corresponding emission factors. Offshore flaring amounts are given in Denmark's oil and gas production (Danish Energy Authority, 2008b) while flaring in treatment/storage plants are given in DONG Energy's green accounts (Dong Energy, 2008). The emission factors for flaring are based on the EEA (2007) and the calorific value for natural gas in Denmark which again is based on measurements in quality measuring station. SO_2 and NO_x emissions from flaring in refineries are given in the data set delivered by the individual refineries.

3.5.3 Activity data

Extraction of oil and gas and loading of ships

Activity data used in the calculations of the emissions from oil and gas production and loading of ships are shown in Table 3.5.3. Data are based on information from the Danish Energy Authority (Danish Energy Authority, 2008b) and from the green accounts from the Danish gas transmission company DONG Energy (DONG Energy, 2008).

Table 3.5.3 Activity data for 2007.

Activity	Symbols	Activity data	Data source
Number of platforms	N_p	55	Danish Energy Authority (2008b)
Produced gas, 10^6 Nm^3	P_{gas}	10 046	Danish Energy Authority (2008b)
Produced oil, 10^3 m^3	$P_{oil,vol}$	18 083	Danish Energy Authority (2008b)
Produced oil, 10^3 ton	P_{oil}	15 551	Danish Energy Authority (2008b)
Oil loaded, 10^3 m^3	$L_{oil\ off\text{-}shore}$	2 163	Danish Energy Authority (2008b)
Oil loaded, 10^3 ton	$L_{oil\ off\text{-}shore}$	1 860	Danish Energy Authority (2008b)
Oil loaded, 10^3 m^3	$L_{oil\ on\text{-}shore}$	12 000	DONG (2008)
Oil loaded, 10^3 ton	$L_{oil\ on\text{-}shore}$	10 320	DONG (2008)

Mass weight raw oil = 0.86 tonnepr m^3

As seen in Figure 3.5.1a the production of oil and gas in the North Sea has generally increased in the years 1990-2004. Since 2004 the production has decreased. The number of platforms is yet still increasing (Figure 3.5.1b). Five major platforms were completed in 1997-1999 which is the main reason for the great increase in the oil production in the years 1998-2000.

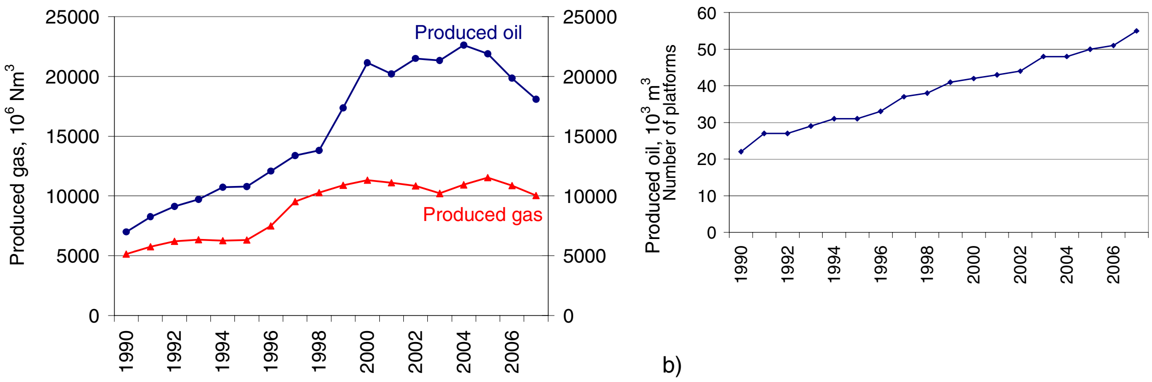


Figure 3.5.1 a) Production of oil and gas and b) the number of platforms in the Danish part of the North Sea.

The amounts of oil loaded offshore on ships roughly follow the trend of the oil and gas production (Figure 3.5.2). Data for offshore loading is not available until 1999. For onshore loading of ships the trend is more smoothed.

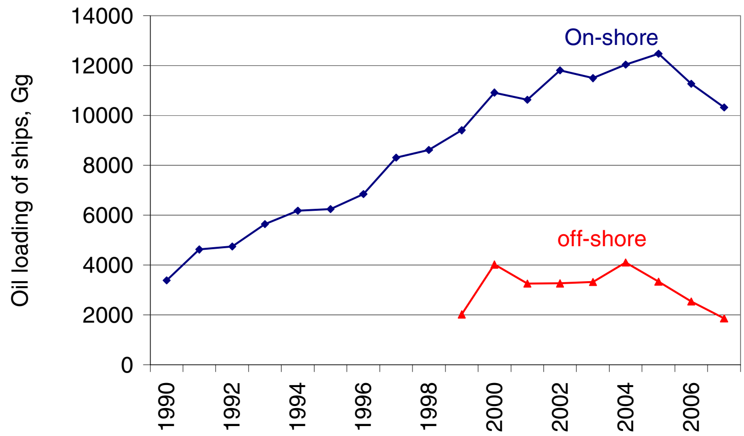


Figure 3.5.2 Onshore and offshore loading of ships.

Oil refining

Data on the amount of crude oil processed in refineries are given by the refineries in their annual green account. Data are shown in Table 3.5.4. In the last years the amount of crude oil being processed has been slightly decreasing to 7 963 Gg in 2007.

Table 3.5.4 Processed crude oil in refineries, emissions and emission factors.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Crude oil, 1000 Mg	7 263	7 798	8 232	8 356	8 910	9 802	10 522	7 910	7 906	8 106
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Crude oil, 1000 Mg	8 406	8 284	8 045	8 350	8 264	8 033	8 179	7 963		

Filling stations

The Danish Energy statistics holds data on the sale of gasoline which is the basis for estimating emissions of NMVOC from filling stations. The gasoline sales show an increase from 1990-1998 and a slightly decreasing trend from 1999-2007 (Figure 3.5.3). In 2007 the gasoline sale was 1 817 240 Mg.

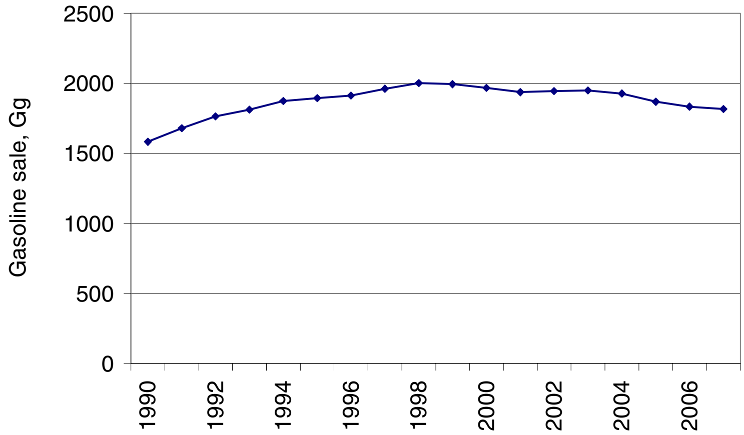


Figure 3.5.3 Gasoline sales in Denmark 1990-2007.

Transmission, storage and distribution of gas

The activity data used in the calculation of the emissions from natural gas is shown in Table 3.5.5. For 1990-2006 the data is collected from the gas companies by the Danish Gas Technology Centre, DGC. This data collection has stopped by 2007 and therefore data are collected directly from the gas companies and from DONG Energy's green accounts. Is has not been possible to get data on distribution for 2007 and therefore the distributed amount of gas has been extrapolated from the distributed amount in 2006 by the ratio between the transmitted amount in 2006 and 2007.

Table 3.5.5 Data on transmission and distribution of gas.

ACTIVITY DATA	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Transmission, Mm^3 *	2 739	3 496	3 616	3 992	4 321	4 689	5 705	6 956	6 641	6 795
Distribution, Mm^3 **	1 574	1 814	1 921	2 185	2 362	2 758	3 254	3 276	3 403	3 297
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Transmission, Mm^3 *	7 079	7 289	7 287	7 275	7 384	7 600	7 600	6 400		
Distribution, Mm^3 **	3 181	3 675	3 420	3 420	3 248	2 983	3 319	3 022		

* In 1990-1997 transmission rates refer to Danish energy statistics, in 1998 the transmission rate refers to the annual environmental report of DONG, in 1999-2006 emissions refer to DONG/Danish Gas Technology Centre (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007). In 2007 transmission data refers to the annual environmental report 2008 by Energinet.dk.

**) In 1999-2006 distribution rates refer to DONG/Danish Gas Technology Centre/Danish gas distribution companies (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007), In 1990-98 distribution rates are estimated from the Danish energy statistics. Distribution rates are assumed to equal total Danish consumption rate minus the consumption rates of sectors that receive the gas at high pressure. The following consumers are assumed to receive high pressure gas: town gas production companies, production platforms and power plants. In 2007 distributions data is estimated according to 2006 and the rate between transmission in 2006 and 2007.

In 2007 the gas transmission was 6 400 Mm3 and the distribution is estimated to 3 022 Mm^3 (Figure 3.5.4). This is a decrease according to last year owing to a mild winter and a greater Danish import of electricity from Norway and Sweden.

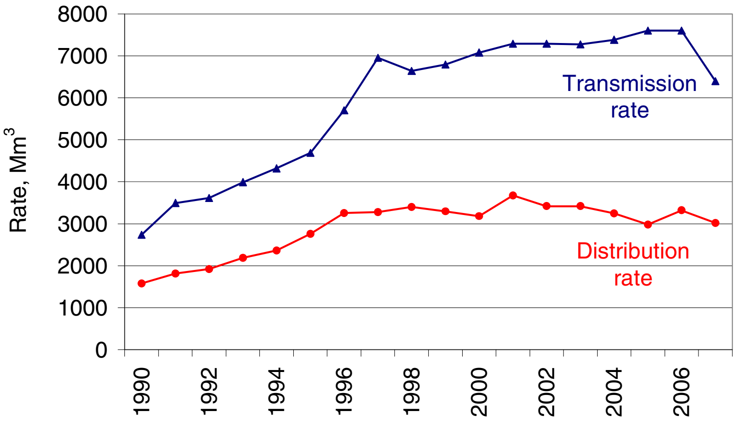


Figure 3.5.4 Transmission and distribution rates of gas.

Data on the transmission pipelines excluding offshore pipelines and on the distribution network are given by DGC and Energinet.dk concerning length and material. In 2007 the length of the transmission pipelines was 860 km. Because the distribution system in Denmark is relatively new most of the distribution network is made of PE. In 2007 the length of the distribution network was 18 959 km of which 0km was made of cast iron, 1 896 km was made of steel and 17 063 km made of plastic (PE). For this reason the fugitive emission is negligible under normal circumstances as the PE distribution system is basically tight with only minimal fugitive losses. The PE pipes are however vulnerable and therefore most of the fugitive emissions from the pipes are caused by losses due to excavation damages and construction and maintenance activities performed by the gas companies. These losses are either measured or estimated by calculation in each case by the gas companies.

In Denmark there are two natural gas storage facilities. Both are oblique to make a green account on annual basis. Data on gas input and withdrawal are included and were 746 Mm^3 and 581 Mm^3 in 2007, respectively. Until 2000 emissions from storage of gas were included in transmission in the inventories.

Flaring

The fuel consumption rates are shown in Table 3.5.6. Flaring rates in gas treatment and gas storage plants are not available until 1995. The mean value for flaring in treatment and storage facilities for the following ten years (1995 to 2004) has been adopted as basis for the emission calculation for the years 1990-1994.

The amount of flared gas is high in 2007 because of a greater maintenance work at the gas treatment plant. The flared amount is 1 972 491 Nm^3 in 2007 in contrast to 975 071 Nm^3 in 2006.

The offshore flaring amounts have been decreasing over the last 4 years in accordance with the exploration as seen in Table 3.5.6.

Table 3.5.6 Natural gas flaring rate (Danish Energy Authority, 2008b & DONG Energy, 2008).

Year	Flaring, offshore, TJ	Flaring, treatment and storage, TJ
1990	4 275	35
1991	8 827	35
1992	9 105	35
1993	7 877	35
1994	7 759	35
1995	6 017	45
1996	6 650	30
1997	9 619	35
1998	7 007	30
1999	15 280	32
2000	9 896	29
2001	10 688	35
2002	8 788	43
2003	9 105	32
2004	10 371	34
2005	7 323	42
2006	7 165	39
2007	6 096	79

3.5.4 Emission factors

Loading of ships

In the EMEP/CORINAIR Guidebook (EEA, 2007) standard emission factors for different countries are given. In the Danish emission inventory the Norwegian emission factors are used for estimation of fugitive emissions from loading of ships onshore and off shore (EMEP/CORINAIR, 2007, Table 8.15). The emission factors are listed in Table 3.5.7.

Table 3.5.7 Emission factors for loading of ships offshore and onshore.

	CH_4, fraction of loaded	NMVOC, fraction of loaded	Reference
Ships off-shore	0.00005	0.001	EEA, 2007
Ships on-shore	0.000002	0.0002	EEA, 2007

Oil refining

The refineries deliver information on consumption of fuel gas and fuel oil. The calorific values given by the refineries are used when available. When not available standard calorific values given in the basic data tables from the Danish Energy Authority combined with the conversion factor between fuel gas and fuel oil given by the refinery are used for calculation.

The emissions are given for SO_2, NO_x and VOC. Before 2004 the VOC emissions were not split in CH_4 and NMVOC. The assumption that 1 % of the VOC emission is CH_4 and the remaining 99 % is NMVOC is adapted for the years before 2004.

Filling stations

NMVOC from filling stations is calculated by use of different emission factors for the time-series as shown in Table 3.5.8. In 1994 the emission factors for NMVOC from filling stations were investigated by Fenhann and Kilde (1994) for the years 1990 1991 and 1992, individually. The emission factors reported for reloading and refuelling for 1990 were used for the years 1980-1990, while the emission factors for 1991 was used for that year only. For the years 1992-1995 only the emission factor for refuelling reported by Fenhann and Kilde (1994) was used in the Danish emission inventory. For Reloading of tankers the British emission factor was adopted for the years 1992-2007. For the years 1996-1999 emission factors for the sum of reloading and refuelling have been estimated using interpolation between 1995 and 2000.

Tabel 3.5.8 Emission factors used for estimating NMVOC from filling stations.

EMF NMVOC	Reloading of tankers, kg NMVOC pr tonnes gasoline	Refuelling of vehicles, kg NMVOC pr tonnes gasoline	Sum of reloading and refuelling, kg NMVOC pr tonnes gasoline	Source
1980-1990	1.28	1.52	2.80	Fennmann & Kilde1994
1991	0.64	1.52	2.16	Fennmann & Kilde1994
1992-1995	0.08	1.52	1.60	GB EMF, Fennmann & Kilde1994
1996			1.38	Interpolation between 1995 and 2000
1997			1.17	Interpolation between 1995 and 2000
1998			0.96	Interpolation between 1995 and 2000
1999			0.75	Interpolation between 1995 and 2000
2000-2007	0.08	0.46	0.53	GB EMF

Transmission, storage and distribution of gas

The emission inventories make use of no emission factors in the case of transmission, storage and distribution of gas as the emissions are reported by the gas companies.

Flaring

The emission factors for offshore flaring are shown in Table 3.5.9. The CO_2 emission factor follows the same time-series as natural gas combusted in stationary combustion plants. The dioxin emission factor origins from a Danish study by Henriksen et al. (2006) and is, like emission factors for particulate matter, the same as the emission factors used for combustion of natural gas in Danish public power plants. The remaining emission factors are based on EEA (2007) and are constant for the years 1990-2006. In 2007 the emission factors have been recalculated, which gives a minor divergence according to earlier years. The divergence is caused by introducing a conversion factor of 1.055 between Sm^3 and Nm^3 in the 2007 inventory. Further, the NO_x emission factor has been updated due to the conclusion in a new Danish study of NO_x emissions from offshore flaring carried out by the Danish Ministry of the Environment (2008). The new NO_x emission factor (31.008 g pr GJ or 0.0015 tonnes NO_x pr tonnes gas) is around one tenth of the old emission factor (300 g pr GJ or 0.015 tonnes NO_x pr tonnes gas) and corresponds well with the emission factors used to estimate NO_x emission in other lands with oil production in the North Sea (Netherlands (approx. 0.0014 tonnes NO_x pr tonnes gas) and United Kingdom (approx. 0.0013 tonnes NO_x pr tonnes gas)).

Table 3.5.9 Emission factors for offshore flaring of natural gas 2007.

Pollutant	Emission factor	Unit
SO_2	0.300	g pr GJ
NO_x	31.008	g pr GJ
NMVOC	2.395	g pr GJ
CH_4	4.789	g pr GJ
CO	23.947	g pr GJ
CO_2	56.780	kg pr GJ
N_2O	0.479	g pr GJ
TSP	0.100	g pr GJ
PM_{10}	0.100	g pr GJ
$PM_{2.5}$	0.100	g pr GJ
Dioxin	0.025	ng pr GJ
Fluoranthene	21.000	mg pr GJ

3.5.5 Emissions

Extraction of oil and gas and loading of ships

From the activity data in Table 3.5.3 and equation 3.5.3 and 3.5.4 the fugitive emissions of CH_4 and NMVOC from extraction are calculated. Corresponding emissions from loading of ships are estimated by Table 3.5.3, Table 3.5.7 and equation 3.5.5. The emissions are listed in Table 3.5.10 along with the emissions from storage of oil given in the green accounts from DONG Energy (2008).

Table 3.5.10 CH_4 and NMVOC emissions for 2007.

	CH_4, tonnes	NMVOC, tonnes
Fugitive emissions from extraction	1 736	582
Oil tanks	1 780	3 917
Offshore loading of ships	93	1 860
Onshore loading of ships	103	2 064
Total	3 722	8 423

Oil refining

In Table 3.5.11 the activity data and emissions of CH_4 and NMVOC from the two Danish refineries are listed for the years 1990-2007. Further, the emissions of SO_2 from oil refining and sulphur recovery in refineries are shown. In years prior to 2004 1 % of the VOC emission is assumed to be CH_4 and 99 % NMVOC. The increase in CH_4 emission in 2004 owe to new measurements at one of the two refineries which make it possible to split the VOC emission data into CH_4 and NMVOC. The emission of SO_2 has shown a pronounced decrease since 1990 because of technical improvements at the refineries. Note that SO_2 from refining and recovery prior to 1994 was summarized and reported as an area source in category 1B2a vi. Note also that SO_2 from oil refining from 2001 are included in stationary combustion.

Table 3.5.11 Emissions of CH_4 and NMVOC from oil refining in refineries.

	1990[1]	1991[1]	1992[1]	1993[1]	1994	1995	1996	1997	1998	1999
CH_4 emission, Mg	37	40	42	43	57	48	62	45	45	45
NMVOC emission, Mg	3 667	3 937	4 203	4 219	5 855	4 546	5 875	4 547	4 558	4 558
SO_2, oil refining, Mg					934	585	167	216	253	234
SO_2, sulphur recovery, Mg	3 335	2 713	3 147	2 526	3 332	2 437	2 447	1 766	1 188	1 125
continued	2000	2001[2]	2002[2]	2003[2]	2004[2]	2005[2]	2006[2]	2007[2]		
CH_4 emission, Mg	50	44	43	37	613	612	2 101	2 116		
NMVOC emission, Mg	4 983	4 338	4 302	3 708	3 732	3 550	3 848	3 773		
SO_2, oil refining Mg	178	0	0	0	0	0	0	0		
SO_2, sulphur recovery Mg	803	672	332	246	119	255	679	610		

1) Prior to 1994 SO_2 emissions from oil refining and sulphur recovery are reported as area sources in category 1B2a vi.

2) From 2001 SO_2 emissions from oil refining are included in stationary combustion.

Service stations

Emissions from service stations are calculated using the emission factors in Table 3.5.8 and the sales of gasoline given by the Danish Energy statistics. The NMVOC emissions are listed in Table 3.5.12.

Table 3.5.12 Emission of NMVOC from service stations 1990-2007.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NMVOC emission, Mg	4 432	3 629	2 817	2 894	2 994	3 026	2 648	2 298	1 918	1 488
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
NMVOC emission, Mg	1 048	1 033	1 037	1 039	1 027	996	977	969		

Transmission, storage and distribution of gas

Emissions of CH_4 are given by the gas companies. The CH_4 emissions for transmission are estimated on basis of registered loss in the transmission grid and the emission from the natural gas consumption in the pressure regulating stations (Ørtenblad, 2007) and CH_4 emissions from gas distribution are estimated by use of emission factors from the Danish EPA and OPG as well as from the gas composition. It includes flaring, discharge and blasting of gas, emissions from production and consumption of energy (electricity, gas, diesel, gasoline and diesel for cars) (Ørtenblad, 2007).

The emissions of NMVOC are calculated on basis of the CH_4 emission according to the gas quality measured by Energinet.dk (equation 3.5.8).

$$E_{NMVOC} = E_{CH_4} \cdot (0.225 / 0.738) \qquad \text{(eq. 3.5.8)}$$

For the years before 2000 emissions from transmission and storage have not been estimated separately and storage is included in transmission (Table 3.5.13). The decrease in NMVOC from transmission from 2006 to 2007 owe to completion of a greater construction work and rerouting of a major pipeline (Table 3.5.14). As mentioned earlier the pipelines in Denmark are relatively new and most emissions are due to construction and maintenance. There have been no appreciable construction work in 2007 and therefore a low emission.

The increased emission from distribution in 2004 owe to venting of the distribution network.

Table 3.5.13 CH_4 emission from transmission, storage and distribution.

CH_4 EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Transmission Mg*	98	161	49	102	83	315	104	235	156	191
Storage Mg**										
Distribution Mg**						80	95	23	24	43
Continued										
CH_4 EMISSIONS	2000	2001	2002	2003[1,2]	2004[1]	2005[1]	2006[1]	2007[3]		
Transmission Mg*	86	157	78	88	85	141	152	7		
Storage Mg**	83	73	67	68	86	54	67	71		
Distribution Mg	49	56	39	39	142	62	96	88		

*In 1991-95 CH4 emissions are based on the annual environmental report from DONG for the year 1995. In 1996-99 the CH_4 emission refers to the annual environmental reports from DONG for the years 1996-99. In 2000-2006 the CH_4 emission refers to DONG/Danish Gas Technology Centre (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007). In 2007 the CH_4 emission refers to the annual environmental reports from Energinet.dk for 2008.

**Danish Gas Technology Centre/DONG/Danish gas distribution companies (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007. Emissions from storage are included in transmission 1990-1999.

1) Data from Naturgas Fyn not included until 2007 as data has not been available.

2) Assumed same emission as in 2002.

3) Distribution data are extrapolated from 2006 according to change in transmission data.

Table 3.5.14 NMVOC emission from transmission, storage and distribution.

NMVOC emission*	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Transmission, Mg**	30	49	15	31	25	96	32	72	48	58
Storage, Mg***										
Distribution, Mg***						80	95	23	24	43
Continued	2000	2001	2002	2003[1,2]	2004[1]	2005[1]	2006[1]	2007[3]		
Transmission, Mg**	52	48	24	27	26	43	46	2		
Storage, Mg***		22	20	21	26	16	20	22		
Distribution, Mg***	15	17	12	12	43	19	29	27		

*NMVOC emissions are estimated from the CH_4 emission according to the gas quality given by Energinet.dk.

**In 1991-95 CH4 emissions are based on the annual environmental report from DONG for the year 1995. In 1996-99 the CH_4 emission refers to the annual environmental reports from DONG for the years 1996-99. In 2000-2006 the CH_4 emission refers to DONG/Danish Gas Technology Centre (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007). In 2007 the CH_4 emission refers to the annual environmental reports from Energinet.dk for 2008.

***Danish Gas Technology Centre/DONG/Danish gas distribution companies (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007. Emissions from storage are included in transmission 1990-1999.

1) Data from Naturgas Fyn not included until 2007 as data has not been available.

2) Assumed same emission as in 2002.

3) Distribution data are extrapolated from 2006 according to change in transmission data.

Flaring

As shown in Figure 3.5.5 there was a marked increase in the amount of offshore flaring in 1997 and 1999. The increase in 1997 was due to the new field Dan and the completion of the Harald field. The increase in 1999 was due to the opening of the three new fields Halfdan, Siri and Syd Arne.

The time-series for the emission of CO_2 from offshore flaring of natural gas fluctuates due to the fluctuations in the fuel rate and to a minor degree due to the CO_2 emission factor. The latter rests on gas quality measurements. Fuel rate and CO_2 emission are shown in Figure 3.5.5.

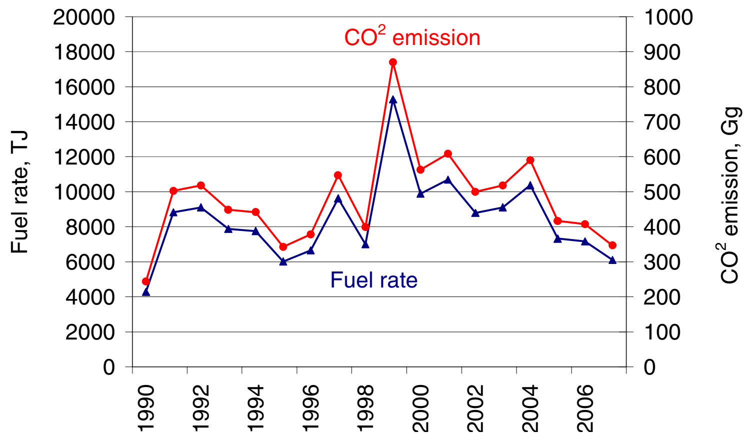


Figure 3.5.5 Fuel rate and CO_2 emission from offshore flaring of gas 1990-2007.

Besides in the offshore sector flaring also takes place in refineries and gas treatment/storage plants. In case of SO_2 flaring in refineries is the most significant emission source (Table 3.5.15 and Table 3.5.16). In 1990-1993 emissions from petroleum product processing were included in emissions from flaring in refineries (1B2c). From 1994 the data delivery format was changed which made it possible to split the emissions into contributions from flaring and processing, respectively. Emissions from processing are from 1994 included in 1B2a iv.

The decreasing emissions of SO_2 in 1995 and 1997 are due to technical improvements of the sulphur recovery system at one of the two Danish refineries (Table 3.5.15). The increase in SO_2 from flaring in refineries in 2005 and 2007 was due to shutdown for inspection and maintenance.

Table 3.5.15 Emissions from flaring in refineries.

Emission	1990*	1991*	1992*	1993*	1994	1995	1996	1997	1998	1999
SO_2, tonnes	943	926	935	1 190	520	203	218	138	70	50
NO_x, tonnes	41	41	41	41	235	26	41	27	34	31
NMVOC, tonnes	34	34	34	34	34	34	34	22	28	27
CO, tonnes	5	5	5	5	5	5	5	3	4	4
CO_2, tonnes	23	23	23	23	29	23	23	15	19	18
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
SO_2, tonnes	51	46	68	96	53	296	257	526		
NO_x, tonnes	33	21	39	24	31	26	21	22		
NMVOC, tonnes	28	18	33	20	26	34	28	28		
CO, tonnes	5	3	6	3	4	6	5	5		
CO_2, tonnes	19	13	23	14	18	24	19	20		

* In 1990-1993 emissions from petroleum product processing were included in flaring in refineries due to the data delivery form. From 1994 emissions from petroleum product processing were given in 1B2a iv.

Table 3.5.16 Emissions from flaring offshore and in gas treatment/storage plants.

Emission	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SO_2, tonnes	1	3	3	2	2	2	2	3	2	5
NO_x, tonnes	131	270	278	242	239	197	208	302	218	480
NMVOC, tonnes	13	26	27	23	23	22	22	32	24	49
CO, tonnes	105	217	224	195	193	157	170	247	181	391
CO_2, tonnes	240	495	511	445	439	339	375	548	401	878
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
SO_2, tonnes	3	3	3	3	3	2	2	2		
NO_x, tonnes	313	338	279	292	322	230	225	195		
NMVOC, tonnes	33	35	31	31	34	25	24	21		
CO, tonnes	256	276	230	239	263	190	186	160		
CO_2, tonnes	573	619	510	534	588	416	406	347		

3.5.6 Uncertainties and time-series consistency

Estimations of uncertainty are based on the Tier 1 methodology in IPCC Good Practice Guidance (IPCC, 2000). The results of the uncertainty estimates are shown in Table 3.5.17.

Table 3.5.17 Uncertainty calculated for the year 2007, CRF sector 1B Fugitive emissions.

Pollutant	Uncertainty of emission inventory [%]	Uncertainty of emission trend [%]
CO_2	16	30
CH_4	52	69
N_2O	52	15
GHG*	18	29

*Combined uncertainty estimated in MS Excel according to the IPCC Tier 1 method.

Uncertainties for activity rates for oil and gas activities are 15 %, referring to the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (Table 3.5.18). The uncertainty of the emission factor for CO_2 is the uncertainty of emission factors for flaring. This emission factor uncertainty is 5 % according to IPCC. Uncertainty with regard to CH_4 and N_2O emission factors is assumed to be 50 % in both cases.

Table 3.5.18 Uncertainty of activity rates and emission factors

	Uncertainty Activity Rate [%]	Uncertainty Emission Factor [%]
CO_2	15	5
CH_4	15	50
N_2O	15	50

Time-series consistency is kept by using consistent data sources and by checking up delivered data for methodological changes.

3.5.7 Source specific QA/QC and verification

Data deliveries

The following table lists the external data deliveries used for the inventory of fugitive emissions. Further the table holds information on the contacts at the data delivery companies.

Table 3.5.19 List of external data deliveries.

Dataset	Description	Activity data, emission factors or emissions	Reference	Contact(s)	Data agreement/ Comment
Data for offshore extraction	Gas and oil production. Dataset for production of oil, gas and number of platforms. CRF 1B2a	Activity data	The Danish Energy Agency (DEA)	Jan H. Andersen	No formal data agreement.
Gas distribution	Natural gas from the distribution company, sales and losses (meter differences)	Activity data	DONG Energy, HNG and MN, Naturgas Fyn	Finn Adser, Ole B. Hansen & Sofie Faaborg-Andersen, Ron Cronin	No formal data agreement.
Gas transmission	Natural gas from the transmission company, sales and losses (meter differences)	Activity data	Energinet.dk	Christian Friberg B. Nielsen	
Environmental report from DONG	Gas and oil production. The amount of oil loaded onshore and emissions from raw oil tanks. CRF 1B2a	Activity data and emission data	DONG, 2007	Mike Robson	No formal data agreement.
Air emissions from refinery (Statoil and Shell)	Fuel consumption and emission data. CRF 1B2a.	Activity data and emission data	Statoil, Shell	Claus Stefan Kock, Lis Rønnow Rasmussen	No formal data agreement.
Environmental indicators of the gas industry	Data for natural gas transmission/distribution and storage. CRF 1B2b.	Activity data and emission data	DONG Energy, HNG and MN, Naturgas Fyn	Finn Adser, Ole B. Hansen, Sofie Faaborg-Andersen	No formal data agreement.
Service stations	Data on gasoline sales	Activity data	The Danish Energy Agency (DEA)		
CO_2 quota reports	Reports according to the CO_2 emission trading scheme	Activity data			Not necessary due to obligation by law
Emissions from storage and treatment of gas	Green accounts from plants defined as large point sources (Lille Torup, Stenlille, Nybro, Oil terminal)	Activity data	Various plants.		Not necessary due to obligation by law
Off shore flaring		Activity data	The Danish Energy Authority		
Emission factors	Emission factors origin from a large number of sources	Emission factors	See chapter regarding emission factors		

Data storage level 1

The elaboration of a formal QA/QC plan started in 2004 and the first version is available (Sørensen et al. 2005). The plan describes the concepts of quality work and definitions of sufficient quality, critical control points and a list of Points of Measuring (PM). Please refer to the general chapter on QA/QC.

Data Storage level 1	1. Accuracy	DS.1.1.1	General level of uncertainty for every dataset including the reasoning for the specific values.

The DEA is responsible for the official Danish energy statistics as well as reporting to the IEA. NERI regards the data as being complete and in accordance with the official Danish energy statistics and IEA reporting. The uncertainties connected with estimating fuel consumption do not, therefore, influence the accordance between IEA data, the energy statistics and the dataset on SNAP level utilised by NERI. For the remaining datasets, it is assumed that the level of uncertainty is relatively small, except for the emissions from refineries. For further comments regarding uncertainties, see Chapter 3.5.6.

Data Storage level 1	1. Accuracy	DS.1.1.2	Quantification of the uncertainty level of every single data value including the reasoning for the specific values.

The uncertainty for external data is not quantified. The uncertainties of activity data and emission factors are quantified see Chapter 3.5.6.

Data Storage level 1	2.Comparability	DS.1.2.1	Comparability of the data values with similar data from other countries, which are comparable with Denmark, and evaluation of discrepancy.

Systematic inter-country comparison has only been made on Data Storage Level 4. Refer to DS 4.3.2.

Data Storage level 1	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included, by setting down the reasoning behind the selection of datasets.

External data sources are the Danish Energy Authority and annual environmental reports from plants which are obligated to publish environmental reports. Further, reporting from the gas companies. A summary of each dataset is not yet given.

Data Storage level 1	4.Consistency	DS.1.4.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PMs)

All external data are stored in the inventory file system and are accessible for all inventory staff members. Refer to Section 1.3.

Data Storage level 1	6.Robustness	DS.1.6.1	Explicit agreements between the external institution holding the data and NERI about the condition of delivery

Formal agreements are made with the DEA. Most of the other external data sources are available due to legal requirements in this regard. See Table. 3.5.19

Data Storage level 1	7.Transparency	DS.1.7.1	Summary of each dataset including the reasoning for selecting the specific dataset

See DS 1.3.1

Data Storage level 1	7.Transparency	DS.1.7.3	References for citation for any external data set have to be available for any single value in any dataset.

Refer to Table 3.5.19 for general references. The references are available in the inventory file system. Refer to Section 1.3.

Data Storage level 1	7.Transparency	DS.1.7.4	Listing of external contacts for every dataset.

Refer to Table 3.5.19

Data Processing Level 1

Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage Level 2 in relation to type of variability (distribution as: normal, log normal or other type of variability)

Refer to Section 1.7 in the Danish NIR and the QA/QC Section 3.5.6.

Data Processing level 1	1. Accuracy	DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals)

The uncertainty assessment of activity data and emission factors are discussed in Section 1.7 concerning uncertainties.

Data Processing level 1	1. Accuracy	DP.1.1.3	Evaluation of the methodological approach using international guidelines

The methodological approach is consistent with international guidelines and described in Section 3.5.2.

Data Processing level 1	1. Accuracy	DP.1.1.4	Verification of calculation results using guideline values.

This PM has only been carried out for some of the sources, but will be completed for the key categories.

Data Processing level 1	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCCC and IPCC.

The calculations follow the principles in international guidelines.

Data Processing level 1	3.Completeness	DP.1.3.1	Assessment of the most important quantitative knowledge which is lacking.

Regarding the emissions from refineries, more detailed data material would be preferred. Further, more detailed data on emissions from exploration of oil and gas would be preferred.

Data Processing level 1	3.Completeness	DP.1.3.2	Assessment of the most important cases where access is lacking with regard to critical data sources that could improve quantitative knowledge.

No accessibility to critical data sources is lacking.

Data Processing level 1	4.Consistency	DP.1.4.1	In order to keep consistency at a high level, an explicit description of the activities needs to accompany any change in the calculation procedure.

A change in calculating procedure would entail that an updated description would be elaborated.

Data Processing level 1	5.Correctness	DP.1.5.1	Show at least once, by independent calculation, the correctness of every data manipulation.

During data processing it is checked that calculations are performed correctly. However, documentation for this needs to be elaborated.

Data Processing level 1	5.Correctness	DP.1.5.2	Verification of calculation results using time-series.

A time-series for activity data on SNAP level as well as emission factors is used to identify possible errors in the calculation procedure.

Data Processing level 1	5.Correctness	DP.1.5.3	Verification of calculation results using other measures.

This PM has only been carried out for some of the sources.

Data Processing level 1	5.Correctness	DP.1.5.4	Shows one-to-one correctness between external data sources and the databases at Data Storage level 2.

There is a direct line between the external datasets, the calculation process and the input data used on Data Storage level 2. During the calculation process, numerous controls are in place to ensure correctness, e.g. sum checks of the various stages in the calculation procedure.

Data Processing level 1	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described.
Data Processing level 1	7.Transparency	DP.1.7.2	The theoretical reasoning for all methods must be described.
Data Processing level 1	7.Transparency	DP.1.7.3	Explicit listing of assumptions behind all methods.

Direct references to the NIR will be worked out.

Data Processing level 1	7.Transparency	DP.1.7.4	Clear reference to data set at Data Storage level 1.

References to external data sets are in most cases incorporated in the data storage and calculation systems. References will be worked out for the remaining sources.

Data Processing level 1	7.Transparency	DP.1.7.5	A manual log to collect information on recalculations.

At present, a manual log table is not in place on this level. However, this feature will be implemented in the future. A manual log table is incorporated in the national emissions database, Data Storage level 2.

Data storage level 2

Data Storage level 2	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data types at level 2 to data at level 1

To ensure a correct connection between data on level 2 to data on level 1, different controls are in place, e.g. control of sums and random tests.

Data Storage level 2	5.Correctness	DS.2.5.2	Check if a correct data import to level 2 has been made.

Data import is checked by use of sum control and random testing. The same procedure is applied every year in order to minimise the risk of data import errors.

Other QC procedures

A list of QA/QC tasks are performed directly in relation to the fugitive emission part of the Danish emission inventories. The following procedures are carried out to ensure the data quality:

- Checking of time-series in the IPCC and SNAP source categories. Considerable changes are controlled and explained.
- Comparison with the inventory of the previous year. Any major changes are verified.
- Total emission, when aggregated to IPCC and LRTAP reporting tables, is compared with totals based on SNAP source categories (control of data transfer).
- A manual log table in the emission databases is applied to collect information about recalculations.
- The emission from the large point sources (refineries, gas treatment and storage plants) are compared with the emission reported the previous year.
- Some automated checks have been prepared for the emission databases:
  - Check of units for fuel rate, emission factor and plant-specific emissions.
  - Check of emission factors for large point sources. Emission factors for pollutants that are not plant-specific should be the same as those defined for area sources.
  - Additional checks on database consistency.
- Most emission factor references are now incorporated in the emission database, itself.
- Most data sources are implemented in the fugitive emission model.
- Annual environmental reports are kept for subsequent control of plant-specific emission data.

The QC work will continue in future years.

3.5.8 Recalculations

Offshore flaring: Recalculations have been made for fugitive emissions 1985-2006 according to emission of NO_X from flaring. The Danish Ministry of the Environment has leaded an evaluation on NO_X emissions from flaring with the aim to improve the emission factor that is used in the

Danish national emission inventory. The evaluation concluded that it is more representative to make a change from using the standard NO_X emission factor given in the EMEP/CORINAIR guidebook to use an emission factor that is in accordance with the guidelines by the British (UKOOA), the American (OGP) and the Norwegian (OLF) oil and gas producers. The changed emission factor causes the estimated NO_X emission from flaring to reduce by a factor of 10. The new implemented emission factor is 0.0015 tonnes NO_X pr tonnes gas.

Emissions from oil refining has in earlier years been reported under 1B2a vi "Other". In 2007 "Oil refined" has been relocated to 1B2a iv "Refining/Storage". This was a result of a suggestion made during the internal EU review.

Flaring and processing of petroleum products in refineries: Recalculation has been made for the years 2005-2006 according to availability of new data from the Danish refineries.

Flaring in natural gas storage plants: The data have been relocated from CRF 1B2b iv to 1B2b iii for the year 2000 to make the time-series consistent.

Source-specific planned improvements

The following future improvements are suggested.

- **Emissions from storage of fuels in tank facilities:** The recent edition of the Danish emission inventory holds emissions from extraction of fuels, combustion of fuels and from service stations. To make the inventory complete emissions from storage of fuels in tank facilities should be included in the future if data is available. Work is going on to locate greater tank facilities in Denmark and collect the available data. In cases where no emission estimates or measurements are available a set of emission factors have to be set up.
- **Emissions from town gas:** Work is going on to add an improvement to the Danish inventories by including emissions from town gas production and distribution. In earlier years town gas was used in Denmark to a great extend, but most plants were closed during the seventies owing to the oil crises. Since 1985 only four plants have had town gas production. Two gas plants were shut down in January 2004 and November 2005, respectively leaving only two cities with a town gas supply today. Collection of data on town gas, including production, distribution, networks and gas loss is in process.
- **Emissions from offshore extraction of oil and gas:** The fugitive emissions from extraction of oil and gas are based on a standard formula. If possible a better estimate should be implemented.

References for Chapters 3.5

Danish Energy Authority, 2008b: Annual report on oil & gas production 2007. Available at:
http://www.ens.dk/graphics/Publikationer/Olie_Gas_UK/oil_and_gas_production_in_denmark_07/index.htm (18-02-2009)

Danish Ministry of the Environment (2008): Emissionsfaktorer for NOx-emissioner fra flaring fra platforme i Nordsøen. Not published.

DONG Energy, 2008: Annually environmental report from DONG Energy.

Energinet.dk, 2008: Environmental Report 2008. Available at: http://www.energinet.dk/NR/rdonlyres/EC3E484D-08D5-4179-9D85-7B9A9DBD3E08/0/Environmentalreport2008.pdf

European Environmental Agency (EEA), 2007: EMEP/CORINAIR Emission Inventory Guidebook – 2007. Technical report No 16/2007. Available at: http://www.eea.europa.eu/publications/EMEPCORINAIR5 (25-02-2009)

Fenhann, J., & Kilde, N.A., 1994: Inventory of Emissions to the Air from Danish Sources 1972-1992. Risø National Laboratory, Roskilde, Denmark.

Henriksen, T.C., Illerup, J.B. & Nielsen, O.-K. 2006: Dioxin Air Emission Inventory 1990-2004. National Environmental Research Institute, Denmark. 90 pp. – NERI Technical report no 602. Available at: http://www.dmu.dk/Pub/FR602.pdf (25-02-2009)

Karll, B. 2003, Personal communication, e-mail 17-11-2003, Danish Gas Technology Centre.

Karll, B. 2005, Personal communication, e-mail 09-11-2005, Danish Gas Technology Centre.

Oertenblad, M. 2006, personal communication, e-mail 2006, Danish Gas Technology Centre

Oertenblad, M. 2007, personal communication, e-mail 2007, Danish Gas Technology Centre

4 Industrial processes (CRF Sector 2)

4.1 Overview of the sector

The aim of this chapter is to present industrial emissions of greenhouse gases, not related to generation of energy. An overview of the sources identified is presented in Table 4.1 with an indication of the contribution to the industrial part of the emission of greenhouse gases in 2007. The emissions are extracted from the CRF tables.

Table 4.1 Overview of industrial greenhouse gas sources (2007).

Process	IPCC Code	Substance	Emission ktonneCO_2-eq.	%
Cement	2A		1 407	55.6
Refrigeration	2F	HFCs+PFCs	734	29.0
Foam blowing	2F	HFCs	103	4.07
Lime	2A		67	2.64
Limestone and dolomite use	2A		51.0	2.01
Other (yellow bricks)	2A		38.0	1.50
Other (lubricants)	2G		37.9	1.50
Other (expanded clay products)	2A		26.9	1.06
Other (laboratories, double glaze windows)	2F	SF_6	15.3	0.60
Electrical equipment	2F	SF_6	15.1	0.59
Other (container glass, glass wool)	2A		15.0	0.59
Aerosols/Metered dose inhalers	2F	HFCs	10.9	0.43
Other (fibre optics)	2F	HFCs+PFCs	7.63	0.30
Catalysts/fertilisers	2B		2.16	0.09
Road paving	2A		2.00	0.08
Asphalt roofing	2A		0.005	0.0002
Metal production	2C		0	0
Nitric acid	2B	N_2O	0	0
Total			2 533	100

The subsectors *Mineral products* (2A) constitutes 64 %, *Chemical industry* (2B) constitutes below 1 %, *Metal production* constitutes 0 %, *Consumption of halocarbons and SF_6* (2F) constitutes 35 %, and *Other* (2G) constitutes 1.5 % of the industrial emission of greenhouse gases. The total emission of greenhouse gases (excl. LUCF) in Denmark is estimated to 66.6 Mt CO_2-eq., of which industrial processes contribute with 2.53 Mt CO_2-eq. (3.8 %). The emission of greenhouse gases from industrial processes from 1990-2007 are presented in Figure 4.1.

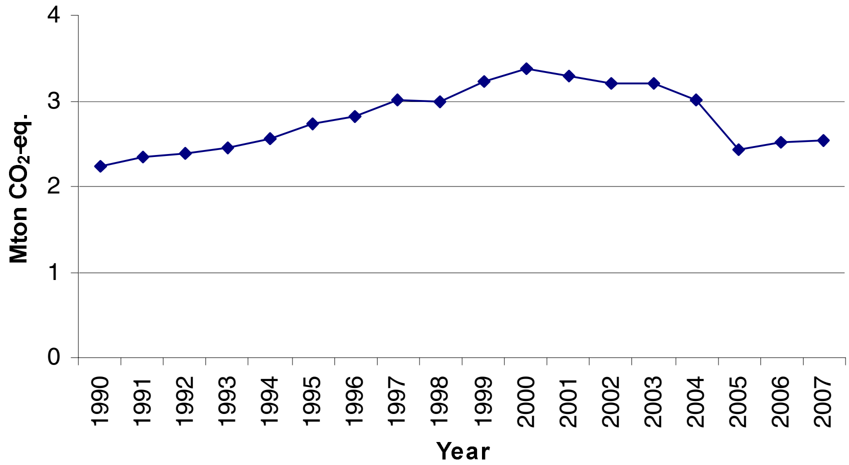


Figure 4.1 Emission of greenhouse gases from industrial processes (CRF Sector 2) from 1990-2007.

The key categories in the industrial sector constitute 2.1 and 1.1 % of the total emission of greenhouse gases. The trends in greenhouse gases from the industrial sector/subsectors are presented in Table 4.2 and they will be discussed subsector by subsector below. The emissions are extracted from the CRF tables.

Table 4.2 Emission of greenhouse gases from industrial processes in different subsectors from 1990-2007.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CO_2 (kt CO_2)										
A. Mineral Products	1 073	1 246	1 366	1 383	1 406	1 407	1 516	1 685	1 620	1 600
B. Chemical Industry	0.80	0.80	0.80	0.80	0.80	0.80	1.45	0.87	0.56	0.58
C. Metal Production	28.4	28.4	28.4	31.0	33.5	38.6	35.2	35.0	42.2	43.0
G. Other	49.7	48.9	48.1	47.6	46.9	48.8	48.9	47.1	44.9	42.7
Total	1 152	1 324	1 443	1 462	1 487	1 495	1 601	1 768	1 708	1 686
CH_4										
	-	-	-	-	-	-	-	-	-	-
N_2O (kt N_2O)										
B. Chemical Industry	3.36	3.08	2.72	2.56	2.60	2.92	2.69	2.74	2.60	3.07
HFCs (kt CO_2 eq.)										
F. Consumption of Halocarbons and SF_6	-	-	3.44	93.9	135	218	329	324	411	503
PFCs (kt CO_2 eq.)										
F. Consumption of Halocarbons and SF_6	-	-	-	-	0.053	0.50	1.66	4.12	9.10	12.5
SF_6 (kt CO_2 eq.)										
F. Consumption of Halocarbons and SF_6	44.5	63.5	89.2	101	122	107	61.0	73.1	59.4	65.4

Continued	2000	2001	2002	2003	2004	2005	2006	2007
CO_2 (kt CO_2)								
A. Mineral Products	1 620	1 617	1 660	1 531	1 648	1 548	1 610	1 607
B. Chemical Industry	0.65	0.83	0.55	1.05	3.01	3.01	2.18	2.16
C. Metal Production	40.7	46.7	NA,NO	NA,NO	NA,NO	15.6	NA,NO	NA,NO
G. Other	39.7	38.5	39.9	37.0	37.7	37.6	37.5	37.9
Total	1 701	1 703	1 701	1 569	1 688	1 604	1 649	1 647
CH_4								
N_2O (kt N_2O)								
B. Chemical Industry	3.24	2.86	2.50	2.89	1.71	0.00	0.00	0.00
HFCs (kt CO_2 eq.)								
F. Consumption of Halocarbons and SF_6	605	647	672	695	749	795	815	840
PFCs (kt CO_2 eq.)								
F. Consumption of Halocarbons and SF_6	17.9	22.1	22.2	19.3	15.9	13.9	15.7	15.4
SF_6 (kt CO_2 eq.)								
F. Consumption of Halocarbons and SF_6	59.2	30.4	25.0	31.4	33.1	21.8	36.0	30.3

A number of improvements have been planned and are in progress, e.g. inclusion of iron foundries.

4.2 Mineral products (2A)

4.2.1 Source category description

The subsector *Mineral products* (2A) cover the following processes:

- Production of cement.
- Production of lime (quicklime).
- Production of bricks, tiles and expanded clay products.

- Limestone and dolomite use.
- Roof covering with asphalt materials.
- Road paving with asphalt.
- Production of container glass/glass wool.

Production of cement is identified as a key category; see *Annex 1: Key Category Analyses*.

The time-series for the emission of CO_2 from *Mineral products* (2A) are presented in Table 4.3 The emissions are extracted from the CRF tables and the values are rounded.

Table 4.3 Time-series for emission of CO_2 (kt) from Mineral products (2A).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1. Production of Cement	882	1 088	1 192	1 206	1 192	1 204	1 282	1 441	1 390	1 355
2. Production of Lime	116	82.7	95.0	93.2	96.1	87.7	82.0	87.4	74.4	78.9
3. Limestone and dolomite use	18.1	23.2	25.2	32.6	53.1	55.2	89.3	89.6	91.2	99.2
5. Asphalt roofing	0.019	0.014	0.012	0.018	0.021	0.020	0.024	0.019	0.026	0.026
6. Road paving	1.76	1.76	1.79	1.81	1.75	1.77	1.77	1.77	1.70	1.75
7. Other										
Glass and Glass wool	17.4	15.6	14.5	14.1	14.9	14.1	13.9	14.0	15.0	18.1
Yellow Bricks	23.0	23.0	24.0	22.0	30.8	28.7	29.8	33.1	33.4	32.0
Expanded Clay	14.9	12.1	12.7	13.0	17.3	15.3	16.6	18.3	14.6	14.8
Total	1 073	1 246	1 366	1 383	1 406	1 407	1 516	1 685	1 620	1 600
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
1. Production of Cement	1 385	1 388	1 416	1 330	1 459	1 363	1 395	1 407		
2. Production of Lime	76.7	80.7	103	75.1	67.9	63.5	69.2	66.9		
3. Limestone and dolomite use	93.6	92.2	85.4	74.5	64.2	60.7	73.8	51.0		
5. Asphalt roofing	0.032	0.025	0.017	0.018	0.020	0.024	0.024	0.005		
6. Road paving	1.72	1.66	1.66	1.67	1.85	1.84	1.84	2.00		
7. Other										
Glass and Glass wool	15.9	16.0	16.3	13.5	13.3	12.6	13.5	15.0		
Yellow Bricks	32.8	27.8	27.0	27.0	28.9	32.2	34.8	38.0		
Expanded Clay	14.2	10.5	10.8	9.53	12.7	14.0	20.9	26.9		
Total	1 620	1 617	1 660	1 531	1 648	1 548	1 610	1 607		

The increase in CO_2 emission is most significant for the production of cement. From 1990 to 2007, the CO_2 emission increased from 882 to 1 407 kt CO_2, i.e. by 60 %. The maximum emission occurred in 2004 and constituted 1 539 kt CO_2; see Figure 4.2.

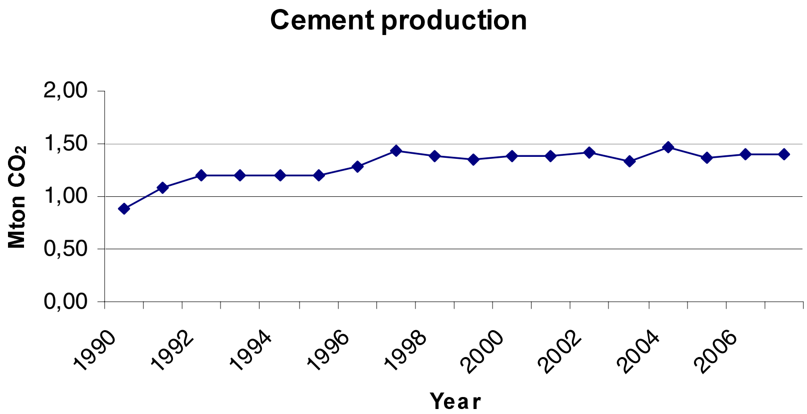


Figure 4.2 Emission of CO_2 from cement production.

The increase can be explained by the increase in the annual cement production. The emission factor has only changed slightly as the distribution between types of cement especially grey/white cement has been almost constant from 1990-1997.

4.2.2 Methodological issues

General

The CO_2 emission from the production of cement has been estimated from the annual production of cement expressed as TCE (total cement equivalents[8]) and an emission factor estimated by the company (Aalborg Portland, 2008a; 2008b; 2008c). The emission factor has been estimated from the loss of ignition determined for the different kinds of clinkers produced, combined with the volumes of grey and white cements produced. Determination of loss of ignition takes into account all the potential raw materials leading to release of CO_2 and omits the Ca-sources leading to generation of CaO in cement clinker without CO_2 release. The applied methodology is in accordance with EU guidelines in calculation of CO_2 emissions (Aalborg Portland, 2008c). However, from the year 2005 the CO_2 emission compiled by Aalborg Portland for EU-ETS is used in the inventory (Aalborg Portland, 2008a). Activity data, and emission factors for cement production are presented in Table 4.4.

Table 4.4 Activity data, emission factors, and CO_2 emission for cement production.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Tonne TCE	1 619 976	1 998 674	2 214 104	2 244 329	2 242 409	2 273 775	2 418 988	2 718 923	2 754 405	2 559 575
Tonne clinker	NI	NI	NI	NI	NI	NI	NI	NI	2 462 249	2 387 282
EF tonne CO_2 pr tonne TCE[1]	0.545	0.544	0.539	0.537	0.532	0.529	0.530	0.530	0.505	-
EF tonne CO_2 pr tonne TCE[2]	-	-	-	-	-	-	-	-	0.505	0.529
EF tonne CO_2 pr tonne TCE[3]	-	-	-	-	-	-	-	-	-	-
EF tonne CO_2 pr tonne clinker[4]	NE	NE	NE	NE	NE	NE	NE	NE	0.565	0.567
Tonne CO_2	882 402	1 087 816	1 192 336	1 206 093	1 192 196	1 203 777	1 282 064	1 441 029	1 390 975	1 354 015
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Tonne TCE	2 612 721	2 660 972	2 698 459	2 546 295	2 861 471	2 706 371	2 842 282	2 946 294		
Tonne clinker	2 452 394	2 486 146	2 508 415	2 363 610	2 611 617	2 520 788	2 632 112	2 706 048		
EF tonne CO_2 pr tonne TCE[1]	-	-	-	-	-	-	-	-		
EF tonne CO_2 pr tonne TCE[2]	0.530	0.517	0.529	0.532	0.510	-	-	-		
EF tonne CO_2 pr tonne TCE[3]	-	-	-	-	-	0.504	0.491	0.478		
EF tonne CO_2 pr tonne clinker[4]	0.565	0.553	0.569	0.573	0.559	0.541	0.530	0.520		
Tonne CO_2	1 384 742	1 375 723	1 427 485	1 354 629	1 459 350	1 363 000	1 395 466	1 408 329		

1. 1990-1998: EF based on information provided by Aalborg Portland.
2. 1998-2004: EF based on information provided by Aalborg Portland (Aalborg Portland, 2008c).
3. 2005-2007: EF based on emissions reported to EU-ETS (Aalborg Portland, 2008a).
4. 1998-2007: EF based on clinker production statistics provided by Aalborg Portland (Aalborg Portland, 2009).

NI No information.

NE Not estimated.

The CO_2 emission from the production of burnt lime (quicklime) as well as hydrated lime (slaked lime) has been estimated from the annual pro-

[8] TCE (total cement equivalent) expresses the total amount of cement produced for sale and the theoretical amount of cement from the amount of clinkers produced for sale.

duction figures, registered by Statistics Denmark – see Table 4.5 and emission factors.

Table 4.5 Statistics for production of lime and slaked lime (tonnes) (Statistics Denmark, 2008).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Lime	127 978	86 222	104 526	106 587	112 480	100 789	95 028	102 587	88 922	95 177
Slaked lime	27 686	27 561	23 821	17 559	14 233	15 804	13 600	12 542	8 445	7 654
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Lime	92 002	96 486	122 641	87 549	77 844	71 239	78 652	75 504		
Slaked lime	8 159	9 012	12 006	11 721	12 532	13 839	13 731	14 028		

The emission factors applied are 0.785 kg CO_2 pr kg CaO as recommended by IPCC (IPCC, 1997, vol. 3, p. 2.8) and 0.541 kg CO_2 pr kg hydrated lime (calculated from company information on composition of hydrated lime (Faxe Kalk, 2003)).

The CO_2 emission from the production of bricks and tiles has been estimated from information on annual production registered by Statistics Denmark, corrected for amount of yellow bricks and tiles. This amount is unknown and, therefore, is assumed to be 50 %; see Table 4.6.

Table 4.6 Statistics for production of yellow bricks and expanded clay products (tonnes) (Statistics Denmark, 2007).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Yellow bricks	291 348	291 497	303 629	278 534	389 803	362 711	377 652	419 431	423 254	405 241
Expanded clay products	331 760	268 871	282 920	288 310	383 768	340 881	368 080	406 716	324 413	329 393
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Yellow bricks	414 791	351 955	342 179	341 981	365 388	407 940	465 504	348 928		
Expanded clay products	316 174	232 289	239 664	211 794	281 828	310 901	411 869	504 925		

The content of $CaCO_3$ and a number of other factors determine the colour of bricks and tiles and, in the present estimate, the average content of $CaCO_3$ in clay has been assumed to be 18 %. The emission factor lime (0.44 kg CO_2 pr kg $CaCO_3$) has been used to calculate the emission factor for yellow bricks: 0.079 tonne CO_2 pr tonne yellow bricks. For verification of this approach see Figure 4.3. For 2006 and 2007 emission factors have been derived from CO_2 emissions reported by the brickworks to EU-ETS (confidential reports from approximately 20 brickworks) and production statistics (Statistics Denmark, 2008). The emission factors are calculated to 0.0747 and 0.1089 tonne CO_2 pr tonne yellow bricks.

The CO_2 emission from the production of container glass/glass wool has been estimated from production statistics published in environmental reports from the producers (Rexam Glass Holmegaard, 2007; Ardagh Glass Holmegaard, 2008; Saint-Gobain Isover, 2008) and emission factors based on release of CO_2 from specific raw materials (stoichiometric determination).

The CO_2 emission from consumption of limestone for flue gas cleaning has been estimated from statistics on generation of gypsum (wet flue gas cleaning processes) and the stoichiometric relations between gypsum and release of CO_2:

$$SO_2 (g) + ½O_2 (g) + CaCO_3 (s) + 2H_2O \rightarrow CaSO_4,2H_2O (s) + CO_2 (g)$$

and the emission factor is: 0.2325 tonnes CO_2 pr tonne gypsum.

Statistics on the generation of gypsum from power plants are compiled by Energinet.dk (2008). However, for 2006 and 2007 information on consumption of $CaCO_3$ at the relevant power plants has been compiled (from environmental reports) and used in the calculation of CO_2-emission from flue gas cleaning.

Information on the generation of gypsum at waste incineration plants does not explicitly appear in the Danish waste statistics (Miljøstyrelsen, 2009). However, the total amount of waste products generated can be found in the statistics. The amount of gypsum is calculated by using information on flue gas cleaning systems at Danish waste incineration plants (Illerup et al., 1999; Nielsen & Illerup, 2002) and waste generation from the different flue gas cleaning systems (Hjelmar & Hansen, 2002).

The CO_2 emission from the production of expanded clay products has been estimated from production statistics compiled by Statistics Denmark and an emission factor of 0.045 tonne CO_2 pr tonne product. For 2006 and 2007 emission factors have been derived from CO_2 emissions reported to EU-ETS (Damolin, 2008; Maxit, 2008) and production statistics (Statistics Denmark, 2008). The emission factors are calculated to 0.0507 and 0.0532 tonne CO_2 pr tonne product.

The CO_2 emission from the refining of sugar is estimated from production statistics for sugar and a number of assumptions: consumption of 0.02 tonne $CaCO_3$ pr tonne sugar and precipitation of 90 % CaO resulting in an emission factor at 0.0088 tonne CO_2 pr tonne sugar. However, from the year 2006 the CO_2 emission compiled by the company for EU-ETS is used in the inventory (Danisco, 2008).

The indirect emission of CO_2 from asphalt roofing and road paving has been estimated from production statistics compiled by Statistics Denmark and default emission factors presented by IPCC (1997) and EMEP/CORINAIR (2004). The default emission factors, together with the calculated emission factor for CO_2, are presented in Table 4.7.

Table 4.7 Default emission factors for application of asphalt products.

		Road paving with asphalt	Use of cutback asphalt	Asphalt roofing
CH_4	G pr tonnes	5	0	0
CO	G pr tonnes	75	0	10
NMVOC	G pr tonnes	15	64 935	80
Carbon content fraction of NMVOC	%	0.667	0.667	0.8
Indirect CO_2	Kg pr tonnes	0.168	159	0.250

EU-ETS (EU Emission Trading Scheme)

Guidelines for calculating company specific CO_2 emissions are developed by EU (EU, 2007). The guidelines present standard methods for minor companies and methods for developing individual plans for major companies. The standard methods include default emission factors similar to the default emission factors presented by IPCC (e.g. for limestone), whereas, the major companies has to use individual methods to determine the actual composition of raw materials (e.g. purity of limestone or Ca pr Mg ratio in dolomite) or the actual CO_2 emission from the specific process.

4.2.3 Uncertainties and time-series consistency

The time-series are presented in Table 4.3. The methodology applied for the years 1990-2007 is considered to be consistent as the emission factor has been determined by the same approach for all years. The emission factor has only changed slightly as the distribution between types of cement, especially grey/white cement, has been almost constant from 1990-1997. Furthermore, the activity data originates from the same company for all years.

For the production of lime and bricks, as well as container glass and glass wool, the same methodology has also been applied for all years. The emission factors are based either on stoichiometric relations or on a standard assumption of $CaCO_3$-content of clay used for bricks. The source for the activity data is, for all years, Statistics Denmark.

The source-specific uncertainties for mineral products are presented in Section 4.8. The overall uncertainty estimate is presented in Section 4.7.

4.2.4 Verification

The estimation of CO_2 release from the production of bricks based on an assumption of 50 % yellow bricks has been verified by comparing the estimate with actual information on emission of CO_2 from calcination of lime compiled by the Danish Energy Authority (DEA) (DEA, 2004). The information from the companies (tile-/brickworks; based on measurements of $CaCO_3$ content of raw material) has been compiled by DEA in order to allocate a CO_2 quota to Danish companies with the purpose of future reductions. The result of the comparison is presented in Figure 4.3.

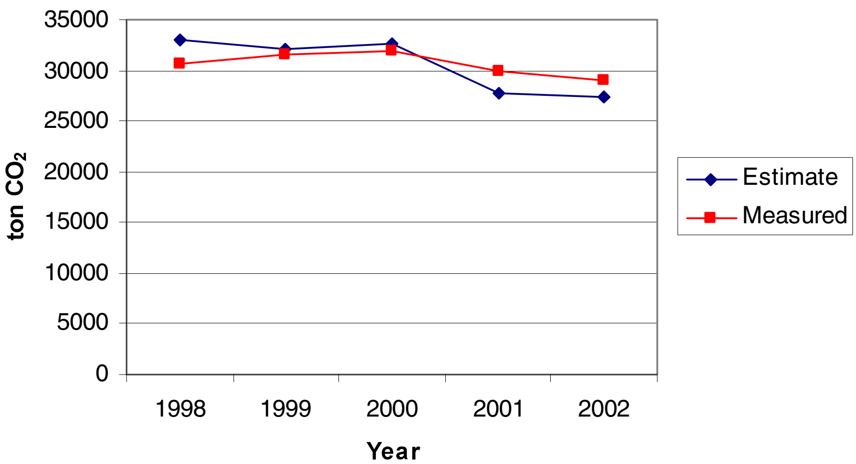


Figure 4.3 Estimated and “measured” CO_2 emission from tile-/brickworks; “measured” means information provided to the Danish Energy Authority by the individual companies (DEA, 2004).

Figure 4.3 shows a reasonable correlation between the estimated and measured CO_2 emission.

4.2.5 Recalculations

The emission of CO_2 from production of cement has been revised for the years 1998-2005 based on new information from the company; see Table 4.4. For yellow bricks and expanded clay products the CO_2 emission has been adapted from the company reports to EU-ETS as the emission factors calculated previously and used until 2005 were found not to be in line with the actual emission.

4.2.6 Source-specific planned improvements

Production statistics for glass and glass wool as well as information on consumption of raw materials will be completed for 1990-1995.

4.3 Chemical industry (2B)

4.3.1 Source category description

The subsector *Chemical industry* (2B) covers the following processes:

- Production of nitric acid/fertiliser.
- Production of catalysts/fertilisers.

Production of nitric acid is identified as a key category.

The time-series for emission of CO_2 and N_2O from *Chemical industry* (2B) are presented in Table 4.8.

Table 4.8 Time-series for emission of greenhouse gasses from Chemical industry (2B).

2B	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2. Nitric acid production (kt N_2O)	3.36	3.08	2.72	2.56	2.60	2.92	2.69	2.74	2.60	3.07
2. Nitric acid production (kt CO_2 eq.)	1 043	955	844	795	807	904	834	848	807	950
5. Other (kt CO_2)	0.80	0.80	0.80	0.80	0.80	0.80	1.45	0.87	0.56	0.58
Total (kt CO_2 eq.)	1 044	956	844	796	807	905	836	849	807	951

Continued	2000	2001	2002	2003	2004	2005	2006	2007
2. Nitric acid production (kt N_2O)	3.24	2.86	2.50	2.89	1.71	0	0	0
2. Nitric acid production (kt CO_2 eq.)	1 004	885	774	895	531	0	0	0
5. Other (kt CO_2)	0.65	0.83	0.55	1.05	3.01	3.01	2.18	2.16
Total (kt CO_2 eq.)	1 004	886	775	896	534	3.01	2.18	2.16

The emissions are extracted from the CRF tables and the values are rounded.

The emission of N_2O from nitric acid production is the most considerable source of GHG from the chemical industry. The trend for N_2O from 1990 to 2003 shows a decrease from 3.36 to 2.89 kt, i.e. -14 %, and a 40 % decrease from 2003 to 2004. However, the activity and the corresponding emission show considerable fluctuations in the period considered and the decrease from 2003 to 2004 can be explained by the closing of the plant in the middle of 2004.

From 1990 to 2007, the emission of CO_2 from the production of catalysts/fertilisers has increased from 0.80 to 2.16 kt with maximum in 2004-5, due to an increase in the activity as well as changes in raw material consumption.

4.3.2 Methodological issues

The N_2O emission from the production of nitric acid/fertiliser is based on measurement for 2002. For the previous years, the N_2O emission has been estimated from annual production statistics from the company and an emission factor of 7.5 kg N_2O pr tonne nitric acid, based on the 2002 emission measured (Kemira Growhow, 2004). The production of nitric acid ceased in the middle of 2004.

The CO_2 emission from the production of catalysts/fertilisers is based on information in an environmental report from the company (Haldor Topsøe, 2008), combined with personal contacts. In the environmental report, the company has estimated the amount of CO_2 from the process and the amount from energy conversion. Based on information from the company, the emission of CO_2 has been calculated from the composition of raw materials used in the production (for the years 1990 and 1996-2004) and for 2006 assumed to be the same as in 2004 based on the same activity (produced amount). For the years 1991-1995, the production, as well as the CO_2 emission, has been assumed to remain the same as in 1990.

4.3.3 Uncertainties and time-series consistency

The time-series are presented in Table 4.8. The applied methodology regarding N_2O is considered to be consistent. The activity data is based on information from the specific company. The emission factor applied has been constant from 1990 to 2001 and is based on measurements in 2002. The production equipment has not been changed during the period.

The estimated CO_2 emissions are considered to be consistent as they are based on stoichiometric relations combined with company assumptions for the years 1991-1995.

The source-specific uncertainties for the chemical industry are presented in Section 4.8. The overall uncertainty estimate is presented in Section 4.7.

4.3.4 Recalculations

No source-specific recalculations have been performed regarding emissions from the chemical industry.

4.3.5 Source-specific planned improvements

No improvements are planned for this sector.

4.4 Metal production (2C)

4.4.1 Source category description

The subsector *Metal production* (2C) covers the following process:

- Steelwork

The time-series for emission of CO_2 from *Metal production* (2C) is presented in Table 4.9. The emissions are extracted from the CRF tables and the values presented are rounded.

Table 4.9 Time-series for emission of CO_2 (kt) from Metal production (2C).

2C	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1. Iron and steel production	28.4	28.4	28.4	31.0	33.5	38.6	35.2	35.0	42.2	43.0
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
1. Iron and steel production	40.7	46.7	NA,NO	NA,NO	NA,NO	15.6	NA,NO	NA,NO		

From 1990 to 2001, the CO_2 emission from the electro-steelwork has increased from 28 to 47 kt, i.e. by 68 %. The increase in CO_2 emission is similar to the increase in the activity as the consumption of metallurgical coke pr amount of steel sheets and bars produced has almost been constant during the period. The electro-steelwork reopened and closed down again in 2005.

4.4.2 Methodological issues

The CO_2 emission from the consumption of metallurgical coke at steelworks has been estimated from the annual production of steel sheets and steel bars combined with the consumption of metallurgical coke pr produced amount (Stålvalseværket, 2002). The carbon source is assumed to be coke and all the carbon is assumed to be converted to CO_2 as the carbon content in the products is assumed to be the same as in the iron scrap. The emission factor (3.6 tonnes CO_2 pr tonne metallurgical coke) is based on values in the IPCC-guidelines (IPCC (1997), vol. 3, p. 2.26). Emissions of CO_2 for 1990-1991 and for 1993 have been determined with extrapolation and interpolation, respectively.

4.4.3 Uncertainties and time-series consistency

The time-series (see Table 4.9) is considered to be consistent as the same methodology has been applied for the whole period. The activity, i.e. amount of steel sheets and bars produced as well as consumption of metallurgical coke, has been published in environmental reports. The emission factor (consumption of metallurgical coke pr tonnes of product) has been almost constant from 1994 to 2001. For the remaining years, the same emission factor has been applied. In 2002, production stopped. For 2005 the production has been assumed to be one third the production in 2001 as the steelwork was operating between 4 and 6 months in 2005.

The source-specific uncertainties for the metal production are presented in Section 4.8. The overall uncertainty estimate is presented in Section 4.7.

4.4.4 Recalculations

No source-specific recalculations have been performed regarding emissions from the metal production.

4.4.5 Source-specific planned improvements

The emission of CO_2 from consumption of metallurgical carbon in iron foundries is not included at the moment. However, this source will be investigated and included.

4.5 Production of Halocarbons and SF_6 (2E)

There is no production of Halocarbons or SF_6 in Denmark.

4.6 Metal Production (2C) and Consumption of Halocarbons and SF_6 (2F)

4.6.1 Source category description

The sub-sector *Consumption of halocarbons and SF_6* (2F) includes the following source categories and the following F-gases of relevance for Danish emissions:

- 2C4: SF_6 used in Magnesium Foundries: SF_6; see Table 4.10.
- 2F1: Refrigeration: HFC32, 125, 134a, 152a, 143a, PFC (C_3F_8); see Table 4.11.
- 2F2: Foam blowing: HFC134a, 152a; see Table 4.12.
- 2F4: Aerosols/Metered dose inhalers: HFC134a; see Table 4.13.
- 2F8: Production of electrical equipment: SF_6; see Table 4.14.
- 2F9: Other processes (laboratories, double glaze windows, fibre optics): SF_6, HFC23, CF_4, C_3F_8, C_4F_8; see Table 4.15.

A quantitative overview is given below for each of these source categories and each F-gas, showing their emissions in tonnes through the times-series. The data is extracted from the CRF tables that form part of this submission and the data presented is rounded values. It must be noticed that the inventories for the years 1990-1993 (1994) might not cover emissions of these gases in full. The choice of base-year for these gases is 1995 for Denmark.

Table 4.10 SF_6 used in magnesium foundries (t).

2C4	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SF_6 used in magnesium foundries	1.30	1.30	1.30	1.50	1.90	1.50	0.40	0.60	0.70	0.70
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
SF_6 used in magnesium foundries	0.89	NO	NO	NO	NO	NO	NO	NO		

Table 4.11 Consumption of HFCs and PFC in refrigeration and air condition systems (t).

2F1 Refrigeration	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
HFC32	NE	NE	NE	NA	NA	0.11	0.84	1.77	2.72	3.77
HFC125	NE	NE	NE	NA	0.23	2.58	9.46	15.8	21.8	31.7
HFC134a	NE	NE	0.32	2.63	10.3	14.3	16.3	34.2	45.9	94.3
HFC152a	NE	NE	NE	NA	NA	NA	NA	0.05	0.36	0.49
HFC143a	NE	NE	NE	NA	0.22	2.43	8.65	13.7	19.3	29.1
PFC (C_3F_8)	NE	NE	NE	NA	0.0075	0.072	0.24	0.59	1.30	1.78
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
HFC32	5.75	7.33	8.44	10.1	12.0	13.7	14.5	15.4		
HFC125	43.1	45.1	48.5	54.9	59.9	67.7	70.6	73.6		
HFC134a	112	128	151	162	169	181	188	198		
HFC152a	0.58	0.58	0.51	0.41	0.33	0.26	0.21	0.17		
HFC143a	39.6	40.1	43.2	49.0	52.8	60.3	63.0	65.6		
PFC (C_3F_8)	2.29	2.64	2.67	2.51	2.27	1.99	1.76	1.51		

Table 4.12 Consumption of HFCs in foam blowing (t).

2F2 Foam blowing	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
HFC32	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA
HFC125	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA
HFC134a	NE	NE	2.00	66.4	87.1	136	187	138	164	125
HFC152a	NE	NE	3.00	30.0	46.0	43.4	32.2	15.2	9.30	37.7
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
HFC32	NA	3.72	NA	NA	NA	NO	NO	NO		
HFC125	NA	3.72	NA	NA	NA	NO	NO	NO		
HFC134a	127	132	122	98.8	110	91	82	79		
HFC152a	16.2	12.8	12.5	1.63	5.81	1.49	2.56	2.82		

Table 4.13 Consumption of HFC in aerosols/metered dose inhalers (t).

2F4 Aerosols	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
HFC134a	NE	NE	NE	NA	NA	NA	NA	NA	0.60	8.10
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
HFC134a	12.9	9.24	7.59	7.40	6.65	10.5	12.4	8.40		

Table 4.14 Consumption of SF_6 in electrical equipment (t).

2F8 Electrical equipment	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SF_6	0.060	0.11	0.11	0.12	0.14	0.16	0.18	0.38	0.27	0.48
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
SF_6	0.47	0.53	0.37	0.40	0.43	0.52	0.54	0.63		

Table 4.15 Consumption of SF_6, HFCs, and PFCs in other processes (t).

2F9 Other	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SF_6	0.50	1.25	2.32	2.61	3.07	2.83	1.97	2.08	1.52	1.55
HFC23	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CF_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_3F_8	NE,NO	NE,NO	NE,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_4F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
SF_6	1.12	0.75	0.68	0.91	0.96	0.39	0.96	0.64		
HFC23	NO	NO	NO	NO	NO	NA,NO	0.08	0.24		
CF_4	NO	NO	NO	NO	NO	NA,NO	0.25	0.14		
C_3F_8	0.27	0.52	0.50	0.25	NA,NO	NO	NO	NO		
C_4F_8	NO	NO	NO	NO	NO	NA,NO	0.20	0.45		

The emission of SF_6 has been decreasing in recent years due to the fact that activities under Magnesium Foundry no longer exist and due to a decrease in the use of electric equipment. Also, a decrease in "other" occurs, which for SF_6 is used in window plate production use, laboratories and in the production of running shoes.

The emission of HFCs increased rapidly in the 1990s and, thereafter, increased more modestly due to a modest increase in the use of HFCs as a refrigerant and a decrease in foam blowing. The F-gases have been regulated in two ways since 1 March 2001. For some types of use there is a ban on use of the gases in new installations and for other types of use, taxation is in place. These regulations seem to have influenced emissions so that they now only increase modestly.

The phase out of F-gasses has in particular been effective within the foam blowing sector and refrigeration installations. According to foam blowing, there was a stepwise phase-out of HFC-134a used for foam blowing in hard and soft foam production, during the period 2001-2004. In 2006, all foam productions in DK have substituted HFC. Especially the phase-out of HFCs in soft foam is significant for the GWP emission in this period.

With respect to HFC refrigeration, it is not possible to determine a stabile decreasing trend yet. Since the introduction of taxes on HFC's in 2001, the consumption decreased in 2002-2003, but then the consumption of HFCs for refrigeration purposes increased again. Especially HFC-404a and HFC-134a increased. This increase is explained with another regulatory initiatives in Danish legislation, where new refrigeration systems containing HCFC-22 (ODP) was banned from 2001. It coursed a boom in HFC refrigeration systems during 2002-2004, because the HFC technology was cheap and well proven. Thus, the consumption of HFC for refrigeration has changed after 1 January 2007, where new larger HFC installations with stocks exceeding 10 kg are banned. The data for 2008 is not available yet but there are strong indications for, that the consumption of HFCs for refrigeration purposes will decrease significant. Alternative refrigeration technologies based on CO_2, propan/buthan and ammonia is now introduced and available for customers.

Table 4.16 and Figure 4.4 quantify an overview of the emissions of the gases in CO_2-eq. The reference is the trend table as included in the CRF table for year 2007.

Table 4.16 Time-series for emission of HFCs, PFCs and SF_6 (kt CO_2-eq.).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
HFCs	-	-	3.44	93.9	135	218	329	324	411	503
PFCs	-	-	-	-	0.05	0.50	1.66	4.12	9.10	12.5
SF_6	44.5	63.5	89.2	101	122	107	61.0	73.1	59.4	65.4
Total	44.5	63.5	92.6	195	257	326	392	401	480	581
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
HFCs	605	647	672	695	749	795	815	840		
PFCs	17.9	22.1	22.2	19.3	15.9	13.9	15.7	15.4		
SF_6	59.2	30.4	25.0	31.4	33.1	21.8	36.0	30.3		
Total	682	700	719	746	798	831	867	886		

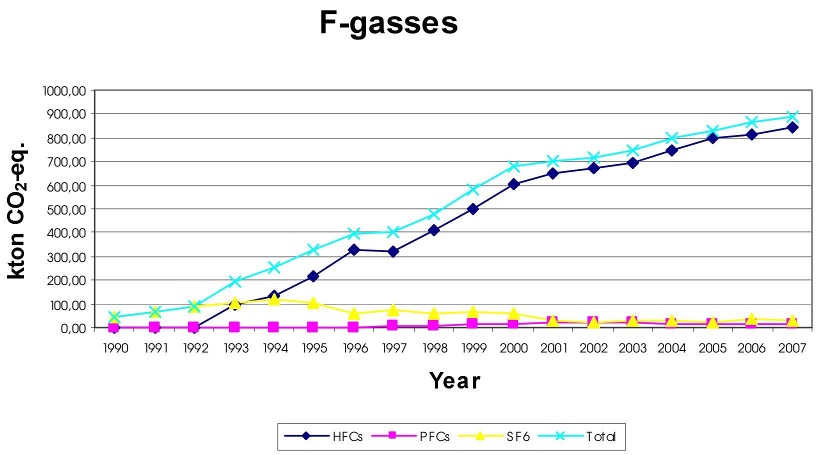


Figure 4.4 Time-series for emission of HFCs, PFCs and SF_6 (kt CO_2-eq.).

The decrease in the SF_6 emission has brought its emissions in CO_2-eq. down to the level of PFC. Overall, and for all uses, the most dominant group by far is HFCs. In this grouping, HFCs constitute a key category, both with regard to the key category level and trend analysis.

4.6.2 Methodological issues

The data for emissions of HFCs, PFCs, and SF_6 has been obtained in continuation on work on inventories for previous years. The determination includes the quantification and determination of any import and export of HFCs, PFCs, and SF_6 contained in products and substances in stock form. This is in accordance with the IPCC guidelines (IPCC (1997), vol. 3, p. 2.43ff), as well as the relevant decision trees from the IPCC Good Practice Guidance (IPCC, 2000) p. 3.53ff).

For the Danish inventories of F-gases, a Tier 2 bottom-up approach is basically used. As for verification using import/export data, a Tier 2 top-down approach is applied. In an annex to the F-gas inventory report 2007 (DEPA, 2009), there is a specification of the approach applied for each sub-source category.

The following sources of information have been used:

- Importers, agency enterprises, wholesalers and suppliers.
- Consuming enterprises, and trade and industry associations.
- Recycling enterprises and chemical waste recycling plants.
- Statistics Denmark.
- Danish Refrigeration Installers' Environmental Scheme (KMO).

- Previous evaluations of HFCs, PFCs and SF_6.

Suppliers and/or producers provide consumption data of F-gases. Emission factors are primarily defaults from the GPG, which are assessed to be applicable in a national context. In case of commercial refrigerants and Mobile Air Condition (MAC), national emission factors are defined and used.

Import/export data for sub-source categories where import/export is relevant (MAC, fridge/freezers for household) are quantified on estimates from import/export statistics of products + default values of the amount of gas in the product. The estimates are transparent and described in the annex to the report referred to above.

The Tier 2 bottom-up analysis used for determination of emissions from HFCs, PFCs, and SF_6 covers the following activities:

- Screening of the market for products in which F-gases are used.
- Determination of averages for the content of F-gases pr product unit.
- Determination of emissions during the lifetime of products and disposal.
- Identification of technological development trends that have significance for the emission of F-gases.
- Calculation of import and export on the basis of defined key figures, and information from Statistics Denmark on foreign trade and industry information.

The determination of emissions of F-gases is based on a calculation of the actual emission. The actual emission is the emission in the evaluation year, accounting for the time lapse between consumption and emission. The actual emission includes Danish emissions from production, from products during their lifetimes and from waste products.

Consumption and emissions of F-gases are, whenever possible, determined for individual substances, even though the consumption of certain HFCs has been very limited. This has been carried out to ensure transparency of evaluation in the determination of GWP values. However, the continued use of a category for *Other HFCs* has been necessary since not all importers and suppliers have specified records of sales for individual substances.

The potential emissions have been calculated as follows:

Potential emission = import + production - export - destruction/treatment.

Table 4.17 Content (w/w%) of "pure" HFC in HFC-mixtures, used as trade names.

HFC mixtures	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-152a	HFC-227ea
	%	%	%	%	%	%
HFC-365						8
HFC-401a					13	
HFC-402a		60				
HFC-404a		44	4	52		
HFC-407a	23	25	52			
HFC-410a	50	50				
HFC-507a		50		50		

The substances have been accounted for in the survey according to their trade names, which are mixtures of HFCs used in the CRF, etc. In the transfer to the "pure" substances used in the CRF reporting schemes, the following ratios have been used; see Table 4.17.

The national inventories for F-gases are provided and documented in a yearly report (DEPA, 2009). Furthermore, detailed data and calculations are available and archived in an electronic version. The report contains summaries of methods used and information on sources as well as further details on methodologies.

Activity data is described in a spreadsheet for the current year.

4.6.3 Uncertainties and time-series consistency

The time-series for emission of Halocarbons and SF_6 are presented in Section 4.6.1. The time-series are consistent as regards methodology. No potential emission estimates are included as emissions in the time-series and the same emission factors are used for all years.

No appropriate measures of uncertainties have been established and no uncertainty estimates following the GPG procedures have been developed for the F-gas calculations, to date.

In general, uncertainty in inventories will arise through at least three different processes:

1. Uncertainties from definitions (e.g. incomplete, unclear, or faulty definition of an emission or uptake);
2. Uncertainties from natural variability of the process that produces an emission or uptake;
3. Uncertainties resulting from the assessment of the process or quantity depending on the method used: (i) uncertainties from measuring; (ii) uncertainties from sampling; (iii) uncertainties from reference data that may be incompletely described, and (iv) uncertainties from expert judgement.

Uncertainties due to poor definitions are not expected to be an issue in the F-gas inventory. The definitions of chemicals, the factors, sub-source categories in industries etc. are well defined.

Uncertainties from natural variability are likely to occur over the short-term while estimating emissions in individual years. But over a longer time period, 10-15 years, these variabilities level out in the total emission.

This is due to that input data (consumption of F-gases) is known and is valid data, and has no natural variability due to the chemicals stabile nature.

Uncertainties that arise due to imperfect measurement and assessment are probably an issue for the:

- Emission from MAC (HFC-134a).
- Emission from commercial refrigerants (HFC-134a).

Due to the limited knowledge for these sources, the expert assessment of consumption of F-gases can lead to inexact values of the specific consumption of F-gases.

The uncertainty varies from substance to substance. Uncertainty is greatest for HFC-134a due to its widespread application in products that are imported and exported. The greatest uncertainty in application is expected to arise from consumption of HFC-404a and HFC-134a in commercial refrigerators and mobile refrigerators. The uncertainty involved in year-to-year data is influenced by the uncertainty associated with the rates at which the substances are released. This results in significant differences in the emission determinations in the short-term (approx. five years); differences that balance in the long-term.

The source-specific uncertainties for consumption of halocarbons and SF_6 are presented in Section 4.8. The overall uncertainty estimate is presented in Section 1.7.

4.6.4 QA/QC and verification

Comparison of emissions estimates using different approaches

Inventory agencies should use the Tier 1 potential emissions method for a check on the Tier 2 actual emission estimates. Inventory agencies may consider developing accounting models that can reconcile potential and actual emission estimates and which may improve the determination of emission factors over time.

This comparison was carried out in 1995-1997 and, for all three years, it shows a difference of approx. factor 3 higher emission by using potential emission estimates.

Inventory agencies should compare bottom-up estimates with the top-down Tier 2 approach, since bottom-up emission factors have the highest associated uncertainty. This technique will also minimise the possibility that certain end-uses are not accounted for in the bottom-up approach.

This comparison has not been developed.

National activity data check

For the Tier 2a (bottom-up) method, inventory agencies should evaluate the QA/QC procedures associated with estimating equipment and product inventories to ensure that they meet the general procedures outlined in the QA/QC plan and that representative sampling procedures are used. This is particularly important for the ODS (Ozone Depleting

Substances)-substitute subsectors because of the large populations of equipment and products.

The spreadsheets containing activity data have incorporated several data-control mechanisms, which ensure that data estimates do not contain calculation failures. A very comprehensive QC procedure on the data in the model for the whole time-series has been carried for the present submission in connection with the process which provided, (1) data for the CRF background tables 2(II).F. for the years (1993)-2006 and (2) data for potential emissions in CRF tables 2(I). This procedure consisted of a check of the input data for the model for each substance. As regards the HFCs, this checking was carried out in relation to their trade names. Conversion was made to the HFC substances used in the CRF tables, etc. A QC was that emission of the substances could be calculated and checked comparing results from the substances as trade names and as the "no-mixture" substances used in the CRF.

Emission factors check

Emission factors used for the Tier 2a (bottom-up) method should be based on country-specific studies. Inventory agencies should compare these factors with the default values. They should determine if the country-specific values are reasonable, given similarities or differences between the national source category and the source represented by the defaults. Any differences between country-specific factors and default factors should be explained and documented.

Country-specific emission factors are explained and documented for MAC and commercial refrigerants and SF_6 in electric equipment. Separate studies have been carried out and reported. For other sub-source categories, the country-specific emission factors are assessed to be the same as the IPCC default emission factors.

Emission check

As the F-gas inventory is developed and made available in full in spreadsheets, where HFCs data relate to trade names, special procedures are performed to check the full possible correctness of the transformation to the CRF-format through Access databases.

Recalculations

In the group 2F9 *Other processes* production of fibre optics has been included.

4.6.5 Planned improvements

It is planned to improve uncertainty estimates as well as the information on the choice of EFs and the specific approaches applied.

4.7 Other (2G)

4.7.1 Source category description

The subsector *Other* (2G) covers the following process:

- Consumption of lubricant oil.

The time-series for emission of CO_2 from *Other* (2G) is presented in Table 4.18.

Table 4.18 Time-series for emission of CO_2 (kt) from Other (2G).

2G	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1. Consumption of lubricant oil	49.7	48.9	48.1	47.6	46.9	48.8	48.9	47.1	44.9	42.7
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
1. Consumption of lubricant oil	39.7	38.5	39.9	37.0	37.7	37.6	37.5	37.9		

The emissions are extracted from The CRF tables and the values are rounded.

The emission of CO_2 from consumption of lubricants is decreasing from 49.7 kt in 1990 to 37.9 kt in 2007.

4.7.2 Methodological issues

The emission of CO_2 from consumption of lubricant oil is calculated according to the following formula:

$$E_{CO2} = LC \bullet CC_{\text{lub}ricant} \bullet ODU_{\text{lub}ricant} \bullet 44/12$$

where:

E_{CO2} = emission of CO_2

LC = consumption of lubricants

CC = carbon content of lubricant

ODU = amount of lubricant oxidised during use

In the calculation the following default values have been applied: CC = 20.1 kg C pr kg lubricant and ODU = 0.2. The activity data applied id presented in Table 4.19.

Table 4.19 Consumption of lubricant oil (TJ) (Danish Energy Authority).

2C	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1. Consumption of lubricant oil	3 372	3 315	3 265	3 226	3 185	3 314	3 317	3 199	3 043	2 898
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
1. Consumption of lubricant oil	2 693	2 611	2 704	2 512	2 560	2 550	2 544	2 574		

4.7.3 Uncertainties and time-series consistency

The time-series is presented in Table 4.18. The applied methodology has been the same during all the years and is therefore considered to be consistent. The activity data is based on information from Danish Energy Authority. The same emission factor has been used for all the years from 1990 to 2007.

4.7.4 Recalculations

The sector *Other* (2G), consumption of lubricant oil is included in the inventory for the first time.

4.7.5 Source-specific planned improvements

No improvements are planned for this sector.

4.8 Uncertainty

The source-specific uncertainties for industrial processes are presented in Table 4.20. The uncertainties are based on IPCC guidelines combined with assessment of the individual processes.

The producer has delivered the activity data for production of cement as well as calculated the emission factor based on quality measurements. The uncertainties on activity data and emission factors are assumed to be 1 % and 2 %, respectively.

The activity data for production of lime and bricks are based on information compiled by Statistics Denmark. Due to the many producers and the variety of products, the uncertainty is assumed to be 5 %. The emission factor is partly based on stoichiometric relations and partly on an assumption of the number of yellow bricks. The last assumption has been verified (see Table 4.20). The combined uncertainty is assumed to be 5 %.

The producers of glass and glass wool have registered the consumption of - raw materials containing carbonate. The uncertainty is assumed to be 5 %. The emission factors are based on stoichiometric relations and, therefore, uncertainty is assumed to be 2 %.

The producers have registered the production of nitric acid during many years and, therefore, the uncertainty is assumed to be 2 %. The measurement of N_2O is problematic and is only carried out for one year. Therefore, uncertainty is assumed to be 25 %.

The uncertainty for the activity data as well as for the emission factor is assumed to be 5 % for production of catalysts/fertilisers and iron and steel production.

The emission of F-gases is dominated by emissions from refrigeration equipment and, therefore, the uncertainties assumed for this sector will be used for all the F-gases. The IPCC propose an uncertainty at 30-40 % for regional estimates. However, Danish statistics have been developed over many years and, therefore the uncertainty on activity data is assumed to be 10 %. The uncertainty on the emission factor is, on the other hand, assumed to be 50 %. The base year for F-gases for Denmark is 1995.

Table 4.20 Uncertainties on activity data and emission factors as well as overall trend uncertainties for the different greenhouse gases.

	Activity data uncertainty	Emission factor uncertainty				
		CO_2	N_2O	HFCs[3]	PFCs[3]	SF_6[3]
	%	%	%	%	%	%
2A1. Production of Cement	1	2				
2A2. Production of Lime and Bricks	5	5				
2A3. Limestone and dolomite use	5	5				
2A5. Asphalt roofing	5	25				
2A6. Road paving with asphalt	5	25				
2A7. Other[1]	5	2				
2B2. Nitric acid production	2		25			
2B5. Other[2]	5	5				
2C1. Iron and Steel production	5	5				
2F. Consumption of HFC	10			50		
2F. Consumption of PFC	10				50	
2F. Consumption of SF_6	10					50
Overall uncertainty in 2006		1.974	25.08[4]	50.99	50.99	50.99
Trend uncertainty		1.968	1.439[4]	54.23	441.6	4.742

1) Production of yellow bricks, expanded clay products, container glass and glass wool.
2) Production of catalysts/fertilisers.
3) The base year for F-gases is for Denmark 1995.
4) 2004. The production closed down in the middle of 2004.

4.9 Quality assurance/quality control (QA/QC)

4.9.1 Internal QA/QC

The approach used for quality assurance/quality control (QA/QC) is presented in Section 4.6. The present chapter presents QA/QC considerations for industrial processes based on a series of Points of Measuring (PMs); see Section 4.6.

Data Storage level 1	1. Accuracy	DS.1.1.1	General level of uncertainty for every dataset including the reasoning for the specific values.

The uncertainty assessment has been performed on Tier 1 level by using default uncertainty factors. The applied uncertainty factors are presented in Table 4.17.

Data Storage level 1	1. Accuracy	DS.1.1.2	Quantification of the uncertainty level of every single data value including the reasoning for the specific values.

See DS.1.1.1. As Tier 1 and default uncertainty factors are applied, the individual datasets have not been assessed.

Data Storage level 1	2.Comparability	DS.1.2.1	Comparability of the data values with similar data from other countries, which are comparable with Denmark, and evaluation of discrepancy.

Comparability of the data has not been performed at "Data Storage level 1". However, investigation of comparability at CRF level is in progress.

The applied data sets are presented in Table 4.21.

Data Storage level 1	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included setting down the reasoning behind the selection of datasets.

Table 4.21 Applied data sets.

File or folder name	Description	AD or E	Reference	Contact(s)	Comment
Ardagh Glass Holmegaard gr2007.pdf		E	www.cvr.dk		
Damolin Fur gr2007.pdf			www.cvr.dk		
Damolin Mors gr2007.pdf			www.cvr.dk		
Danisco Assens gr2006-2007.pdf		AD	www.danisco.dk www.cvr.dk		AD used for estimation of production at three different locations 1990-1995.
Danisco Nakskov gr2006-2007.pdf		AD	www.danisco.dk www.cvr.dk		AD used for estimation of production at three different locations 1990-1995.
Danisco Nykøbing gr2006-2007.pdf		AD	www.danisco.dk www.cvr.dk		AD used for estimation of production at three different locations 1990-1995.
Faxe_Kalk-brandt_kalk.pdf	Chemical composition of product.		www.faxekalk.dk		
Faxe_Kalk-hydratkalk_191103.pdf	Chemical composition of product.		www.faxekalk.dk		
Haldor Topsoe gr2007\		AD, E	www.cvr.dk		
Haldor Topsoe 1990.xls		E	Haldor Topsøe	Allan Willumsen	
Haldor Topsoe – emissioner 1996 – 2004.xls		E	Haldor Topsøe	Allan Willumsen	
Kemira GR2003.pdf		AD, E	www.kemira-growhow.com		
Maxit Hinge\			www.cvr.dk		
Rockwool gr2007.pdf		AD	www.cvr.dk		
Saint Gobain gr2007.pdf		AD,E	Saint-Gobain Isover www.isover.dk	Anette Åkesson	
Stålvalseværket (2002) – paper version.		AD, E	Stålvalseværket		
Aalborg Portland miljoredegorelse_2007.pdf		AD, E	www.aalborg-portland.dk		
Aalborg Portland energy 2000-2004 answer.xls		AD	Aalborg Portland	Henrik Møller Thomsen	
DS produktion af klinker + letbeton.xls		AD	Danmarks Statistik; www.statistikbanken.dk		
DS produktion af sukker.xls		AD	Danmarks Statistik; www.statistikbanken.dk		
DS produktion af øl.xls		AD	Danmarks Statistik; www.statistikbanken.dk		

The data sources - in general - can be grouped as follows:

- Company specific environmental reports.
- Personal communication with individual companies.
- Company specific information compiled by Danish Energy Authority in relation to the EU-ETS.
- Industrial organisations.
- Statistics Denmark.
- Secondary literature.
- IPCC guidelines.

The environmental reports contribute with company-specific emission factors, technical information and, in some cases, activity data. The environmental reports are primarily used for large companies and, for some companies, are supplemented with information from personal contacts, especially for completion of the time-series for the years before the legal requirement to prepare environmental reports (i.e. prior to 1996).

Statistics Denmark is used as source for activity data as they are able to provide consistent data for the period 1990-2007. In the cases where the statistics do not contain transparent data, statistics from industrial organisations are used to generate to required activity data.

For many of the processes, the default emission factors are based on chemical equations and are, therefore, the best choice. In some cases, the default EF has been modified in order to reflect local conditions.

Secondary literature may be used in the interpretation or in disaggregation of the public statistics.

Data Storage level 1	4.Consistency	DS.1.4.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PMs).

See DS.1.4.1. Consistency is secured by application of the same data source over the period in question, e.g. activity data from Statistics Denmark, or by using personal contacts in the individual companies to obtain activity data for the period when environmental reports were not mandatory. For some activities, statistics compiled by industrial organisations were applied.

Data Storage level 1	6.Robustness	DS.1.6.1	Explicit agreements between the external institution holding the data and NERI about the condition of delivery.

An agreement regarding inclusion of information - compiled by Danish Energy Authority for EU-ETS - in the Danish GHG-inventory has been signed. The implementation of this information has been introduced for production of cement as well as sugar refining.

Data Storage level 1	7.Transparency	DS.1.7.1	Summary of each dataset including the reasoning for selecting the specific dataset.

The datasets applied are presented in Table 4.21. For the reasoning behind their selection, see DS.1.3.1.

Data Storage level 1	7.Transparency	DS.1.7.3	References for citation for any external dataset have to be available for any single value in any dataset.

The data applied, including references for citation, are presented in Table 4.21.

Data Storage level 1	7.Transparency	DS.1.7.4	Listing of external contacts for every dataset.

The applied data including external contacts are presented in Table 4.21.

Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to type of variability (distribution as: normal, log normal or other type of variability).

The uncertainty assessment has been performed on Tier 1 level, assuming a normal distribution of activity data as well as emission data, by application of default uncertainty factors. Therefore, no considerations regarding distribution or type of variability have been performed.

Data Processing level 1	1. Accuracy	DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals).

See DP.1.1.2.

Data Processing level 1	1. Accuracy	DP.1.1.3	Evaluation of the methodological approach using international guidelines.

The applied methodologies are in line with the international guidelines issued by the IPCC combined with national adjustments. The degree of fulfilment of the required methodology has been documented in an internal note (Kyoto note).

Data Processing level 1	1. Accuracy	DP.1.1.4	Verification of calculation results using guideline values.

The emission factors applied are mostly based on chemical equations and are, therefore, in accordance with the default EFs. E.g. for production of nitric acid, where the emission factor is dependent on process conditions, a comparison has been made to the default EF listed in the guideline. E.g. for the deviation of the emission factor for calcination in the cement process, an explanation has been developed in cooperation with the company.

Data Processing level 1	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCCC and IPCC.

See DP.1.1.3

Data Processing level 1	3.Completeness	DP.1.3.1	Assessment of the most important quantitative knowledge which is which is lacking.

This issue will be investigated further.

Data Processing level 1	3.Completeness	DP.1.3.2	Assessment of the most important cases where access is lacking with regard to critical data sources that could improve quantitative knowledge.

Accessibility to critical company-specific information will be established as a consequence of the formal agreement with the Danish Energy Authority concerning data compiled in relation to the EU-ETS.

Data Processing level 1	4.Consistency	DP.1.4.1	In order to keep consistency at a high level, an explicit description of the activities needs to accompany any change in the calculation procedure.

Recalculations are described in the NIR. A manual log is included in the tool used for data processing at Data Processing level 2. This log also includes changes on Data Processing level 1.

Data Processing level 1	5.Correctness	DP.1.5.1	Show at least once, by independent calculation, the correctness of every data manipulation.

The sector report for industry (in prep.) presents an independent example of the calculations to ensure the correctness of every data manipulation.

Data Processing level 1	5.Correctness	DP.1.5.2	Verification of calculation results using time-series.

The calculations are verified by checking the time-series.

Data Processing level 1	5.Correctness	DP.1.5.3	Verification of calculation results using other measures.

A methodology to verify calculation of results using other measures will be developed.

Data Processing level 1	5.Correctness	DP.1.5.4	Shows one-to-one correctness between external data sources and the databases at Data Storage level 2.

A methodology to check the correctness between external data sources and the databases at storage level 2 will be developed.

Data Processing level 1	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described.

The calculation principles and equations are based on the methodology presented by the IPCC. A detailed description can be found in the sector report for industry (in prep.).

Data Processing level 1	7.Transparency	DP.1.7.2	The theoretical reasoning for all methods must be described.

The theoretical reasoning for choice or development of methods is described in detail in the sector report for industry (in prep.).

Data Processing level 1	7.Transparency	DP.1.7.3	Explicit listing of assumptions behind all methods.

The assumptions used in the different methods are described in the sector report for industry (in prep.) and also included in the present report. An explicit list of assumptions will be developed in the coming sector report.

Data Processing level 1	7.Transparency	DP.1.7.4	Clear reference to data set at Data Storage level 1.

Explicit references from the data processing to each dataset can be found in the sector report for industry (in prep.).

Data Processing level 1	7.Transparency	DP.1.7.5	A manual log to collect information about recalculations.

A manual log is included in the tool used for data processing at data level 2. This log also includes changes on Data Processing level 2. A detailed log will be developed in the sector report for industry (in prep.).

Data Processing level 2	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data types at level 2 to data at level 1.

The sector report for industry (in prep.) presents the connection between the datasets on Data Storage level 1 and Data Processing level 2. Individual calculations are used to check the output of the data processing tool used at Data Processing level 2.

Data Processing level 2	5.Correctness	DS.2.5.2	Check if a correct data import to level 2 has been made.

See DS.2.5.2.

4.9.2 External QA/QC

External QA/QC is described for one source: cement production.

Cement production

Aalborg Portland has an environmental management system that meets the requirements in DS/ISO 14001, EMAS etc. (Aalborg Portland, 2008). The environmental management system is part of an integrated process management system. The system is certified according to the standards by the accredited body: Danish Standards. Information on raw material consumption as well as internal recycling is compiled in an environmental database. Some pollutants (NO_x, SO_2, CO and TSP) are measured continuously. Emission of CO_2 is calculated based on (fuel and) raw material consumption and raw material flow according to an approved CO_2

emission plan (EU-ETS). The CO_2 emission plan has to fulfil the requirements in the guidelines developed by EU (EU, 2007).

References

Ardagh Glass Holmegaard, 2008: Grønt regnskab for Rexam Glass Holmegaard A/S 2007, CVR nr. 18445042 (in Danish).

Damolin, 2008: CO_2-opgørelse og afrapportering 2007. Damolin Fur A/S og Damolin Mors A/S. (In Danish) Confidential.

Danisco Sugar, 2008: CO_2-opgørelse og afrapportering 2007. Danisco Sugar. Fremstilling af sukker. (In Danish) Confidential.

Danish Energy Authority (DEA), 2004: Anders Baunehøj Hansen, personal communication, 15 December 2004.

Danish Energy Authority (DEA), 2008: The Danish energy statistics, Available at: http://www.ens.dk/graphics/UK_Facts_Figures/Statistics/yearly_statistics/2007/BasicData2007.xls (2009-02-27).

Danish Environmental Protection Agency (DEPA), 2009: The greenhouse gases HFCs, PFCs and SF_6. Danish consumption and emissions, 2007. Environmental Project No 1284. Available at: http://www2.mst.dk/udgiv/publications/2009/978-87-7052-962-4/pdf/978-87-7052-963-1.pdf (18 May, 2009)

EMEP/CORINAIR, 2004: Emission Inventory Guidebook 3rd edition, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections, 2004 update. Available at: http://reports.eea.eu.int/EMEPCORINAIR4/en (15-04-2007).

Energinet.dk, 2007: Baggrundsrapport til Miljøberetning 2006 (in Danish).

EU, 2007: Commission decission of 18 July 2007 establishing guidelines for monittoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. Available at: http://eur-lex.europa.eu/

Faxe Kalk, 2003: Diverse produktblade (in Danish).

Haldor Topsøe, 2008: Miljøredegørelse for katalysatorfabrikken 2007 (12. regnskabsår); incl. 1996-2006 (in Danish).

Hjelmar, O. & Hansen, J.B., 2002: Restprodukter fra røggasrensning på affaldsforbrændingsanlæg. Nyttiggørelse eller deponering? DHI - Institut for Vand & Miljø. Kursusmateriale fra kurset Røggasrensning 2002. IDA, Brændsels- og Energiteknisk Selskab (in Danish).

Illerup, J.B., Geertinger A.M., Hoffmann, L. & Christiansen, K., 1999: Emissionsfaktorer for tungmetaller 1990-1996. Faglig rapport fra DMU, nr. 301. Miljø- og Energiministeriet, Danmarks Miljøundersøgelse (in Danish).

IPCC, 1997: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Available at: http://www.ipcc-nggip.iges.or.jp/public/gl/invs6.htm (15-04-2007).

IPCC, 2000: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Available at: http://www.ipcc-nggip.iges.or.jp/public/gp/english/ (15-04-2007).

Kemira GrowHow, 2004: Miljø & arbejdsmiljø. Grønt regnskab 2003; incl. 1996-2002 (in Danish).

Maxit, 2008: CO_2-opgørelse og afrapportering 2007. Maxit a.s. Hinge og Maxit a.s. Ølst. (In Danish) Confidential.

Miljøstyrelsen, 2009: Affaldsstatistik 2007. Orientering fra Miljøstyrelsen (In Danish; to be published).

Nielsen, M. & Illerup, J.B., 2003: Emissionsfaktorer og emissionsopgørelse for decentral kraftvarme. Eltra PSO projekt 3141. Kortlægning af emissioner fra decentrale kraftvarmeværker. Delrapport 6. Danmarks Miljøundersøgelser. 116 s. Faglig rapport fra DMU nr. 442. Available at: http://www-.dmu.dk/udgivelser/ (in Danish).

Rexam Glass Holmegaard, 2007: Grønt regnskab for Rexam Glass Holmegaard A/S 2006, CVR nr. 18445042; incl. 1996/97-2005 (in Danish).

Rockwool, 2008: Miljøredegørelse 2007 for fabrikkerne i Hedehusene, Vamdrup og Øster Doense; incl. 1996-2006 (in Danish).

Saint-Gobain Isover, 2008: Miljø- og energiredegørelse 2007; incl. 1996-2006 (in Danish).

Statistics Denmark, 2008: Statbank Denmark. Available at: www.statbank.dk

Stålvalseværket, 2002: Grønt regnskab og miljøredegørelse 2001. Det Danske Stålvalseværk A/S; incl. 1992, 1994-2000 (in Danish).

Aalborg Portland, 2008a: CO_2-opgørelse og afrapportering 2007. Aalborg Portland A/S. Fremstilling af klinker (cement). Confidential.

Aalborg Portland, 2008b: Environmental report 2007; including 1996-2006

Aalborg Portland, 2008c: Henrik Møller Thomsen, Personal communication 17 September 2008.

Aalborg Portland, 2009: Torben Ahlmann-Laursen, Personal communication 3 march 2009.

5 Solvents and other product use (CRF Sector 3)

5.1 Overview of the sector

Non-methane volatile hydrocarbons (NMVOCs) are not considered direct greenhouse gases but once emitted in the atmosphere they will over a period of time oxidise to CO_2. Furthermore NMVOCs act as precursors to the formation of ozone.

Use of solvents and other organic chemicals in industrial processes and households are important sources of evaporation of NMVOCs, and are related to the source categories Paint application (CRF sector 3A), Degreasing and dry cleaning (CRF sector 3B), Chemical products, manufacture and processing (CRF sector 3C) and Other (CRF sector 3D). In this section the methodology for the Danish NMVOC emission inventory for solvent use is presented and the results for the period 1995 – 2007 are summarised. The method is based on a chemical approach, and this implies that the SNAP category system is not directly applicable. Instead emissions will be related to specific chemicals, products, industrial sectors and households and to the CRF sectors mentioned before.

5.2 Paint application (CRF Sector 3A), Degreasing and dry cleaning (CRF Sector 3B), Chemical products, Manufacture and processing (CRF Sector 3C) and Other (CRF Sector 3D)

5.2.1 Solvent use

Table 5.1 and Figure 5.1 show the emissions of chemicals from 1985 to 2007, where the used amounts of single chemicals have been assigned to specific products and CRF sectors. The methodological approach for finding emissions in the period 1995 - 2007 is described in the following section. A linear extrapolation is made for the period 1985 – 1994. A general decrease is seen throughout the sectors. Table 5.2 shows the used amounts of chemicals for the same period. Table 5.1 is derived from Table 5.2 by applying emission factors relevant to individual chemicals and production or use activities. Table 5.3 showing the used amount of products is derived from Table 5.2, by assessing the amount of chemicals that is comprised within products belonging to each of the four source categories. The conversion factors are rough estimates, and more thorough investigations are needed in order to quantify the used amount of products more accurately.

In Table 5.4 the emission for 2007 is split into individual chemicals. The most abundantly used solvents are ethanol, turpentine, or white spirit defined as a mixture of stoddard solvent and solvent naphtha and propylalcohol. Ethanol is used as solvent in the chemical industry and as windscreen washing agent. Turpentine is used as thinner for paints, lacquers and adhesives. Propylalcohol is used in cleaning agents in the manufacture of electrical equipment, flux agents for soldering, as solvent and thinner and as windscreen washing agent. Household emissions are dominated by propane and butane, which are used as aerosols in spray cans, primarily in cosmetics. For some chemicals the emission factors are precise but for others they are rough estimates, e.g. from SFT (1994). Emission factors are divided into four categories: 1) chemical industry (lowest EF), 2) other industry, 3) non-industrial activities, 4) domestic and other diffuse use (highest EF). This implies that high emission factors are applicable for use of solvent containing products and lower emission factors are applicable for use in industrial processes.

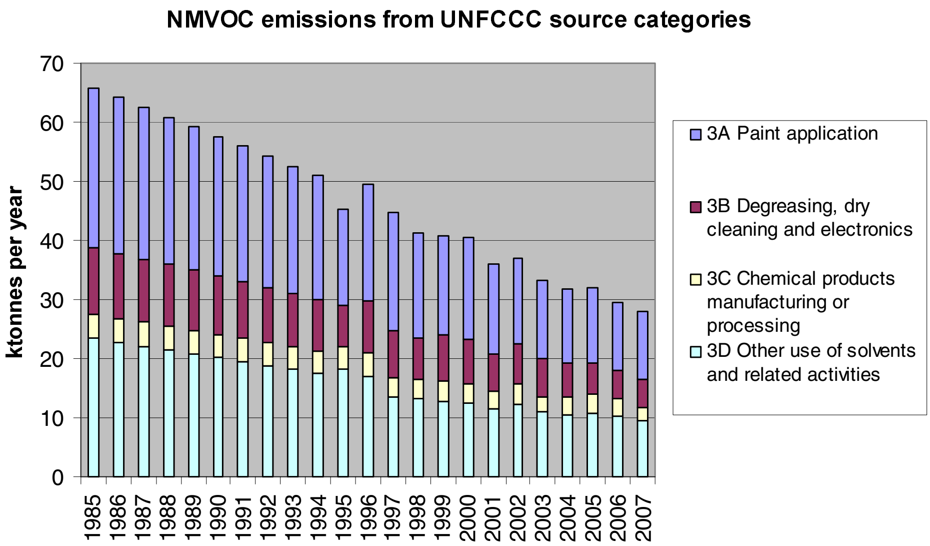


Figure 5.1 Emissions of chemicals in ktonnes pr yr (equal to Gg pr year). The methodological approach for finding emissions in the period 1995 – 2007 is described in the text, and a linear extrapolation is made for 1985 – 1994. Figures can be seen in Table 5.1.

Table 5.1 Emission of chemicals in Gg pr year.

Total emissions Gg pr year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
Paint application (3A)	27.1	26.4	25.7	25.0	24.3	23.6	22.9	22.2	21.5	20.8	16.3	
Degreasing and dry cleaning (3B)	11.2	11.0	10.7	10.4	10.1	9.87	9.60	9.33	9.06	8.78	6.96	
Chemical products, manufacturing and processing (3C)	4.15	4.11	4.07	4.03	3.98	3.94	3.90	3.85	3.80	3.76	3.61	
Other (3D)	23.4	22.7	22.1	21.4	20.8	20.1	19.5	18.9	18.2	17.6	18.3	
Total NMVOC	65.9	64.2	62.5	60.9	59.2	57.6	55.9	54.2	52.6	50.9	45.2	
Total CO_2 [a]	205	200	195	190	185	179	174	169	164	159	141	
Continued	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Paint application (3A)	19.8	20.1	17.6	16.6	17.4	15.4	14.5	13.3	12.6	12.6	11.5	11.4
Degreasing and dry cleaning (3B)	8.77	7.78	7.00	7.77	7.42	6.20	6.70	6.33	5.60	5.25	4.78	4.84
Chemical products, manufacturing and processing (3C)	4.02	3.42	3.31	3.44	3.18	3.03	3.39	2.62	3.00	3.19	3.15	2.18
Other (3D)	17.0	13.5	13.3	12.9	12.6	11.5	12.3	11.0	10.6	10.8	10.2	9.52
Total NMVOC	49.5	44.7	41.2	40.7	40.6	36.1	36.9	33.3	31.8	31.9	29.5	27.9
Total CO_2 [a]	154	139	128	127	127	113	115	104	99.2	99.4	92.1	87.1

[a] 0.85*3.67*total NMVOC.

Table 5.2 Used amounts of chemicals in Gg pr year.

Used amounts of chemical Gg pr year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
Paint application (3A)	38	40	41	43	45	47	48	50	51	52	52	
Degreasing and dry cleaning (3B)	20	21	22	23	24	25	25	25	25	25	26	
Chemical products, manufacturing and processing (3C)	61	64	66	69	71	76	78	81	84	86	95	
Other (3D)	24	25	26	27	28	29	30	31	32	33	42	
Total NMVOC	144	150	156	161	167	177	182	187	191	196	214	
Continued	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Paint application (3A)	56	87	55	49	52	47	48	53	70	82	75	79
Degreasing and dry cleaning (3B)	27	26	23	26	26	24	25	24	26	26	28	36
Chemical products, manufacturing and processing (3C)	93	97	93	97	103	105	106	91	110	122	130	136
Other (3D)	36	38	33	33	35	36	35	35	44	46	52	51
Total NMVOC	212	248	203	204	216	211	213	203	250	277	284	302

Table 5.3 Used amounts of products in Gg pr year.

Used amounts of products Gg pr year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
Paint application (3A)	255	265	276	286	297	314	322	330	339	347	344	
Degreasing and dry cleaning (3B)	40	42	44	45	47	50	50	50	50	50	52	
Chemical products, manufacturing and processing (3C)	307	319	332	345	357	378	391	404	418	431	473	
Other (3D)	119	124	129	134	139	147	152	156	160	165	211	
Total products	722	751	781	811	841	888	914	941	967	993	1079	
Continued	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Paint application (3A)	370	579	364	324	345	315	317	351	469	544	499	529
Degreasing and dry cleaning (3B)	53	52	46	52	51	47	50	48	52	53	55	72
Chemical products, manufacturing and processing (3C)	467	487	463	484	513	523	529	455	549	612	651	678
Other (3D)	182	190	167	164	177	179	173	176	222	232	259	256
Total products	1072	1308	1039	1024	1087	1064	1068	1030	1291	1441	1464	1534

Table 5.4 Chemicals with highest emissions 2007.

Chemical	Emissions 2007 (tonnes)
ethanol	6311
turpentine (white spirit: stoddard solvent and solvent naphtha)	5186
propylalcohol	4537
pentane	2524
methanol	1499
acetone	1124
toluene	1118
xylene	989
butanone	690
propane	667
butane	667
glycolethers	658
propylenglycol	565
formaldehyde	380
1-butanol	249
cyclohexanones	114
methyl methacrylate	105
phenol	98.0
butanoles	96.4
butylacetate	71.7
ethylenglycol	65.7
styrene	57.1
ethylacetate	49.4
tetrachloroethylene	41.9
acyclic aldehydes	27.3
triethylamine	20.9
naphthalene	17.4
acyclic monoamines	5.66
acrylic acid	4.55
Total 2007	27939

5.2.2 Other use (N_2O)

Five companies sell N_2O in Denmark and only one company produces N_2O. N_2O is primarily used in anaesthesia by dentists, veterinarians and in hospitals and in minor use as propellant in spray cans and in the production of electronics. Due to confidentiality no data on produced amount are available and thus the emissions related to N_2O production are unknown. An emission factor of 1 is assumed for all uses, which equals the sold amount to the emitted amount.

Total reported and estimated sales (emissions) of NO_2 are:

2007: 0.12 Gg N_2O

5.2.3 Uncertainties and time-series consistency

An estimate of the overall uncertainty in EMEP/CORINAIR of 165 % is used.

5.2.4 Methodological issues

The emissions of Non-Methane Volatile Organic Compounds (NMVOC) from industrial use and production processes and household use in Denmark have been assessed. Until 2002 the NMVOC inventory in Denmark was based on questionnaires and interviews with different industries, regarding emissions from specific activities, such as lacquering, painting impregnation etc. However, this approach implies large uncertainties due to the diverse nature of many solvent-using processes. For example, it is inaccurate to use emission factors derived from one printwork in an analogue printwork, since the type and combination of inks may vary considerably. Furthermore the employment of abatement techniques will result in loss of validity of estimated emission factors.

A new approach has been introduced, focusing on single chemicals instead of activities. This will lead to a clearer picture of the influence from each specific chemical, which will enable a more detailed differentiation on products and the influence of product use on emissions.

The procedure is to quantify the use of the chemicals and estimate the fraction of the chemicals that is emitted as a consequence of use. Mass balances are simple and functional methods for calculating the use and emissions of chemicals

$$use = production + import - export - destruction/disposal - hold\ up \quad (Eq.1)$$

$$emission = use * emission\ factor \quad Eq.2)$$

where "hold up" is the difference in the amount in stock in the beginning and at the end of the year of inventory.

A mass balance can be made for single substances or groups of substances, and the total amount of emitted chemical is obtained by summing up the individual contributions. It is important to perform an in-depth investigation in order to include all relevant emissions from the large amount of chemicals. The method for a single chemical approach is shown in Figure 5.2.

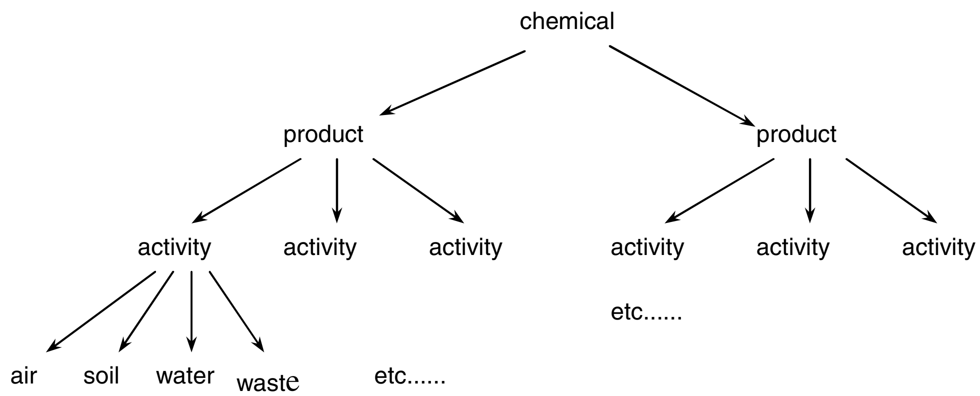


Figure 5.2 Methodological flow in a chemical based emission inventory.

The tasks in a chemical focused approach are

- Definition of chemicals to be included

- Quantification of use amounts from Eq.1
- Quantification of emission factors for each chemical

In principle all chemicals that can be classified as NMVOC must be included in the analysis, which implies that it is essential to have an explicit definition of NMVOC. The definition in solvent directive (1999/13/EC) of VOCs is as follows: "Volatile organic compound shall mean any organic compound having at 293.15 K a vapour pressure of 0,01 kPa or more, or having a corresponding volatility under the particular condition of use". A list of 650 single chemicals and a few chemical groups described in "National Atmospheric Emission Inventory", cf. Annex 3.F, is used. Probably the major part will be insignificant in a mass balance, but a detailed investigation must be made before any chemicals can be excluded. It is important to be aware that some chemicals are comprised in products and will not be found as separate chemicals in databases, e.g. diethylhexylphthalate (DEHP), which is the predominant softener in PVC. In order to include these chemicals the product use must be found and the amount of chemicals in the product must be estimated. It is important to distinguish the amount of chemicals that enters the mass balance as pure chemical and the amount that is associated to a product, in order not to double-count.

Production, import and export figures are extracted from Statistics Denmark, from which a list of 427 single chemicals, a few groups and products is generated. For each of these a *use* amount in tonnes pr yr (from 1995 to 2006) is calculated. It is found that 34 different NMVOCs comprise over 95 % of the total use, and it is these 34 chemicals that are investigated further.

In the Nordic SPIN database (Substances in Preparations in Nordic Countries) information for industrial use categories and products specified for individual chemicals, according to the NACE and UCN coding systems is available. This information is used to distribute the *use* amounts of individual chemicals to specific products and activities. The product amounts are then distributed to the CRF sectors 3A – 3D.

Emission factors, cf. Eq. 2, are obtained from regulators or the industry and can be provided on a site by site basis or as a single total for whole sectors. Emission factors can be related to production processes and to use. In production processes the emissions of solvents typically are low and in use it is often the case that the entire fraction of chemical in the product will be emitted to the atmosphere. Each chemical will be associated with four emission factors; 1) chemical industry (lowest EF), 2) other industry, 3) non-industrial activities, 4) domestic and other diffuse use (highest EF). This implies that high emission factors are applicable for use of solvent containing products and lower emission factors are applicable for use in industrial processes.

Outputs from the inventory are

- a list where the 34 most predominant NMVOCs are ranked according to emissions to air,
- specification of emissions from industrial sectors and from households,

- contribution from each NMVOC to emissions from industrial sectors and households,
- yearly trend in NMVOC emissions, expressed as total NMVOC and single chemical, and specified in industrial sectors and households.

5.2.5 Uncertainties and time-series consistency

Important uncertainty issues related to the mass-balance approach are

(i) Identification of chemicals that qualify as NMVOCs. Although a tentative list of 650 chemicals from the "National Atmospheric Emission Inventory" has been used, it is possible that relevant chemicals are not included, e.g. chemicals that are not listed with their name in Statistics Denmark but as a product.

(ii) Collection of data for quantifying production, import and export of single chemicals and products where the chemicals are comprised. For some chemicals no data are available in Statistics Denmark. This can be due to confidentiality or that the amount of chemicals must be derived from products wherein they are comprised. For other chemicals the amount is the sum of the single chemicals *and* product(s) where they are included. The data available in Statistics Denmark is obtained from Danish Customs & Tax Authorities and they have not been verified in this assessment.

(iii) Distribution of chemicals on products, activities, sectors and households. The present approach is based on amounts of single chemicals. To differentiate the amounts into industrial sectors it is necessary to identify and quantify the associated products and activities and assign these to the industrial sectors and households. No direct link is available between the amounts of chemicals and products or activities. From the Nordic SPIN database it is possible to make a relative quantification of products and activities used in industry, and combined with estimates and expert judgement these products and activities are differentiated into sectors. The contribution from households is also based on estimates. If the household contribution is set too low, the emission from industrial sectors will be too high and vice versa. This is due to the fact that the total amount of chemical is constant. A change in distribution of chemicals between industrial sectors and households will, however, affect the total emissions, as different emission factors are applied in industry and households, respectively.

A number of activities are assigned as "other", i.e. activities that can not be related to the comprised source categories. This assignment is based on expert judgement but it is possible that the assigned amount of chemicals may more correctly be included in other sectors. More detailed information from the industrial sectors is continuously being implemented.

(iv) Rough estimates and assumed emission factors are used for some chemicals. For some chemicals more reliable information has been obtained from the literature and from communication with industrial sectors. In some cases it is more appropriate to define emission factors for sector specific activities rather than for the individual chemicals.

A quantitative measure of the uncertainty has not been assessed. Single values have been used for emission factors and activity distribution ratios etc. In order to perform a stochastic evaluation more information is needed.

5.2.6 QA/QC and verification

Table 5.6 External and internal data.

File or folder name	Description	AD or Emf.	Reference	Contact(s)	Data agreement/ Comment
“Emissioner NMVOC” folder	Production, import and export data from Statistics Denmark	Activity data	Statistics Denmark	Patrik Fauser	
NMVOC emissions.xls	Calculations, emissionfactors, SPIN data. For industrial branches	Activity data and emissionfactors	Statistics Denmark, SPIN, reports, personal communication	Patrik Fauser	
Use Category National.xls	Calculations, emissionfactors, SPIN data. For CRF	Activity data and emissionfactors	Statistics Denmark, SPIN, reports, personal communication	Patrik Fauser	

The QA/QC procedure is outlined in section 1.6. In general, Critical Control Points (CCP) have been defined as elements or actions which need to be addressed in order to fulfil the quality objectives. The CCPs have to be based on clear measurable factors, expressed through a number of Points for Measuring (PM). In section 1.6 the list of PMs are listed.

Data Storage level 1	1. Accuracy	DS.1.1.1	General level of uncertainty for every data set including the reasoning for the specific values

The sources of data described in the methodology section and in DS.1.2.1 and DS.1.3.1 are used in this inventory. It is the accuracy of these data that define the uncertainty of the inventory calculations. Any data value obtained from Statistics Denmark and SPIN is given as a single point estimate and no probability range or uncertainty is associated with this value. Information from reports is sometimes given in ranges.

Data Storage level 1	1. Accuracy	DS.1.1.2	Quantification of the uncertainty level of every single data value including the reasoning for the specific values.

No uncertainty levels are quantified for the external data.

Data Storage level 1	2. Comparability	DS.1.2.1	Comparability of the data values with similar data from other countries, which are comparable with Denmark and evaluation of the discrepancy.

1) Production and import/export data from Statistics Denmark for single chemicals can be directly compared with data from Eurostat for other countries. This has been done for a few chosen chemicals and countries. Furthermore chosen Danish data from Eurostat have been validated with data from Statistics Denmark in order to check the consistency in data transfer from national to international databases.

2) Use categories for chemicals in products are found from Nordic SPIN database. Data for all Nordic countries are available and reported uniformly. For chosen chemicals a comparison of chemical amounts and use has been made between countries.

3) A joint Nordic project funded by the NMR has been used on methodological issues and for emission factors.

Data Storage level 1	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included by setting up the reasoning for the selection of data sets

A number of external date sources form the basis for calculating emissions of single chemicals. The general methodology in the emission inventory is described above.

1) Statistics Denmark. Statistics Denmark is used as the main database for collecting data on production, import and export of single chemicals, chemical groups and for some products. In order to obtain a uniform and unique set of data, it is crucial that the data for e.g. production of single chemicals is in the same reporting format and from the same source. The amount of data is very comprehensive and is linked with the data present in Eurostat. The database covers all sectors and is regarded as complete on a national level.

2) Nordic SPIN database (Substances in Preparations in Nordic Countries). SPIN provides data on the use of chemical substances in Norway, Sweden, Denmark and Finland . It is financed by the Nordic Council of Ministers, Chemical group and the data is supplied by the product registries of the contributing countries. The Danish product register (PROBAS) is a joint register for the Danish Working Environment Authority and the Danish EPA and comprises a large number of chemicals and products. The information is obtained from registration according to the Danish EPA rules and from scientific studies and surveys and other relevant sources. The product register is the most comprehensive collection of chemical data in products for Denmark, and the availability of data from the other Nordic countries enables an inter-country comparison. For each chemical the data is reported in a uniform way, which enhances comparability, transparency and consistency.

3) Reports from and personal contacts with industrial branches. It is fundamental to have information from the industrial branches that have direct contact with the activities, i.e. chemicals and products of interest. The information can be in the form of personal communication, but also reported surveys are of great importance. In contrast to the more generic approach of collecting information from large databases, the expert information from industrial branches may give valuable information on specific chemicals and/or products. By considering both sources a verification and optimum reliability and accuracy is obtained. The propane and butane use, as described above, is a good example of the importance of industrial branch information.

4) The present inventory procedure builds partly on information from the previous Danish solvent emission inventory, which is based on questionnaires to industrial branches. Furthermore a joint Nordic collabora-

tion on solvent inventories has given important information on methods and data.

Data Storage level 1	4.Consistency	DS.1.4.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PM's)

Data are predominantly extracted from the internet (Statistics Denmark and SPIN). These are saved as original copies in their original form, cf. Table 5.6. Specific information from industries and experts are saved as e-mails and reports.

Data Storage level 1	6.Robustness	DS.1.6.1	Explicit agreements between the external institution of data delivery and NERI about the condition of delivery

As stated in DS.1.4.1 most data is obtained from the internet. No explicit agreements have been made with external institutions.

Data Storage level 1	7.Transparency	DS.1.7.1	Summary of each data set including the reasoning for selecting the specific data set

See DS.1.3.1.

Data Storage level 1	7.Transparency	DS.1.7.3	References for citation for any external data set have to be available for any single number in any data set.

See Table 5.6.

Data Storage level 1	7.Transparency	DS.1.7.4	Listing of external contacts to every data set

See Table 5.6.

Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to type of variability (Distribution as: normal, log normal or other type of variability)

Tier1 assumes normal distribution of activity data and emission factors.

Data Processing level 1	1. Accuracy	DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals)

In the Emission Inventory Guidebook uncertainty estimates for the final emission calculations are given for the associated SNAP codes. These codes and uncertainty estimates are shown in Table 5.5.

Data Processing level 1	1. Accuracy	DP.1.1.3	Evaluation of the methodological approach using international guidelines

The methodological approach described in section 5.2.4 is based on the detailed methodology as outlined in the Emission Inventory Guidebook.

Data Processing level 1	1. Accuracy	DP.1.1.4	Verification of calculation results using guideline values

No guideline values are stated for Denmark in the Emission Inventory Guidebook.

Data Processing level 1	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCCC and IPCC.

See DP.1.1.3 and DS.1.3.1.

Data Processing level 1	3.Completeness	DP.1.3.1	Assessment of the most important missing quantitative knowledge

In "Uncertainties and time-series consistency" section 5.2.5 important uncertainty issues related to missing quantitative knowledge is stated. To summarise; (i) identification and inclusion of all relevant chemicals. (ii) Collection of data for quantifying production, import and export of single chemicals. (iii) Distribution of chemicals on products, activities, sectors and households. (iv) Emission factors for single chemicals, products and industrial and household activities.

Data Processing level 1	3.Completeness	DP.1.3.2	Assessment of the most important missing accessibility to critical data sources that could improve quantitative knowledge

The issues are referring to DP.1.3.1: (i) Identification of chemicals that qualify as NMVOCs. The definition in solvent directive (1999/13/EC) is used. Here VOCs are defined as follows: "Volatile organic compound shall mean any organic compound having at 293,15 K a vapour pressure of 0,01 kPa or more, or having a corresponding volatility under the particular condition of use". A tentative list of 650 chemicals from the "National Atmospheric Emission Inventory" has been used, it is possible that relevant chemicals are not included. (ii) For some chemicals no data are available in Statistics Denmark. This can be due to confidentiality or that the amount of chemicals must be derived from products wherein they are comprised. (iii) No direct link is available between the amounts of chemicals and products or activities. From the Nordic SPIN database it is possible to make a relative quantification of products and activities used in industry, and combined with estimates and expert judgement these products and activities are differentiated into sectors. More detailed information from the industrial sectors is still required. (iv) For many industrial and household activities involving solvent containing products no estimates on emission factors are available. Large variations occur between industry and product groups. And given the large number of chemicals more specific knowledge regarding industrial processes and consumption is needed.

Data Processing level 1	4.Consistency	DP.1.4.1	In order to keep consistency at a higher level an explicit description of the activities needs to accompany any change in the calculation procedure

Any changes in calculation procedures are noted for each years inventory.

Data Processing level 1	5.Correctness	DP.1.5.1	Shows at least once by independent calculation the correctness of every data manipulation

Calculations performed by IIASA using RAINS codes, which are based on a different methodological approach gives total emission values that are similar to the emissions found in the present approach.

Data Processing level 1	5.Correctness	DP.1.5.2	Verification of calculation results using time-series

No detailed guidelines or calculations are accessible for time-series. These are therefore not used in verification.

Data Processing level 1	5.Correctness	DP.1.5.3	Verification of calculation results using other measures

No other measures are used for verification.

Data Processing level 1	5.Correctness	DP.1.5.4	Shows one to one correctness between external data sources and the data bases at Data Storage level 2

The transfer of emission data from level 1, storage and processing, to data storage level 2 is manually checked.

Data Processing level 1	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described

See methodological approach described in section 5.2.3

Data Processing level 1	7.Transparency	DP.1.7.2	The theoretical reasoning for all methods must be described

See methodological approach described in section 5.2.4

Data Processing level 1	7.Transparency	DP.1.7.3	Explicit listing of assumptions behind all methods

See methodological approach described in section 5.2.4

Data Processing level 1	7.Transparency	DP.1.7.4	Clear reference to data set at Data Storage level 1

See Table 5.6

Data Processing level 1	7.Transparency	DP.1.7.5	A manual log to collect information about recalculations

Any changes in calculation procedures and methods are noted for each years inventory.

Data Storage level 2	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data type at level 2 to data at level 1

See DP.1.5.4.

Data Storage level 2	5.Correctness	DS.2.5.2	Check if a correct data import to level 2 has been made

See DP.1.5.4.

5.2.7 Recalculations

The previous method was based on results from an agreement between the Danish Industry and the Danish Environmental Protection Agency (DEPA). The emissions from various industries were reported to the Danish EPA. The reporting was not annual and linear interpolation was used between the reporting years. It is important to notice that not all use of solvents was included in this agreement and no activity data were available. It is not possible to perform direct comparison of methodologies or to make corrections to the previous method, due to the fundamental differences in structure. But an increase in total emissions was expected due to the more comprehensive list of chemicals.

Improvements and additions are continuously being implemented in the new approach, due to the comprehensiveness and complexity of the use and application of solvents in industries and households. The main improvements in the 2007 reporting include revisions of the following:

- The following chemicals and groups have been removed, compared to the 2006 inventory, due to vapour pressures below 0.01kPa: aminooxygen groups, glycerol, toluendiisocyanate, dioctylphthalate, diethylenglycol.
- Emission factors (EFs) have been adjusted for all chemicals, with most predominant effect for the following chemicals: ethanol, formaldehyde, turpentine, xylene, toluene and ethylenglycol.
- A differentiation of EFs in four different categories has been implemented: 1) chemical industry (lowest EF), 2) other industry, 3) non-industrial activities, 4) domestic and other diffuse use (highest EF). In previous inventories there was only a differentiation in two categories.
- More detailed and reliable information on use amounts and emission factors has been obtained from importers and producers for the fol-

lowing chemicals: methanol, ethanol in windscreen washing agent, naphthalene, propane and butane.

- Acrylic acid has been included in the inventory.

5.2.8 Planned improvements

In 2008 a joint Nordic project was performed regarding sharing of activity data and emission factors and allocation of activity data to source codes. Furthermore methodological issues were discussed. This will lead to thorough improvements in the coming Danish solvent inventory, regarding methodology, EFs and NMVOC to CO_2 conversion factors for chemicals, source allocation and inclusion of more chemicals that are listed as products in Statistics Denmark.

References

Statistics Denmark. Available at: http://www.dst.dk/HomeUK.aspx

SPIN on the Internet. Substances in Preparations in Nordic Countries, Available at: http://www.spin2000.net/spin.html

Emission Inventory Guidebook 3rd edition, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections, 2002 update. Available at: http://reports.eea.eu.int/EMEP-CORINAIR3/en (07-11-2003).

Solvent Balance for Norway, 1994. Statens Forurensningstilsyn, rapport 95:02.

Directive 1999/13/EC of 11 March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations, Brüssel, 1999.

6 Agriculture (CRF Sector 4)

The emission of greenhouse gases from agricultural activities includes the CH_4 emission from enteric fermentation and manure management, and the N_2O emission from manure management and agricultural soils. The emissions are reported in CRF Tables 4.A, 4.B(a), 4.B(b) and 4.D. Furthermore, the emission of non-methane volatile organic compounds (NMVOC) from agricultural soils is given in CRF Table 4s2. CO_2 emissions from agricultural soils are included in the LULUCF sector.

Emission from rice production, burning of savannas and crop residues does not occur in Denmark and the CRF Tables 4.C, 4E and 4.F have, consequently, not been completed. Burning of plant residue has been prohibited since 1990 and may only take place in connection with continuous cultivation of seed grass. It is assumed that the emission is insignificant and, hence, not included in the emission inventory.

6.1 Overview

In CO_2 equivalents, the agricultural sector (with LULUCF) contributes with 15.6 % of the overall greenhouse gas emission (GHG) in 2007. Next to the energy sector, the agricultural sector is the largest source of GHG emission in Denmark. The major part of the emission is related to livestock production, which in Denmark is dominated by the production of cattle and pigs. Given in CO_2 equivalents, the N_2O emission contributed with 62 % of the total GHG emission from the agricultural sector and CH_4 contributed with the remaining 38 % in 2007.

From 1990 to 2007, the emissions decreased from 13.0 Mt CO_2 eqv. to 9.8 Mt CO_2 eqv., which corresponds to a 25 % reduction (Table 6.1). Since the previous reporting, there have been some changes. The change has affected the national emission from the agricultural sector 1990 – 2006 by less than 1 % (Section 6.8).

Table 6.1 Emission of GHG in the agricultural sector in Denmark 1990 – 2007

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CH_4, Gg CO_2-eqv.	4 010	4 052	4 061	4 152	4 018	4 001	4 002	3 906	3 940	3 802
N_2O, Gg CO_2-eqv.	8 999	8 839	8 543	8 320	8 110	7 906	7 567	7 492	7 464	7 015
Total, Gg CO_2-eqv.	13 010	12 890	12 604	12 473	12 127	11 906	11 570	11 398	11 404	10 817
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
CH_4, Gg CO_2-eqv.	3 818	3 908	3 854	3 817	3 749	3 700	3 663	3 835		
N_2O, Gg CO_2-eqv.	6 764	6 611	6 380	6 145	6 254	6 229	5 923	6 238		
Total, Gg CO_2-eqv.	10 582	10 519	10 234	9 962	10 003	9 929	9 586	10 072		

Figure 6.1 shows the distribution of the greenhouse gas emission across the main agricultural sources. The total N_2O emission from 1990-2007 has decreased by 31 %. The decrease in national emissions can largely be attributed to the decrease in N_2O emissions from agricultural soils. This reduction is due to a proactive national environmental policy over the last twenty years. The environmental policy has introduced a series of measures to prevent loss of nitrogen from agricultural soil to the aquatic

environment. The measures include improvements to the utilisation of nitrogen in manure, a ban on manure application during autumn and winter, increasing area with winter-green fields to catch nitrogen, a maximum number of animals pr hectare (ha) and maximum nitrogen application rates for agricultural crops. The main part of the emission from the agricultural sector is related to livestock production. An active environmental policy has brought about a decrease in the N-excretion, a decrease of emission pr produced animal, because of more efficient feeding and a fall in use of mineral fertilizer, which all has reduced the overall GHG emission.

From 1990 to 2007, only a slight reduction in the total CH_4 emission has occurred. The emission from enteric fermentation has increased from 2006-2007 due to an adjustment of feed intake for non dairy cattle. But from 1990 to 2007 the enteric fermentation has decreased due to decrease in the number of cattle. The emission from manure management has increased due to a change towards greater use of slurry-based stable systems, which have a higher emission factor than systems with solid manure. By coincidence, the decrease and the increase almost balance each other out and the total CH_4 emission from 1990 to 2007 has decreased by 5 %.

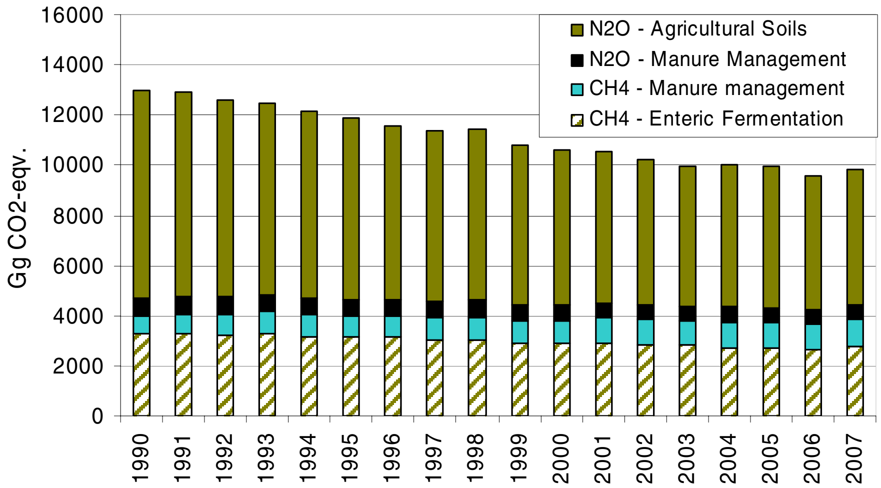


Figure 6.1 Danish greenhouse gas emissions 1990 – 2007.

6.1.1 References – sources of information

The calculations of the emissions are based on methods described in the IPCC Reference Manual (IPCC, 1997) and the Good Practice Guidance (IPCC, 2000).

Activity data and emission factors are collected and discussed in cooperation with specialists and researchers in various institutes, such as the Faculty of Agricultural Sciences – Aarhus University, Statistics Denmark, the Danish Agricultural Advisory Centre, the Danish Plant Directorate and the Danish Environmental Protection Agency. In this way, both data and methods will be evaluated continually, according to the latest knowledge and information. National Environmental Research Institute has established data agreements with the institutes and organisations to assure that the necessary data is available to prepare the emission inventory on time.

Table 6.2 List of institutes involved in the emission inventory for the agricultural sector.

References	Link	Abbreviation	Data/information
National Environmental Research Institute, University of Aarhus	www.dmu.dk	NERI	- reporting - data collecting
Statistics Denmark – Agricultural Statistics	www.dst.dk	DS	- No. of animal - milk yield - slaughter data - land use - crop production - crop yield
Faculty of Agricultural Sciences, University of Aarhus	www.agrsci.dk	FAS	- N-excretion - feeding situation - growth - N-fixed crops - crop residue - N-leaching/runoff - NH_3 emissions factor - stable type (from 2007)
The Danish Agricultural Advisory Centre	www.lr.dk	AAC	- stable type - grassing situation - manure application time and methods
Danish Environmental Protection Agency	www.mst.dk	EPA	- sewage sludge used as fertiliser - industrial waste used as fertiliser
The Danish Plant Directorate	www.pdir.dk	PD	- synthetic fertiliser (consumption and type) - stable type (from 2005)
The Danish Energy Authority	www.ens.dk	DEA	- manure used in biogas plants

The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called IAD (Inventory Agriculture Data), based on the model DIEMA. This model complex, as shown in Figure 6.2, is implemented in great detail and is used to cover emissions of ammonia, particulate matter and greenhouse gases. Thus, there is a direct coherence between the ammonia emission and the emission of N_2O. A more detailed description of DIEMA has been published (Mikkelsen et al. 2006).

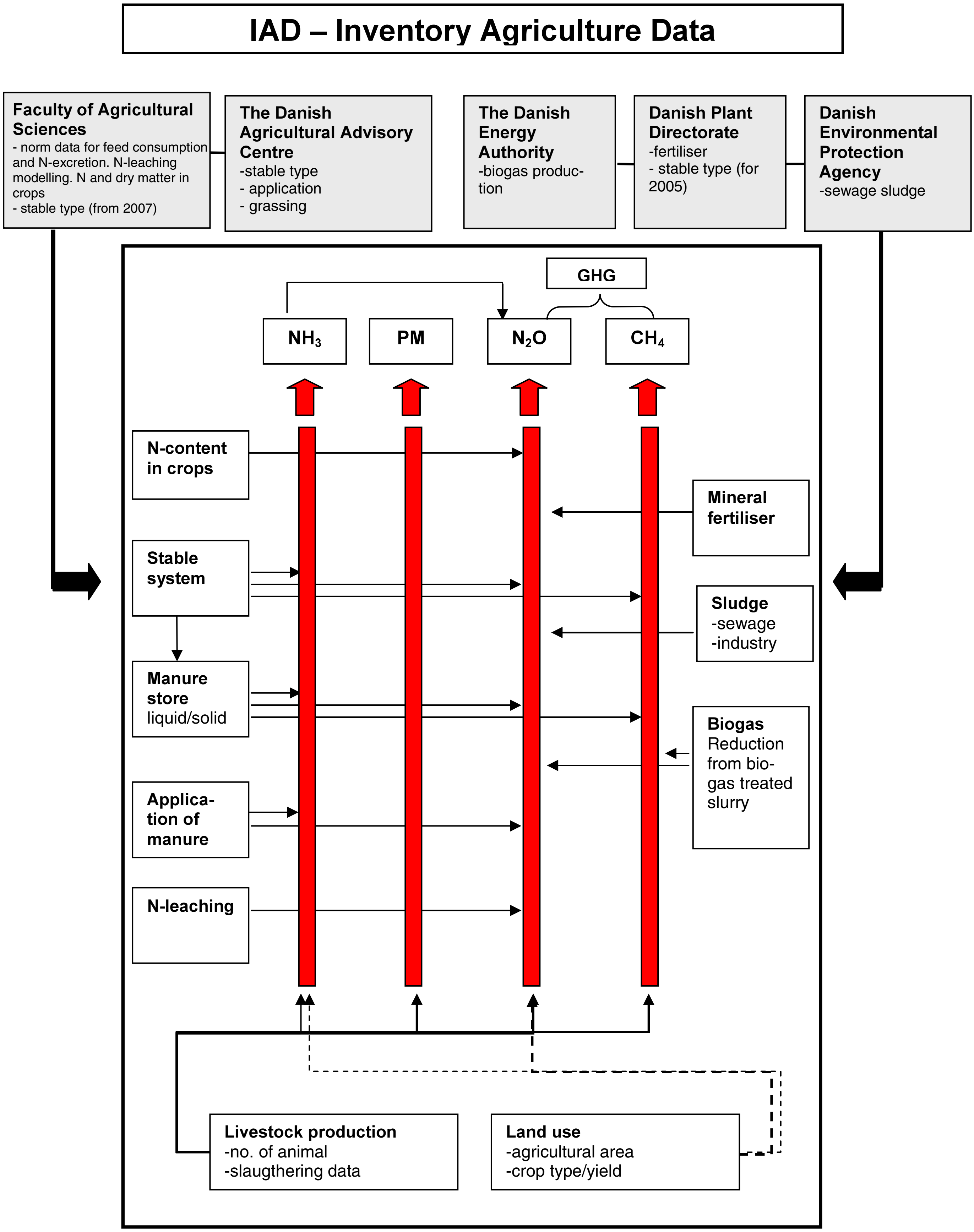


Figure 6.2 IAD – Inventory Agriculture Data.

The IAD model complex is build up as a database, where activity data is stored in one database and the calculations in another linked to the activity database. The main part of the emission is related to livestock production. In short, the emission from livestock production is based on information concerning the number of animals, the distribution of animals according to stable type and final information on feed consumption and excretion.

IAD operates with 32 different livestock categories, according to livestock category, weight class and age. These categories are subdivided into stable type and manure type, which results in around 200 different combinations of livestock subcategories and stable types (see appendix 3D table 6). For each of these combinations, information on e.g. feed intake, digestibility, excretion and methane conversion factors is attached. The emission is calculated from each of these subcategories and then aggregated in accordance with the IPCC livestock categories given in the CRF.

Table 6.3 shows an example of subcategories for cattle and swine.

Table 6.3 Subcategories including in category of Dairy Cattle, Non-Dairy Cattle and Swine.

Aggregated livestock categories as given in IPCC	Subcategories in DIEMA	Number of stable type
Cattle[1)]		
Dairy Cattle		13
Non-Dairy Cattle	Calves < ½ yr (bull)	2
	Calves < ½ yr (heifer)	2
	Bull > ½ yr to slaughter	11
	Heifer > ½ yr to calving	14
	Cattle for suckling	8
Swine	Sows	6
	Piglets	5
	Slaughter pigs	6

[1)] For all subcategories, large breed and jersey cattle are distinguished from each other

It is important to point out that changes over the years, both to the national emission and the implied emission factor, are not only a result of changes in the numbers of animals, but also depend on changes in the allocation of subcategories, changes in feed consumption and changes in stable type.

Number of animals: Livestock production is primarily based on the agricultural census from Statistics Denmark. The emission from slaughter pigs and poultry is based on slaughter data. Approximate numbers of horses, goats and sheep on small farms are added to the number in the Agricultural Statistics, in agreement with the Danish Agricultural Advisory Centre (DAAC), as Statistics Denmark does not include farms less than 5 ha. Statistics Denmark is the source for the database kept by FAO (Food and Agriculture Organization of the United Nations). This explains why the number of sheep, goats and horses in FAO and the Danish emission inventory disagree. The largest difference is found for horses. In the agricultural census, for 2007 the number of horses is estimated to be 52 702. Including horses on small farms and riding schools, however, the number of horses rises to approximately 173 000. Based on the ERT recommendations, improvements to the documentation of number of horses, sheep and goats on small farms, in cooperation with DAAC, is planned for the 2010 reporting.

Stable type: At present, there exist no official statistics concerning the distribution of animals according to stable type. The distribution is, therefore, based on an expert judgement from the Danish Agricultural Advisory Centre (DAAC) and Faculty of Agricultural Sciences (FAS). Approximately 90-95 % of Danish farmers are members of DAAC and DAAC regularly collects statistical data from the farmers on different issues, as well as making recommendations with regard to farm buildings. Hence, DAAC have a very good feeling of which stable types are currently in use. From 2006, all farmers have to report which stable type they are using to the Danish Plant Directorate. These information are now included in the inventory and are in overall consonant with the expert judgement from DAAC. Annex 3D Table 6 shows the stable type for each livestock category 1990 – 2007.

Feed consumption and excretion: The Faculty of Agricultural Sciences (FAS) delivers Danish standards related to feed consumption, manure type in different stable types, nitrogen content in manure, etc. The Danish Normative System for animal excretions is based on data from the Danish Agricultural Advisory Centre (DAAC). DAAC is the central office for all Danish agricultural advisory services. DAAC carries out a considerable amount of research itself, as well as collecting efficacy reports from the Danish farmers for dairy production, meat production, pig production, etc., to optimise productivity in Danish agriculture. In total, feed plans from 15-18 % of the Danish dairy production, 25-30 % of the pig production, 80-90 % of the poultry production and approximately 100 % of the fur production are collected. These basic feeding plans are used to develop the Danish Normative System. For dairy cows, approximately 800 feeding plans are used to develop the norm figures. Previously, the standards were updated and published every third or fourth year – the last one is Poulsen et al. from 2001. These standards have been described and published in English in Poulsen & Kristensen (1998). From 2001, NERI receives updated data annually directly from FAS and the data is available at the homepage of FAS http://www.agrsci.dk/ny_navigation/institutter/institut_for_husdyrsundhed_velfaerd_og_ernaering/husdyrernaering_og_miljoe/normtal

6.1.2 Key category identification

In the key category analysis (refer Annex 1) the agriculture emissions contribute with 5 categories, Table 6.4. All of these categories are in 2007 key categories and 4 of these are key categories for level and trend. All 5 categories are identified as level key categories for the base year 1990.

The 3 most important agriculture key categories are N_2O emission from agricultural soils direct emissions, CH_4 from enteric fermentation and N_2O from Nitrogen use, indirect emissions, contributing in the level analysis 4.1, 3.9 and 3.8 % respectively of the total national GHG emission in 2007.

Table 6.4 Key category identification from the agricultural sector 1990 and 2007.

CRF table	Compounds	Emission source	Key category identification
2007			
4.A	CH_4	Enteric fermentation	Level/trend
4.B(a)	CH_4	Manure management	Level/trend
4.B(b)	N_2O	Manure management	Level
4.D	N_2O	Indirect N_2O emission from nitrogen used in agriculture	Level/trend
4.D	N_2O	Direct N_2O emission from agricultural soils	Level/trend
1990			
4.A	CH_4	Enteric fermentation	Level
4.B(a)	CH_4	Manure management	Level
4.B(b)	N_2O	Manure management	Level
4.D	N_2O	Indirect N_2O emission from nitrogen used in agriculture	Level
4.D	N_2O	Direct N_2O emission from agricultural soils	Level

6.2 CH_4 emission from Enteric Fermentation (CRF Sector 4A)

6.2.1 Description

The major part of the agricultural CH_4 emission originates from digestive processes. In 2007, this source accounts for 29 % of the total GHG emission from agricultural activities. The emission is primarily related to ruminants and, in Denmark, particularly to cattle, which, in 2007, contributed with 91 % of the emission from enteric fermentation. The emission from pig production is the second largest source and covers 6 % of the national emission from enteric fermentation, followed by horses (2 %) and sheep and goats (1 %).

6.2.2 Methodological issues

Implied emission factor

The implied emission factors for all animal categories are based on the Tier 2 approach.

Table 6.5 CH_4 - Enteric fermentation – use of IPCC default values and national parameters.

CH_4 - Enteric fermentation	IPCC default value	National parameters
Gross energy intake (GE)		Annex 3D, Table 2a + 2b
Methane conversion rates (Ym)	Other animal categories	Dairy cattle and heifer: 6.39 – 5.93

Feed consumption for all animal categories is based on the Danish normative figures. The normative data are based on actual efficacy feeding controls or actual feeding plans at farm level, collected by DAAC or FAS. For cattle, approximately 20 % of the herd is included and for pigs, approximately 35 % are included. The data is given in Danish feed units or kg feedstuff and is converted to mega joule (MJ). A more detailed description is given in Mikkelsen et al (2006). For grassing animals the energy content in the winter periods feed plan and the energy plan in grass are distinguished between. Annex 3D, Table 1 provides additional information about grassing days for each livestock category.

In Annex 3D Table 2a, the annual average feed intake is shown, from 1990 to 2007, for each CRF livestock category. Table 2b shows the subcategories for non-dairy cattle and swine. Default values for the methane conversion rate (Y_m) given by the IPCC are used for all livestock categories, except for dairy cattle and heifers, where a national Y_m is used for all years (Annex 3D Table 3a). New investigations from FAS have shown a change in fodder practice from use of sugar beet to maize (whole cereal). Sugar beet feeding gives a higher methane production rate compared to grass and maize due to the high content of easily convertible sugar. The development in fodder practice reflects the change in the average Y_m for dairy cattle and heifer from 6.39 in 1990 to 5.93 in 2007.

The estimation of the national values of Ym is based on model "Karoline" developed by FAS based on average feeding plan for 20 % of all dairy cows in Denmark obtained from the Danish Agricultural Advisory Centre DAAC (Olesen et al.; 2005). FAS have estimated the CH_4 emission for a winter feeding plan for two years, 1991 (Y_m=6.7) and 2002 (Y_m=6.0). Y_m for the years between 1991 and 2002 are estimated by interpolation and for 1990 and 2003 to 2007 by extrapolation where the actual sugar beet area is taken into account. Data for actual sugar beet area are in Annex 3D Table 3b. Sugar beet is only included in the winter feeding plan and the Y_m is therefore also adjusted for days on winter and summer feeding plan. It is assumed that winter feeding plan covers 200 days. The value of the estimated Y_m for 1991 and 2002 are, when adjusted for winter/summer, 6.35 and 5.96, respectively.

Table 6.6 shows the implied emission factors for all IPCC livestock categories. The implied emission factor (IEF) vary across the years for dairy cattle, other cattle and swine due to changes for feed consumption, allocation of subcategories and number of grassing days. For goats and horses new subcategories are introduced in 2007 and therefore the IEF differs from the other years. For sheep the IEF is constant.

No default values are recommended in the IPCC Reference Manual or Good Practice Guidance for poultry and fur farming. The enteric emission from poultry and fur farming is considered non-significant.

Table 6.6 Implied emission factor – Enteric Fermentation 1990 – 2007, kg CH_4 pr head pr yr.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1. Cattle										
a. Dairy	116.59	117.59	118.29	119.17	120.01	119.46	118.50	118.21	118.52	117.66
b. Non-Dairy	35.45	35.49	35.42	35.45	35.17	35.18	35.02	35.29	35.14	35.42
3. Sheep	17.17	17.17	17.17	17.17	17.17	17.17	17.17	17.17	17.17	17.17
4. Goats	13.15	13.15	13.15	13.15	13.15	13.15	13.15	13.15	13.15	13.15
6. Horses	21.34	21.34	21.34	21.34	21.34	21.34	21.34	21.34	21.34	21.34
8. Swine	1.07	1.10	1.12	1.10	1.10	1.07	1.11	1.10	1.10	1.13
9. Poultry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
10. Other (fur farming)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Continued	2000	2001	2002	2003	2004	2005	2006	2007
1. Cattle								
a. Dairy	117.21	119.31	122,01	124.12	126.18	128,08	126.22	130.55
b. Non-Dairy	35.60	35.79	35.90	36.00	35.58	35.62	35.95	40.30
3. Sheep	17.17	17.17	17.17	17.17	17.17	17.17	17.17	17.17
4. Goats	13.15	13.15	13.15	13.15	13.15	13.15	13.15	12.70
6. Horses	21.34	21.34	21.34	21.34	21.34	21.34	21.34	21.81
8. Swine	1.11	1.09	1.09	1.09	1.11	1.05	1.10	1.07
9. Poultry	NE	NE	NE	NE	NE	NE	NE	NE
10. Other (fur farming)	NE	NE	NE	NE	NE	NE	NE	NE

The increase in the IEF for dairy cattle from 1990-2007 is the result of increasing feed consumption due to rising milk yields. On average, the milk yield has increased from 6200 litre pr cow pr yr in 1990 to approximately 8600 litre pr cow pr yr in 2007 (Statistics Denmark). From 2005 to 2006 is seen a fall in the IEF and this can be explained by improvements in fodder efficiency.

The category "Non-Dairy Cattle" includes calves, heifers, bulls and suckle cows and the implied emission factor is a weighted average of these different subcategories. The development 1990 - 2006 in IEF shows a slight increase, which is due to changes in allocation of the subcategories. From 2006 to 2007 is seen a big increase in the IEF, this is do to a updating of the fodder consumption for calves, bulls and heifers. Especially the IEF is depending on the export and slaughtering of bull calves.

The Danish IEF for non-dairy cattle is lower compared with the default value given in the IPCC Reference Manual. This is mainly due to lower weight and because of that a lower feed intake. For heifer, which is an important subcategory a lower Y_m-value compared with the default values provided by the IPCC is used (Table 6.7).

Table 6.7 Subcategories for Non Dairy Cattle 2007 – enteric fermentation.

Non Dairy Cattle – subcategories (Based on an one year production)		Energy intake, MJ pr day	Methane conversion rate (Ym), %	IEF, kg CH_4 pr head pr yr
Calves, bull (0-6 month)		61.5	4.00	16.14
Calves, heifer (0-6 month)		102.4	6.00	39.78
Bull (6 month to slaughter)	large breed: 440 kg sl. weight jersey: 330 kg sl. weight	115.8	4.00	30.39
Heifer (6 month to calving)		130.5	5.93	51.02
Suckling cattle		163.6	6.00	63.91
Average - Non-Dairy Cattle				39.04
IPCC – default value				48.00

The yearly changes for pigs primarily reflect the changes in the allocation of the subcategories (sows, piglets and slaughter pigs). The feed intake for sows and piglets has overall increased while the feed intake for slaughtering pigs has decreased as a result of improved fodder efficacy (Annex 3D Table 2b).

In Table 6.8 the IEF for swine subcategories is shown. The lower IEF for swine compared to the IPCC default values is due a very high efficiency production in the Danish production. The majority of the pork meat is exported and an improvement in the genetic development and the production managements has results in high fodder efficiency especially for the production of slaughter pigs.

Table 6.8 Subcategories for Swine 2007 – enteric fermentation.

Swine – subcategories (Based on an one year production)	Energy intake, MJ pr day	Methane conversion rate (Ym), %	IEF, kg CH_4 pr head pr yr
Sows (incl. piglets until 7.5 kg)	70	0.60	2.8
Piglets (7.5 – 30 kg)	15	0.60	0.6
Slaugther pigs (30 – 105 kg)	41	0.60	1.6
Average - Swine			1.1
IPCC – default value			1.5

The same feed intake for sheep is used for all years, which results in an unaltered IEF. A more detailed division in subcategories for goats and horses have resulted in changes in the feed intake and thereby in the IEF from 2006 to 2007. The IEF for sheep and goats includes lambs and kids, which corresponds to the Danish normative data. This explains why the Danish IEF is nearly twice as high as the IPCC default value.

Activity data

In Table 6.9, the development in the number of animals from the agricultural statistics (Statistics Denmark) and DAAC from 1990 to 2007 is presented. The agricultural census does not include farms less than 5 ha. In the Danish emission inventory, the decision has been made to add number of sheep, goats and horses on small farms based on information from DAAC (see Chapter 1.1.1 – number of animals).

Since 1990, the number of swine and poultry has increased, in contrast to the number of cattle, which has decreased due to an increasing milk yield. Buffalo, camels and llamas, mules and donkeys are not relevant for Denmark.

Table 6.9 Number of animals from 1990 to 2007, 1000 head.

CRF Table 4.A, 4.B (a) and 4.B (b)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
IPCC livestock categories:										
Dairy Cattle	753	742	712	714	700	702	701	670	669	640
Non-Dairy Cattle	1 486	1 480	1 478	1 481	1 405	1 388	1 393	1 334	1 308	1 247
Sheep*	92	107	102	88	80	81	94	78	83	83
Goats*	8	9	9	9	9	9	9	10	10	10
Horses*	135	137	138	140	141	143	144	146	147	149
Swine	9 497	9 783	10 455	11 568	10 923	11 084	10 842	11 383	12 095	11 626
Poultry	16 249	15 933	19 041	19 898	19 852	19 619	19 888	18 994	18 674	21 010
Other; fur farming	2 264	2 112	2 283	1 537	1 828	1 850	1 918	2 212	2 345	2 089
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
IPCC livestock categories:										
Dairy Cattle	636	623	610	596	563	564	550	545		
Non-Dairy Cattle	1 232	1 284	1 187	1 128	1 082	1 006	984	1 021		
Sheep*	81	92	74	83	79	94	102	87		
Goats*	10	11	11	12	12	14	13	28		
Horses*	150	152	153	155	155	156	157	173		
Swine	11 922	12 608	12 732	12 949	13 233	13 534	13 361	13 723		
Poultry	21 830	21 236	20 580	17 796	16 598	17 530	17 249	16 741		
Other; fur farming	2 199	2 304	2 422	2 361	2 471	2 552	2 708	2 837		

* Including animals on small farms (less than 5 ha), which are not covered by the Statistics Denmark.

6.2.3 Time-series consistency

The national emission from enteric fermentation is given in Table 6.10. From 1990 to 2007, the emission has decreased by 14 %, which is primarily related to a decrease in the number of dairy cattle from 753 000 in 1990 to 545 000 in 2007. The number of pigs has increased from 9.5 M in 1990 to 13.7 M in 2007, but this increase is only of minor importance in relation to the total CH_4 emission from enteric fermentation.

Table 6.10 Emission of CH_4 from Enteric Fermentation 1990 – 2007, Gg CH_4.

CRF 4.A	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Dairy Cattle	87.81	87.21	84.22	85.10	83.95	83.91	83.02	79.24	79.30	75.33
Non-Dairy Cattle	52.68	52.53	52.35	52.51	49.42	48.82	48.76	47.07	45.97	44.17
Sheep	1.58	1.83	1.76	1.52	1.37	1.39	1.62	1.34	1.43	1.42
Goats	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.13
Horses	2.88	2.91	2.94	2.98	3.01	3.04	3.07	3.10	3.14	3.17
Swine	10.14	10.74	11.74	12.71	12.03	11.91	12.03	12.53	13.28	13.09
Poultry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Other - fur farming	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total, Gg CH_4	155.19	155.33	153.12	154.92	149.91	149.20	148.63	143.40	143.24	137.29
Total, Gg CO_2 eqv.	3 259	3 262	3 216	3 253	3 148	3 133	3 121	3 011	3 008	2 883
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Dairy Cattle	74.49	74.38	74.38	73.98	71.10	72.27	69.46	71.21		
Non-Dairy Cattle	43.88	45.93	42.60	40.62	38.50	35.82	35.40	41.14		
Sheep	1.40	1.59	1.27	1.43	1.36	1.62	1.75	1.50		
Goats	0.13	0.14	0.14	0.15	0.16	0.18	0.16	0.35		
Horses	3.20	3.23	3.26	3.30	3.31	3.33	3.34	3.77		
Swine	13.28	13.68	13.94	14.05	14.62	14.16	14.69	14.73		
Poultry	NE	NE	NE	NE	NE	NE	NE	NE		
Other - fur farming	NE	NE	NE	NE	NE	NE	NE	NE		
Total, Gg CH_4	136.37	138.94	135.59	133.53	129.05	127.37	124.81	132.69		
Total, Gg CO_2 eqv.	2 864	2 918	2 847	2 804	2 710	2 675	2 621	2 787		

NE = Not estimated.

6.3 CH_4 and N_2O emission from Manure Management (CRF Sector 4B)

6.3.1 Description

The emissions of CH_4 and N_2O from manure management are given in CRF Table 4.B (a) and 4.B (b). This source contributes with 16 % of the national emission from the agricultural sector in 2007 and the major part of the emission originates from the production of swine (57 %) followed by cattle production (33 %). The remaining part is mainly from poultry (6 %).

6.3.2 Methodological issues

CH_4 emission

The IPCC Tier 2 approaches are used for the estimation of the CH_4 emission from manure management. The amount of manure is calculated for each combination of livestock subcategory and stable type and then aggregated to the IPCC livestock categories.

The estimation is based on national data for feed consumption (Poulsen et al. 2001) and standards for digestibility. These data are given in Annex 3D, Tables 4 and 5. For ash content the IPCC standards are used – i.e. 8 % for ruminants and 2 % for other livestock. Default values provided in the IPCC guidelines for the methane production B_o and MCF are used. For liquid systems, the MCF of 10 % in the Reference Manual (IPCC, 1997) is used, which is based on Husted (1996). In the Good Practice Guidance (IPCC, 2000), the MCF for liquid manure has been changed from 10 % to 39 % for cold climates. The results from both Husted (1996) and Massé et al. (2003) indicate that the MCF of 10 % reflects the Danish conditions better than MCF of 39 %. Husted (1996) is, among other sources, based on measurements in Danish stables. Investigations described in Massé et al. (2003) are based on measurements in Canadian agricultural conditions similar to the Danish conditions. Support of this value is also found from a Swedish review (Dustan, 2002), taking both the cold climate and the fact that the slurry containers usually have a surface cover, in to account.

Furthermore a review of the inventory rapports from countries with comparable climate conditions shows a similar approach – Sweden and Finland same value MCF = 10 %, Belgium and Germany MCF ≤ 15 %, Norway and Netherland MCF < 10 %.

ERT has previously accepted the documentation for this assumption – see centralized review § 43 (ARR report) (http://unfccc.int/resource/docs/2006/arr/dnk.pdf).

Animal slurry treated in biogas plants reduce the emission of CH_4 and N_2O (Sommer et al. 2001) and this reduction is included in the emission inventory as reduced emission from dairy cattle and pigs for slaughter, which is the main sources of the production of slurry.

In 2007, approximately 8 % (0.97 Mt of cattle slurry and 1.18 Mt of pig slurry) were treated in biogas plants (DEA 2008) (Annex 3D Table 8). The reduction in the CH_4 emission is based on model calculations for an average size biogas plant with a capacity of 550 m^3 pr day. The reduced CH_4 emission is calculated as:

$$CH4_{reduction,i} = VS_{treatedslurry,i} \cdot B_{o,i} \cdot MCF \cdot 0.67 \cdot R_{CH4-potetial,i}$$

Where; $CH4_{reduction}$ is the reduction in the amount of methane from livestock type *i,* VS treated slurry is the total amount of treated slurry, B_0 is the maximum methane forming capacity, MCF is the methane conversion factor and $R_{CH4\text{-}potential}$ is the reduction potential (Table 6.11). A reduction potential of 30 % for cattle slurry and 50 % for pig slurry is obtained (Nielsen et al. 2002, Sommer et al. 2001).

Tabel 6.11 Key model parameters for reduction in CH_4 emission due to biogas plants.

	Dry matter (dm),[a] %	VS of dm,[b] %	$R_{CH4\text{-}potential}$,[c] %	MCF[d]	B_0[d]
Cattle	10.3	80	30	10	0.24
Swine	6.1	80	50	10	0.45

[a] FAS.

[b] Henrik.B. Møller, DIAS (pers. comm. 2003), Husted 1994 and Massé et al. 2003.

[c] Nielsen et al. 2002, Sommer et al. 2001.

[d] IPCC default.

Due to the biogas plants, the national emission of CH_4 is reduced by 1.26 Gg CH_4 (Table 6.9), which correspond a 3 % reduction of the CH_4 emission from manure management in 2007.

Table 6.12 Reduced CH_4 emissions from biogas treated slurry 1990 – 2007.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Energy production, TJ	230	388	473	556	658	772	830	1005	1222	1253
Amount of treated slurry, Mt										
- cattle	0.09	0.14	0.18	0.21	0.24	0.29	0.31	0.37	0.45	0.47
- swine	0.10	0.18	0.21	0.25	0.30	0.35	0.38	0.46	0.56	0.57
VS total in treated slurry										
- cattle	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04
- swine	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03
Total reduced emission, Gg CH_4	0.11	0.19	0.23	0.27	0.32	0.37	0.40	0.48	0.59	0.61
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Energy production, TJ	1 408	1 524	1 747	2 133	2 276	2 338	2 585	2 603		
Amount of treated slurry, Mt										
- cattle	0.52	0.57	0.65	0.79	0.85	0.87	0.96	0.97		
- swine	0.64	0.69	0.79	0.97	1.03	1.06	1.18	1.18		
VS total in treated slurry										
- cattle	0.04	0.05	0.05	0.07	0.07	0.07	0.08	0.08		
- swine	0.03	0.03	0.04	0.05	0.05	0.05	0.06	0.06		
Total reduced emission, Gg CH_4	0.68	0.74	0.84	1.03	1.10	1.13	1.25	1.26		

CH_4–implied emission factor

Table 6.13 shows the development in the implied emission factors from 1990 to 2007. Variations between the years for dairy cattle, other cattle, poultry, swine and fur farming reflect changes in feed intake, allocation of subcategories, grassing situation and changes in stable type system.

The IEF for sheep, goats and horses is unaltered because of very few changes in feed intake and grassing days. A more detailed division in subcategories for goats and horses will be implemented for manure management in the 2010 submission. The IEF for sheep and goats includes lambs and kids, which correspond to the Danish normative data. This explains why the Danish IEF is nearly twice as high as the IPCC default value.

Table 6.13 Implied emission factor – Manure Management 1990 – 2007, kg CH_4 pr head pr yr.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1a. Dairy Cattle	13.48	13.74	14.01	14.28	14.56	14.64	14.73	14.30	13.96	13.94
1b. Non-Dairy Cattle	2.21	2.11	2.03	1.97	1.88	1.78	1.77	1.74	1.74	1.75
3. Sheep	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
4. Goats	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
6. Horses	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56
8. Swine	2.25	2.39	2.51	2.49	2.52	2.48	2.59	2.60	2.61	2.71
9. Poultry	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
10. Other (Fur farming)	0.20	0.21	0.21	0.22	0.23	0.24	0.25	0.26	0.26	0.27
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
1a. Dairy Cattle	16.06	16.97	17.88	19.03	19.73	18.97	18.61	18.79		
1b. Non-Dairy Cattle	1.74	1.79	1.78	1.77	1.70	1.71	1.72	1.72		
3. Sheep	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32		
4. Goats	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26		
6. Horses	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56		
8. Swine	2.66	2.60	2.61	2.56	2.62	2.53	2.66	2.60		
9. Poultry	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02		
10. Other (Fur farming)	0.35	0.40	0.44	0.48	0.52	0.59	0.59	0.59		

IEF for dairy cattle has increased as a result of an increasing milk yield, but also because of change in stable types. In Annex 3D, Table 6 shows the changes in stable types from 1990 to 2007. Old-style tethering systems with solid manure have been replaced by loose-housing with slurry-based systems. The MCF for liquid manure is ten times higher than that for solid manure. For non-dairy cattle, the opposite development has taken place. An increasing proportion of bull-calves are raised in stables with deep litter, where the MCF is lower than for liquid manure.

For pigs, there has been a similar development as for dairy cattle with a move from solid manure to slurry-based systems. Updated stable type data for 2007 (see Chapter 1.1.1 – stable system) shows fewer animals on slurry systems than previous estimated by the expert judgement from the Danish Agricultural Advisory Centre.

The category "Other" in CRF Table 4s1 is registered emission from fur farming. Denmark produces 2.8 million mink and fox and these contribute with 3 percent of the CH_4 emission from manure management. The IEF for fur farming is rising from 0.20 in 1990 to 0.59 in 2007 due to a development against more mink on slurry based systems.

The implied emission factor based on Tier 2 approach compared to IPCC default values shows some differences and can be explained by looking at the values for the most important parameters as volatile solids (VS), digestibility and the part of animal on slurry based system for each cattle- and swine subcategory as given in 6.14 and 6.15. The national IEF for dairy cattle is higher, which is mainly due to the fact that more cattle are stabled on slurry based system than given in the IPCC assumptions.

A lower VS, higher digestibility and more cattle at stable system dominated by solid manure is the reason for a lower nation IEF for the category "non dairy cattle".

The category of swine operate with three subcategories and for sows and slaughter pigs the IEF is higher compared with the IPCC default value due to more slaughter pigs on slurry based system. Nevertheless, the average IEF for swine is lower because of the great production of piglets, which has a relatively low IEF.

Table 6.14 Cattle – important parameters for calculation of the average implied emission factor for manure management 2007.

	IPCC				DK - 2007			
	VS kg dm pr hd pr day	Digestibility %	Liquid/slurry %	IEF kg CH_4 pr hd pr yr	VS kg dm pr hd pr day	Digestibility %	Liquid/slurry %	IEF kg CH_4 pr hd pr yr
Dairy	5.1	60	40	14	4.9	71 (78)	86	19
Non-dairy	2.7	60-65	50	6	0.5 - 3.7	67-79 (78)	31	2
Calves, bull					0.6	79 (79)	0	0.3
Calves, heifer					0.5	78 (78)	0	0.3
Bulls > ½ yr					0.8	75 (78)	35	2.5
Heifer > ½ yr					1.4	71 (78)	44	2.9
Suckling cattle					3.7	67 (77)	9	1.1

Table 6.15 Swine – important parameters for calculation of the average implied emission factor for manure management 2007

	IPCC				DK - 2007			
	VS kg dm pr hd pr day	Digestibility %	Liquid/slurry %	IEF Kg CH_4 pr hd pr yr	VS kg dm pr hd pr day	Digestibility %	Liquid/slurry %	IEF kg CH_4 pr hd pr yr
Swine	0.5	75		3.0			91	2.6
Sows (incl. piglets until 7 kg)					0.70	81		6.7
Piglets (7-30 kg)					0.14	81		1.5
Slaugther pigs (30-104kg)					0.40	81		4.0

N_2O emission

The N_2O emission from manure management is based on the amount of nitrogen in the manure in stables. The emission from manure deposits on grass is included in "Animal Production" (Section 6.4.2.2). The IPCC default emission values are applied, i.e. 2.0 % of the N-excretion for solid manure, 0.1 % for liquid manure and 0.5 % from poultry in stable systems without bedding. Nitrogen from poultry, without bedding, contributes less than 1 % to the total amount of nitrogen in manure.

The total amount of nitrogen in manure has decreased by 5 % from 1990 to 2007 (Table 6.16), despite the increasing production of pigs and poultry. This reduction is particularly due to an improvement in fodder efficiency, especially for slaughter pigs. A decrease in total amount of nitrogen means also a decrease for the N_2O emission. Another reason for the decreased N_2O emission is the lower emission factor for liquid manure than for solid manure. The development from the previous more traditional tethering systems with solid manure to slurry based system leads to a reduction in the emission of N_2O.

It is important to point out that the N-excretion rates shown in Table 6.16 are values weighted for the subcategories (Table 6.3). N-excretion reflects nitrogen excreted pr animal pr year. The variations in N-excretion in the time-series reflect changes in feed intake, fodder efficiency and allocation of subcategories.

Table 6.16 Nitrogen excretion, annual average 1990 – 2007, kg N pr head pr yr.

CRF table 4.B(b)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Livestock category										
Non-dairy	36.57	36.68	36.80	36.92	36.64	36.56	36.62	36.74	36.71	36.98
Dairy cattle	129.49	128.63	127.76	126.89	126.06	125.22	125.09	124.94	124.82	124.60
Sheep	21.18	21.33	21.47	21.61	21.76	21.90	20.11	18.32	16.53	14.75
Goats	21.18	21.33	21.47	21.61	21.76	21.90	20.11	18.32	16.53	14.75
Swine	11.62	11.43	11.17	10.40	10.38	9.62	9.89	9.74	9.65	9.83
Poultry	0.65	0.66	0.58	0.59	0.66	0.62	0.60	0.62	0.62	0.57
Horses	48.89	47.77	46.66	45.54	44.42	43.31	43.31	43.31	43.31	43.31
Fur farming	4.90	4.83	4.80	4.75	4.70	4.65	4.66	4.65	4.64	4.63
N-excretion, total, Gg N pr yr	293	291	293	293	283	274	275	274	279	270
N-excretion, stable, Gg N pr yr	258	256	258	257	248	238	239	239	244	236
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Livestock category										
Non-dairy	37.20	37.61	37.59	37.44	38.39	38.74	38.00	44.93		
Dairy cattle	125.31	125.31	127.74	129.79	131.56	133.30	134.66	137.58		
Sheep	16.95	16.95	16.95	16.95	16.95	16.95	16.95	16.95		
Goats	16.95	16.95	16.36	16.36	16.36	16.36	16.36	15.41		
Swine	9.65	9.17	9.58	9.25	9.48	8.97	8.55	8.96		
Poultry	0.55	0.57	0.59	0.66	0.75	0.73	0.63	0.59		
Horses	43.31	43.31	43.31	43.31	43.31	43.31	43.31	39.56		
Fur farming	4.63	4.62	4.61	4.61	5.09	5.38	5.18	5.18		
N-excretion, total, Gg N pr yr	271	273	276	270	274	271	259	277		
N-excretion, stable, Gg N pr yr	237	239	243	241	247	246	237	255		

The reduced effects from biogas-treated slurry are included in the N_2O-emission from manure management. No description in IPCC Reference Manual or GPG refers how to provide this reduction, why this estimation is based on Danish studies (Nielsen et al. 2002, Sommer et al. 2001). The reduced N2O emission is calculated as:

$$N_2O - N_{reduction} = N_{i,slurry,treated} \cdot N_{content} \cdot R_{N_2O,potential} \cdot EF_{N_2O}$$

Where; N_2O-N $_{reduction}$ is the reduction in the amount of N_2O, N $_{i,\ slurry,\ treated}$ is the total amount of N in treated slurry from livestock type *i*, R $_{N20,\ potential}$ is the reduction potential (Table 6.17). For the emission factor for N_2O emission EF_{N2O} IPCC default is used (1.25 percent).

Tabel 6.17 Key model parameters for reduction in N_2O emission due to biogas plants.

	Total N in treated slurry, %[a]	$R_{N2O,\ potential}$, %[b]
Cattle	0.538	36
Swine	0.541	40

[a] Poulsen et al. 2001

[b] Nielsen et al. 2002, Sommer et al. 2001

Due to the biogas plants, the national emission of N_2O is reduced by 0.06 Gg N_2O (Table 6.18 and Annex 3D Table 8), which correspond a 3 % reduction of the N_2O emission from manure management in 2007.

Table 6.18 Reduced N_2O emissions from biogas-treated slurry 1990 – 2007.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Energy production, TJ	230	388	473	556	658	772	830	1 005	1 222	1 253
Amount of treated slurry, Mt										
- cattle	0.09	0.14	0.18	0.21	0.24	0.29	0.31	0.37	0.45	0.47
- swine	0.10	0.18	0.21	0.25	0.30	0.35	0.38	0.46	0.56	0.57
Total reduced emission, Gg N_2O	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Energy production, TJ	1 408	1 524	1 747	2 133	2 276	2 338	2 585	2 603		
Amount of treated slurry, Mt										
- cattle	0.52	0.57	0.65	0.79	0.85	0.87	0.96	0.97		
- swine	0.64	0.69	0.79	0.97	1.03	1.06	1.18	1.18		
Total reduced emission, Gg N_2O	0.03	0.03	0.04	0.05	0.05	0.05	0.06	0.06		

6.3.3 Time-series consistency

In Table 6.19, the national emission from manure management from 1990 to 2007 is shown. The N_2O emission has decreased by 15 %. The national emission from manure management has, nevertheless, increased by 10 % in CO_2 equivalents due to the increase in the CH_4 emission.

Table 6.19 Emissions of N_2O and CH_4 from Manure Management 1990 – 2007.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N_2O emission										
Liquid manure, Gg N_2O	0.31	0.31	0.31	0.31	0.30	0.28	0.28	0.28	0.29	0.28
Solid manure, Gg N_2O	1.90	1.90	1.91	1.91	1.86	1.80	1.81	1.81	1.84	1.78
Total, Gg N_2O	2.21	2.20	2.22	2.21	2.15	2.09	2.09	2.10	2.13	2.06
Total, Gg CO_2 eqv.	686	683	687	686	668	647	648	650	660	639
CH_4 emission										
Total, Gg CH_4	35.77	37.62	40.26	42.81	41.41	41.31	41.96	42.60	44.41	43.77
Total, Gg CO_2 eqv.	751	790	846	899	870	867	881	895	933	919
Total Manure Management, Gg CO_2 eqv.*	1 438	1 473	1 533	1 585	1 537	1 514	1 529	1 544	1 593	1 558
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
N_2O emission										
Liquid manure, Gg N_2O	0.29	0.29	0.30	0.30	0.31	0.31	0.30	0.27		
Solid manure, Gg N_2O	1.68	1.69	1.64	1.57	1.61	1.59	1.49	1.63		
Total, Gg N_2O	1.97	1.98	1.94	1.87	1.91	1.90	1.79	1.89		
Total, Gg CO_2 eqv.	611	613	601	581	593	588	555	586		
CH_4 emission										
Total, Gg CH_4	45.44	47.16	47.91	48.23	49.47	48.81	49.63	49.90		
Total, Gg CO_2 eqv.	954	990	1 006	1 013	1 039	1 025	1 042	1 048		
Total Manure Management, Gg CO_2 eqv.*	1 565	1 603	1 607	1 593	1 632	1 613	1 597	1 634		

* Incl. the reduction from biogas treated slurry.

6.4 N_2O emission from Agricultural Soils (CRF Sector 4D)

6.4.1 Description

The N_2O emissions from agricultural soils, CRF Table 4.D, contribute, in 2007 with 56 % of the national emission from the agricultural sector. Figure 6.3 shows the distribution and the development from 1990 to 2007 according to different sources. The main part of the emission originates as direct emission. The largest sources here are manure and fertiliser applied on agricultural soils. Another large source is the indirect N_2O emission, of which the emission from nitrogen leaching is an essential part. The category "Other" includes the emission from sewage sludge and sludge from industry used as fertiliser.

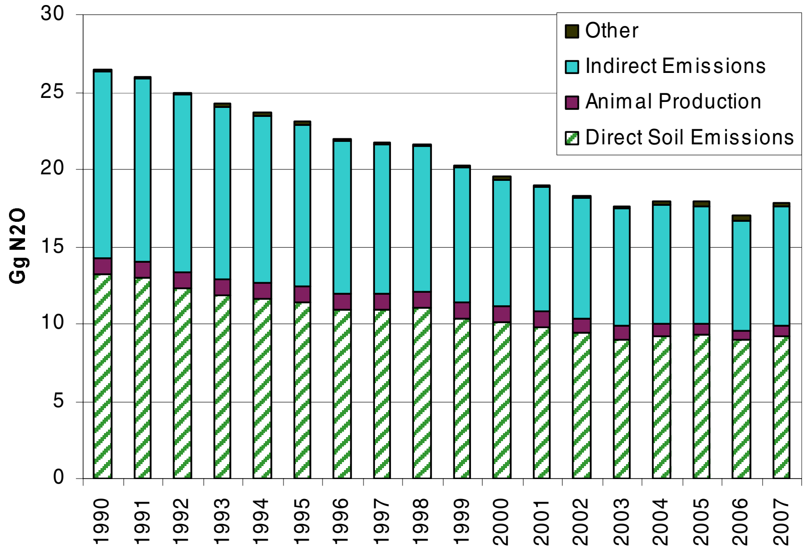


Figure 6.3 N_2O emissions from agricultural soils 1990 - 2007.

6.4.2 Methodological issues

Emissions of N_2O are closely related to the nitrogen balance. The IPCC Tier 1a methodology is used to calculate the N_2O emission. The N_2O emission factors for all sources are based on the default values given in IPCC (2000), except for cultivation of histosols, which is based on a national factor. National data for the evaporation of ammonia is applied from the ammonia emission inventory, which is described in more detail in Mikkelsen et al. 2006 and Denmark's annual inventory report, due to the UNECE-Convention on Longe-Range Transboundary Air Pollution (Nielsen et al., 2008). These reports are available on the internet. A N_2O emission factor survey is presented in Table 6.20. The estimated emissions from the different sub-sources are described in brief in the text which follows.

Table 6.20 Emissions factor - N_2O emission from the Agricultural Soils 1990 – 2007.

Agricultural soils – emission sources CRF Table 4.D	Ammonia emission (national data)	N_2O emission (national value)	N_2O emission (IPCC default value)
			kg N_2O -N pr kg N
1. Direct Soil Emissions			
Synthetic Fertiliser Applied to Soils			0.0125
Animal Wastes Applied to Soils	NH_3 emission = (31-25 %)		0.0125
N-fixing Crops			0.0125
Crop Residue			0.0125
Cultivation of Histosols		2.8 – 3.1 kg N_2O-N pr ha	
2. Animal Production	NH_3 emission = 7 %		0.02
3. Indirect Soil Emissions			
Atmospheric Deposition			0.01
Nitrogen Leaching and Runoff			0.025
4. Other			
Industrial Waste Used as Fertiliser			0.0125
Sewage Sludge Used as Fertiliser			0.0125

Direct emissions

Synthetic fertiliser

The amount of nitrogen (N) applied to soil via use of synthetic fertiliser is estimated from sales estimates from the Danish Plant Directorate, the source for the FAO database. Table 6.21 shows the consumption of each fertiliser type. Furthermore, the ammonia emission factor for each fertiliser is given, based on the values given in EMEP/EEA (2009). The Danish value for the FracGASF is estimated at 0.02 and is considerably lower than the recommended default value in IPCC, i.e. 0.10. The ammonia emission depends on fertiliser type and the major part of the Danish emission is related to the use of calcium ammonium nitrate and NPK fertiliser, where the emission factor is 0.01 kg NH_3-N pr kg N. The low Danish FracGASF is also due to the small consumption of urea (<1%), which has a high emission factor.

Table 6.21 Synthetic fertiliser consumption 2007 and the NH_3 emission factors.

Synthetic fertiliser year 2007	NH_3 Emission factor[1] kg NH_3-N pr kg N	Consumption[2] t N
Fertiliser type		
Calcium and boron calcium nitrate	0.01	0.2
Ammonium sulphate	0.02	4.5
Calcium ammonium nitrate and other nitrate types	0.01	83.4
Ammonium nitrate	0.01	6.9
Liquid ammonia	0.02	3.9
Urea	0.13	0.5
Other nitrogen fertiliser	0.06	18.1
Magnesium fertiliser	0.01	0.0
NPK-fertiliser	0.01	66.8
Diammonphosphate	0.01	0.6
Other NP fertiliser types	0.01	4.2
NK fertiliser	0.01	5.5
Total consumption of N in synthetic fertiliser		194.6
National emission of NH_3-N, M kg	3.69	
Average NH_3-N emission (FracGASF)	0.02	

[1] EMEP/EEA (2009)

[2] The Danish Plant Directorate

The use of mineral fertiliser includes fertiliser used in parks, golf courses and private gardens. 1 % of the mineral fertiliser can be related to these uses outside the agricultural area.

As a result of increasing requirements for improved use of nitrogen in livestock manure and reduce the nitrogen loss to the environment, the consumption of nitrogen in synthetic fertiliser has more than halved from 1990 to 2007 (Table 6.22).

Table 6.22 Nitrogen applied as fertiliser to agricultural soils 1990 – 2007.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N content in synthetic fertiliser, Gg N	400	395	370	333	326	316	291	288	283	263
NH_3-N emission, Gg NH_3-N	7	7	6	6	6	6	5	5	5	4
N in fertiliser applied on soil, Gg N	393	388	363	327	320	310	286	283	279	258
N_2O emission, Gg N_2O	7.72	7.62	7.13	6.42	6.28	6.09	5.61	5.56	5.47	5.08
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
N content in synthetic fertiliser, Gg N	251	234	211	201	207	206	192	195		
NH_3-N emission, Gg NH_3-N	4	4	3	3	4	4	4	4		
N in fertiliser applied on soil, Gg N	247	230	207	198	203	203	188	191		
N_2O emission, Gg N_2O	4.86	4.51	4.07	3.89	3.99	3.98	3.70	3.75		

Manure applied to soil

The amount of nitrogen applied to soil is estimated as the N-excretion in stables minus the ammonia emission, which occur in stables, under storage and in relation to the application of manure. These values are based on national estimations and are calculated in the ammonia emission inventory (Table 6.23). The total N-excretion in stables from 1990 to 2007 has decreased by 1 %. Despite this reduction in N-excretion, the amount of nitrogen applied to soil remains almost unaltered, due to the reduction in the ammonia emission.

Table 6.23 Nitrogen applied as manure to agricultural soils 1990 - 2007

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N-excretion, stable, Gg N	258	256	258	257	248	238	239	239	244	236
N ab Storage, Gg N	214	213	214	216	207	200	201	199	203	199
NH_3-N emission from application, Gg NH_3-N	35	34	33	31	29	27	25	25	25	25
N in manure applied on soil, Gg N	179	179	181	184	178	174	175	174	178	175
N_2O emission, Gg N_2O	3.51	3.52	3.56	3.62	3.50	3.41	3.45	3.43	3.50	3.43
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
N-excretion, stable, Gg N	237	239	243	241	247	246	237	255		
N ab Storage, Gg N	198	200	203	203	207	207	202	214		
NH_3-N emission from application, Gg NH_3-N	25	24	22	27	24	24	23	25		
N in manure applied on soil, Gg N	173	176	181	176	183	184	179	189		
N_2O emission, Gg N_2O	3.41	3.46	3.56	3.46	3.60	3.61	3.51	3.71		

The FracGASM express the fraction of total N-excretion (N ab animal) that is volatilised as ammonia emission in stables, storage and application. The FracGASM has decreased from 0.26 in 1990 to 0.20 in 2007 (Table 6.24). This is the result of an active strategy to improve the utilisation of the nitrogen in manure.

Table 6.24 FracGASM 1990 – 2007.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total N-excretion, Gg N	293	291	293	293	283	274	275	274	279	270
NH_3-N emission from manure, Gg NH_3-N	79	78	77	76	72	68	66	67	68	66
FracGASM	0.26	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.24	0.24
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Total N-excretion, Gg N	271	273	276	270	274	271	259	277		
NH_3-N emission from manure, Gg NH_3-N	66	66	65	68	66	63	61	83		
FracGASM	0.23	0.23	0.23	0.21	0.20	0.19	0.20	0.20		

N-fixing crops

To estimate the emission from N-fixing crops, IPCC Tier 1b is applied. The emission calculated is based on nitrogen content, the fraction of dry matter and the content of protein for each harvest crop type. Data for crop yield is based on data from Statistics Denmark. For nitrogen content in the plants, the data is taken from Danish feedstuff tables (Danish Agricultural Advisory Centre). The estimates for the amount of nitrogen fixed in crops are made by the Danish Institute of Agricultural Science (Kristensen 2003, Høgh-Jensen et al. 1998, Kyllingsbæk 2000).

$$N_2O\text{ - }N_{N\text{-fix}} = \sum (Ts_{i,\text{ yield}} \cdot N_{i,\text{ pct}} \cdot (1 + N_{i,\text{ pct in root and stubble}}) \cdot A_{\text{pct fix}}) \cdot EF_{N2O}$$

Where; N_2O-N is the nitrous oxide emission, Ts_{iyield} is the dry matter, yield, kg pr ha for croptype *i*, $N_{i,pc}$ is the nitrogen percentage in dry matter, $N_{i,pct\ root\ +\ stubble}$ is the nitrogen percentage in root and stubble, $A_{pct\ fix}$ is the percentage of nitrogen which is fixed and for the emission factor for N_2O emission EF_{N2O} the IPCC standard value of 1.25 percent is used.

The Danish inventory includes emissions from clover-grass, despite the fact that this source is not mentioned in the IPCC GPG. Area with grass and clover covered approximately 17 % of the total agricultural area in 2007 and, for this reason, represents an important contributor to the national emission from N-fixing crops.

In Table 6.25 the background data for estimating the N-fixing is listed. The emission from N-fixing crops decreases from 1990-2007, largely due to a reduction in agricultural area.

Table 6.25 Emissions from N-fixing crops 2007.

N_2O emission from nitrogen fixing crops	Dry matter Fraction, %	N-Fraction, % of DM	N-fixing variations 1990-2006, kg N pr ha	N-fixing 2006, kg N pr ha	N-fixing total 2006, kg N fix	N_2O Emission, Gg N_2O
Pulses*	0.85	0.0337	96-179	128	723	0.014
Lucerne	0.21	0.0064	307-517	455	1 675	0.033
Cereals and pulses for green fodder	0.23	0.0061	14-38	23	1 367	0.027
Pulses, fodder cabbage etc.	0.23	0.0061	0-1	NO	NO	NO
Peas for canning*	0.85	0.0337	76-144	103	281	0.006
Seeds for sowing	NE	NE	181-186**	182	990	0.019
Grass and clover field in rotation	0.13	0.0052	40-102	102	26 776	0.526
Grass and clover outside rotation	0.13	0.0052	6-11	7	1 393	0.027
Aftermath	0.13	0.0052	6-16	13	1 596	0.031
Total N-fix					34 801	
Total N_2O emission						0.684

* Dry matter content for straw is 0.87 and the N-fraction is 0.010.

** Average - assumed that N-fix for red clover is 200 kg N pr ha and 180 kg N pr ha for white clover (Kyllingsbæk 2000).

Crop residue

N_2O emissions from crop residues are calculated as the total above-ground quantity of crop residue returned to soil. For cereals, the above-ground residues are calculated as the amount of straw plus stubble and husks. The total amount of straw is given in the annual census and reduced by the amount used for feeding, bedding and biofuel in power plants. Straw for feed and bedding is subtracted because this quantity of removed nitrogen returns to the soil via manure.

$$N_2O - N_{crop\ residue,j} = \sum_{1}^{N} ha_{i,j} \cdot \left(\left(\frac{N_{i,stubble}}{N_{i,ploughing\ frequency}}\right) + N_{husks} + N_{i,tops} + N_{i,leafs}\right) \cdot EF_{N2O}$$

Where; i is the crop type, j is the year, ha is the area on which the crop is grown, N_i is nitrogen derived from husks, stubble, plant tops and leaf debris in kg ha^{-1}, $N_{i,\ plouging\ frequency}$ is the number of years between ploughing and EF_{N2O} is the IPCC standard emission factor 1.25 %.

National values for nitrogen content are used provided by the Faculty of Agricultural Sciences (Djurhuus and Hansen 2003). It is calculated based on relatively few observations, but is at present the best available data. Data for yield and area cultivated are collected from Statistic Denmark. Background data is given in Annex 3D, Table 7.

The national emission from crop residues has decreased 12 % from 1990 to 2007 (Table 6.26). This decrease and the fall in $Frac_R$ is a result of a decrease in the cultivated area of beets for feeding, which has been replaced by cultivation of green maize. Another reason is a fall in the agricultural area and a greater part of the straw is harvest – 52 % in 1990 and 60 % in 2007.

Table 6.26 Emissions from crop residue 1990 – 2007.

Crop residue	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Stubble	18.9	18.5	19.0	19.1	18.3	18.2	18.7	18.8	18.9	18.7
Husks	11.4	11.1	11.8	11.4	11.5	11.6	12.3	12.5	12.6	11.8
Top of beets and potatoes	7.1	7.1	6.7	7.2	6.1	5.8	5.9	5.5	5.7	5.4
Leafs	6.8	6.7	6.7	10.1	10.4	10.3	9.7	8.1	7.9	8.7
Straw	15.1	14.3	6.1	3.9	5.4	10.4	10.7	11.6	11.4	10.1
Crop residue, total, Gg N	59.3	57.7	50.3	51.7	51.7	56.2	57.2	56.5	56.5	54.7
N_2O emission, Gg	1.17	1.13	0.99	1.01	1.02	1.10	1.12	1.11	1.11	1.07
$Frac_R$	0.31	0.30	0.32	0.37	0.34	0.29	0.27	0.28	0.28	0.27
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Stubble	18.6	18.6	18.3	17.6	17.0	17.6	17.8	17.4		
Husks	12.0	12.3	11.5	12.0	12.0	12.3	12.4	12.1		
Top of beets and potatoes	5.3	5.2	5.5	4.9	5.0	4.9	4.4	4.5		
Leafs	9.0	9.2	9.1	9.1	8.5	9.4	9.4	9.2		
Straw	10.8	11.6	9.0	9.0	10.7	10.2	10.0	9.3		
Crop residue, total, Gg N	55.7	57.0	53.4	52.5	53.3	54.4	54.1	52.4		
N_2O emission, Gg	1.09	1.12	1.05	1.03	1.05	1.07	1.06	1.03		
$Frac_R$	0.27	0.24	0.27	0.26	0.23	0.24	0.23	0.24		

Cultivation of histosols

N_2O emissions from histosols are based on the area with organic soils multiplied by the emission factor for C, the C:N relationship for the organic matter in the histosols and an emission factor of 1.25 of the total amount of released N. See the LULUCF section for further description.

Table 6.27 Activity data – cultivation of histosols, ha.

CRF – Table 4.D	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Cultivated histosols	77 987	77 371	77 100	82 211	84 818	83 003	81 594	77 010	76 827	77 346
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Cultivated histosols	78 412	79 665	78 688	78 992	77 420	82 187	82 309	81 099		

Animal production

The amount of nitrogen deposited on grass is based on estimations from the ammonia inventory. It is assumed that 5 %, on average, of the nitrogen from dairy cattle and heifers is excreted on grass (expert judgement from the Danish Agricultural Advisory Centre – Aaes, O.). N-excretion on grass has decreased due to a reduction in the number of dairy cattle. An ammonia emission factor of 7 % is used for all animal categories based on investigations from the Netherlands and the United Kingdom (Jarvis et al. 1989a, Jarvis et al., 1989b and Bussink 1994).

Table 6.28 Nitrogen excreted on grass 1990 - 2007

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N-excretion, grass, Gg N	34	35	35	36	35	36	36	35	35	34
NH_3-N emission, Gg NH_3-N	2	2	2	3	2	2	3	2	2	2
N deposited on grass, Gg N	32	33	33	33	33	33	33	32	32	31
N_2O emission, Gg	1.01	1.03	1.03	1.05	1.03	1.04	1.05	1.02	1.01	0.99
FracGRAZ	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.12	0.13
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
N-excretion, grass, Gg N	34	34	33	30	27	24	22	23		
NH_3-N emission, Gg NH_3-N	2	2	2	2	2	2	2	2		
N deposited on grass, Gg N	32	32	31	27	25	23	21	21		
N_2O emission, Gg	0.99	1.01	0.97	0.86	0.79	0.71	0.65	0.66		
FracGRAZ	0.13	0.13	0.12	0.11	0.10	0.09	0.09	0.09		

$Frac_{GRAZ}$ is estimated as the volatile fraction from grazing animals compared with the total excreted nitrogen (N ab animal) (Table 6.28). The decrease in $Frac_{GRAZ}$ is due to fall in the production of grassing animals e.g. cattle and a readjustment of the nitrogen from dairy cattle excreted on grass (2003-2007).

Indirect emissions

Atmospheric deposition

Atmospheric deposition includes all ammonia emissions sources included in the Danish ammonia emission inventory (Nielsen et al. 2008). This includes the emission from livestock manure, use of synthetic fertiliser, crops, ammonia-treated straw used as feed and sewage sludge plus sludge from industrial production applied to agricultural soils.

The emission from atmospheric deposition has decreased from 1990 – 2007 as a result of the reduction in the total ammonia emission, from 99900 tonnes of NH_3-N in 1990 to 91500 in 2007.

Table 6.29 Ammonia emission 2007.

Ammonia emission	2007
	t NH_3-N
Manure	83 400
Synthetic fertiliser	3 700
Crops	4 300
NH_3 treated straw*	NO
Sewage sludge and sludge from the industrial production	100
Emission total	91 500
N_2O emission, Gg	1.44

*Ammonia treated straw has been prohibited from 2006.

Nitrogen leaching and Run-off

The amount of nitrogen lost by leaching and run-off from 1986 to 2002 has been calculated by FAS. The calculation is based on two different model predictions, SKEP/Daisy and N-Les2 (Børgesen and Grant, 2003), and for both models measurements from field studies are taken into account. SKEP/DAISY is a dynamical crop growth model taking into account the growth factors (Annex 3D 1.4), where as N-Les2 is an empirical leaching model based on more than 1200 leaching studies performed in Denmark from the middle of the 1980'th to 2002 (Annex 3D 1.4). The results of the two models differ only marginally. The average of the two model predictions is used in the emission inventory.

Figure 6.4 shows leaching estimated in relation to the nitrogen applied to agricultural soils as livestock manure, synthetic fertiliser and sludge. The average proportion of nitrogen leaching and runoff has decreased from 39 % in the middle of the nineties to 34 % in 2002. 33.5 % is used in the calculations for 2002-2005 and 33 % for 2006 and 2007. The decline is due to an improvement in the utilisation of nitrogen in manure. The reduction in nitrogen applied is particularly due to the fall in the use of synthetic fertiliser, which has reduced by 51 % from 1990 to 2007.

The proportion of N input to soils lost through leaching and runoff ($Frac_{LEACH}$) used in the Danish emission inventory is higher than the default value of the IPCC (30 %). The high values are partly due to the humid Danish climate, with the precipitation surplus during winter causing a downward movement of dissolved nitrogen. $Frac_{LEACH}$ has decreased from 1990 and onwards. At the beginning of 1990s, manure was often applied in autumn. Now the main part of manure application takes place in the spring and early summer, where there are nearly now downward movements of soil water. The decrease in $Frac_{LEACH}$ over time is due to increasing environmental requirements and banning manure application after harvest. The data based on model estimates from FAS and NERI reflects the Danish conditions and is considered as a best estimate.

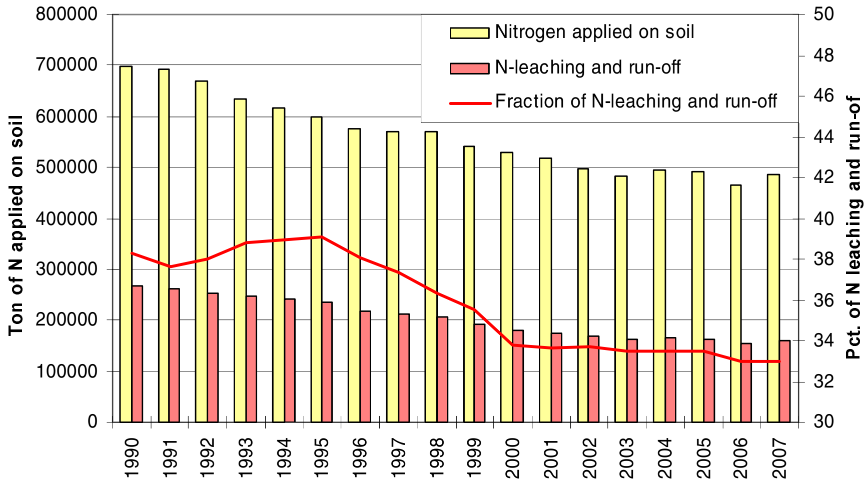


Figure 6.4 Nitrogen applied to agricultural soils and N-leaching from 1990 to 2007.

Other Emissions

The category, "Other", includes emission from sewage sludge and sludge from the industrial production applied to agricultural soils as fertiliser. Information about industrial waste, sewage sludge applied on agricultural soil and the content of nitrogen is provided by the Danish Environmental Protection Agency. It is assumed that 1.9 % of N-input applied to soil volatises as ammonia.

Table 6.30 Emission from sludge applied on agricultural soils 1990 – 2007.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Nitrogen in sewage sludge, t N	3 115	3 207	3 847	4 935	4 446	4 635	4 545	3 973	3 750	3 669
Nitrogen in industrial waste, t N	1 529	2 732	3 023	4 519	4 500	4 500	4 630	4 514	5 110	4 364
NH_3-N emission, t NH_3-N	58	60	72	93	83	87	85	74	70	69
N applied as fertiliser to the soil, t N	4 586	5 879	6 797	9 362	8 863	9 048	9 090	8 413	8 790	7 965
N_2O emission, Gg N_2O	0.09	0.12	0.13	0.18	0.17	0.18	0.18	0.17	0.17	0.16
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Nitrogen in sewage sludge, t N	3 625	3 518	3 600	3 572	3 440	3 604	3 604	3 604		
Nitrogen in industrial waste, t N	5 147	7 274	8 000	8 000	10 000	10 000	11 000	11 000		
NH_3-N emission, t NH_3-N	68	66	67	67	64	68	68	68		
N applied as fertiliser to the soil, t N	8 705	10 726	11 532	11 505	13 375	13 536	14 536	14 536		
N_2O emission, Gg N_2O	0.17	0.21	0.23	0.23	0.26	0.27	0.29	0.29		

6.4.3 Activity data

Table 6.31 provides an overview on activity data from 1990 to 2007 used in relation to the estimation of N_2O emission from agricultural soils. The amount of nitrogen applied to agricultural soil has decreased from 1080 Gg N to 755 Gg N, corresponding to a 30 % reduction, which results in a lower N_2O emission.

Table 6.31 Activity data - agricultural soils 1990 – 2007, Gg N

CRF – Table 4.D	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total amount of nitrogen applied on soil	1080	1060	1016	987	961	937	896	890	890	835
1. Direct Emissions										
Synthetic Fertiliser	393	388	363	327	320	310	286	283	279	258
Animal Waste Applied	179	179	181	184	178	174	175	174	178	175
N-fixing Crops	44	39	33	42	40	37	36	43	48	39
Crop Residue	59	58	50	52	52	56	57	56	56	55
2. Animal Production	32	33	33	33	33	33	33	32	32	31
3. Indirect Emissions										
Atmospheric Deposition	100	96	95	93	89	83	80	80	80	76
N-leaching and Runoff	267	261	254	247	241	234	219	213	207	192
4. Other										
Industrial Waste	2	3	3	5	5	5	5	5	5	4
Sewage Sludge	3	3	4	5	4	5	5	4	4	4
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Total amount of nitrogen applied on soil	811	790	762	735	749	747	713	755		
1. Direct Emissions										
Synthetic Fertiliser	247	230	207	198	203	203	188	191		
Animal Waste Applied	173	176	181	176	183	184	179	189		
N-fixing Crops	38	36	36	31	30	34	35	35		
Crop Residue	56	57	53	53	53	54	54	52		
2. Animal Production	32	32	31	27	25	23	21	21		
3. Indirect Emissions										
Atmospheric Deposition	76	75	73	76	75	71	69	92		
N-leaching and Runoff	179	174	168	162	166	164	154	161		
4. Other										
Industrial Waste	5	7	8	8	10	10	11	11		
Sewage Sludge	4	4	4	4	3	4	4	4		

6.4.4 Time-series consistency

The N_2O emissions from agricultural soils have reduced by 32 % from 1990 to 2007. This is largely due to a decrease in the use of synthetic fertiliser and a decrease in N-leaching as a result of national environmental policy, where action plans have focused on decreasing the nitrogen losses and on improving the nitrogen utilisation in manure.

Table 6.32 Emissions of N_2O from Agricultural Soils 1990 – 2007, Gg N_2O.

CRF – Table 4.D	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total N_2O emission	26.82	26.32	25.35	24.64	24.02	23.43	22.34	22.09	21.97	20.60
1. Direct Emissions	13.65	13.42	12.70	12.26	11.96	11.69	11.25	11.30	11.38	10.70
Synthetic Fertiliser	7.72	7.62	7.13	6.42	6.28	6.09	5.61	5.56	5.47	5.08
Animal Waste Applied	3.51	3.52	3.56	3.62	3.50	3.41	3.45	3.43	3.50	3.43
N-fixing Crops	0.87	0.76	0.64	0.83	0.78	0.73	0.70	0.85	0.94	0.76
Crop Residue	1.17	1.13	0.99	1.01	1.02	1.10	1.12	1.11	1.11	1.07
Cultivation of Histosols	0.38	0.37	0.37	0.37	0.38	0.36	0.36	0.36	0.36	0.36
2. Animal Production	1.01	1.03	1.03	1.05	1.03	1.04	1.05	1.02	1.01	0.99
3. Indirect Emissions	12.07	11.75	11.49	11.15	10.86	10.52	9.86	9.60	9.40	8.75
Atmospheric Deposition	1.57	1.52	1.49	1.46	1.40	1.31	1.26	1.25	1.26	1.20
N-leaching and Runoff	10.50	10.24	10.00	9.69	9.46	9.21	8.60	8.36	8.14	7.55
4. Other	0.09	0.12	0.13	0.18	0.17	0.18	0.18	0.17	0.17	0.16
Industrial Waste	0.03	0.05	0.06	0.09	0.09	0.09	0.09	0.09	0.10	0.09
Sewage Sludge	0.06	0.06	0.07	0.10	0.09	0.09	0.09	0.08	0.07	0.07
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Total N_2O emission	19.88	19.38	18.68	18.00	18.31	18.25	17.37	18.23		
1. Direct Emissions	10.47	10.15	9.75	9.35	9.57	9.70	9.32	9.54		
Synthetic Fertiliser	4.86	4.51	4.07	3.89	3.99	3.98	3.70	3.75		
Animal Waste Applied	3.41	3.46	3.56	3.46	3.60	3.61	3.51	3.71		
N-fixing Crops	0.75	0.70	0.72	0.62	0.59	0.67	0.68	0.68		
Crop Residue	1.09	1.12	1.05	1.03	1.05	1.07	1.06	1.03		
Cultivation of Histosols	0.36	0.36	0.35	0.35	0.35	0.37	0.37	0.36		
2. Animal Production	0.99	1.01	0.97	0.86	0.79	0.71	0.65	0.66		
3. Indirect Emissions	8.25	8.02	7.74	7.56	7.68	7.57	7.12	7.75		
Atmospheric Deposition	1.20	1.18	1.15	1.20	1.17	1.12	1.08	1.44		
N-leaching and Runoff	7.05	6.84	6.59	6.36	6.51	6.45	6.04	6.31		
4. Other	0.17	0.21	0.23	0.23	0.26	0.27	0.29	0.29		
Industrial Waste	0.10	0.14	0.16	0.16	0.20	0.20	0.22	0.22		
Sewage Sludge	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07		

6.5 NMVOC emission

Less than 1 % of the NMVOC emission originates from the agricultural sector, which, in the Danish emission inventory, includes emission from arable land crops and grassland. Activity data is obtained from Statistics Denmark. The emission factor for land with arable crops is 393 g NMVOC pr ha and for grassland, 2120 g NMVOC pr ha (Fenhann and Kilde 1994), (Priemé and Christensen 1991).

Table 6.33 NMVOC emission from agricultural soils 1990 – 2007.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Arable crops, 1000 ha	2 322	2 307	2 293	2 254	2 044	2 064	2 075	2 138	2 125	2 064
Grassland, 1000 ha	466	462	463	484	647	446	450	403	405	398
NMVOC emission, Gg	1.90	1.89	1.88	1.91	2.18	1.76	1.77	1.69	1.69	1.65
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Arable crops, 1000 ha	2 043	2 060	2 065	2 062	2 079	2 086	2 083	2 050		
Grassland, 1000 ha	413	414	396	390	369	446	460	459		
NMVOC emission, Gg	1.68	1.69	1.65	1.64	1.60	1.77	1.79	1.78		

6.6 Uncertainties

Table 6.34 shows the estimated uncertainties for some of the emission sources, based on expert judgement (Olesen et al. 2001, Gyldenkærne, pers. comm., 2005). The uncertainties for the number of animals and the number of hectares with different crops under cultivation are very small.

Due to the large number of farms included in the norm figures, the arithmetic mean can be assumed as a very good estimate, with a low uncertainty. Cattle and pigs are the most important animal categories for Denmark. All cattle have their own ID-number (ear tags) and, hence, the uncertainty in this number is almost non-existent. Statistics Denmark has estimated the uncertainty in the number of pigs to be less than 1 %. The combined effect of low uncertainty in actual animal numbers, feed consumption and excretion rates gives a very low uncertainty in the activity data. The major uncertainty, therefore, relates to the emission factors.

The normative figures (Poulsen et al. 2001) are arithmetic means. Based on the feeding plans, the standard deviation in N-excretion rates between farms can be estimated to ±20 % for all animal types (Hanne D. Poulsen, FAS, pers. comm).

In general, the Tier 1 uncertainty is used in the emission factors. A normal distribution is assumed. In the future it will be considered to investigate the possibilities to use Tier 2 uncertainties calculation to improve the outcome from the uncertainty analysis.

The highest uncertainty is connected with manure management. The emission factor for CH_4 from manure management is 10 %. This figure may be underestimated and the uncertainty is, therefore, increased to 100 % until further investigations reveal new data.

Table 6.34 Estimated uncertainties associated with activities and emission factors for CH_4 and N_2O.

Source	Emission	Emission, Gg CO_2-eqv.	Activity data, %	Emission factor, %	Combined uncertainty	Total uncertainty, %	Uncertainty 95 % Gg CO_2-eqv.
4 Agriculture - total	CH_4 and N_2O	10 072				19	1 865
4.A Enteric Fermentation	CH_4	2 787	10	8	13	13	357
4.B Manure Management	CH_4 and N_2O	1 634	7	73	74	74	1 207
	CH_4 – Table 4.B(a)	1 048	10	100	100		
	N_2O – Table 4.B(b)	586	10	100	100		
4.D Agricultural Soils	N_2O	5 652	7	23	24	24	1 377
4.D1 Direct soil emissions	N_2O	2 956	5	28	29	29	854
Synthetic Fertiliser	N_2O	1 163	3	50	50		
Animal Waste Applied to Soils	N_2O	1 149	10	50	51		
N-fixing Crops	N_2O	212	20	50	54		
Crop Residue	N_2O	319	20	50	54		
Cultivation of Histosols	N_2O	113	20	50	54		
4.D2 Animal Production	N_2O	206	20	25	32	32	66
4.D3 Indirect soil emissions	N_2O	2 490	16	40	43	43	1 078
Atmospheric Deposition	N_2O	446	10	50	51		
N-Leaching and Runoff	N_2O	1 955	20	50	54		
4.D4 Other							
4.D4 Sewage N	N_2O	22	20	50	54		
4.D4 Industrial Waste Used as Fertiliser	N_2O	67	20	50	54		

6.7 Quality assurance and quality control - QA/QC

A general QA/QC plan for the agricultural sector is under development. The following Points of Measures (PM) are taken into account in the inventory for 2007.

Data Storage level 1	1. Accuracy	DS.1.1.1	General level of uncertainty for every dataset including the reasoning for the specific values.

The following external data are in used in the agricultural sector:

- Data from the annual agricultural census made by Statistics Denmark
- The Faculty of Agricultural Sciences, University of Aarhus (FAS)
- The Danish Plant Directorate
- Danish Agricultural Advisory Centre (DAAC)
- The Danish Energy Authority
- Danish Environmental Protection Agency

The emission factors come from various sources:

- IPCC guidelines
- The Faculty of Agricultural Sciences, University of Aarhus (FAS): NH_3 emission, CH_4 emission from enteric fermentation and manure management.

Statistics Denmark

The agricultural census made by Statistics Denmark is the main supply of basic agricultural data. In Denmark, all cattle, sheep and goats have to be registered individually and hence the uncertainty in the data is negligible. For all other animal types, farms having more than 10 animal units are registered.

The Faculty of Agricultural Sciences (FAS)

FAS are responsible for the delivery of N-excretion data for all animal and housing types. Data on feeding consumption on commercial farms are collected annually by DAAC from on-farm efficacy controls. For dairy cattle, data is collected from 15-20 % of all farms, for pigs, 25-30 % and for poultry and mink, 90-100 % of all farms. The farm data are used to calculate average N-excretion from different animal and housing types. Due to the large amount of farm data involved in the dataset, N-excretion is seen as a very good estimate for average N-excretion at the Danish livestock production.

For 2007 the Faculty of Agricultural Sciences provides data for distribution of stable type.

Danish Plant Directorate

Total area with the various agricultural crops is provided to the Danish Plant Directorate via the agricultural subsidy system. For every parcel of land (via a vector-based field map with a resolution of >0.01 ha), the area planted with different crops is reported. If the total crop area within a parcel is larger than the parcel area, a manual control of the information is performed by the Plant Directorate. The area with different crops, therefore, represents a very precise estimate.

All farmers are obliged to do N-mineral accounting on a farm and field level with the N-excretion data from FAS. Data at farm level is reported annually to the Danish Plant Directorate. The N figures also include the quantities of mineral fertilisers bought and sold. Suppliers of mineral fertilisers are required to report all N sales to commercial farmers to the Plant Directorate. The total sold to farmers is very close to the amount imported by the suppliers, corrected for storage. The total amount of mineral fertiliser in Denmark is, therefore, a very precise estimate for the mineral fertiliser consumed. This is also valid for N-excretion in animal manure.

The Danish Plant Directorate, as the controlling authority, performs analysis of feed sold to farmers. On average, 1600 to 2000 samples are analysed every year. Uncertainty in the data is seen as negligible. The data are used when estimating average energy in feedstuffs for pigs, poultry, fur animals, etc.

For 2005 the Danish Plant Directorate provides data for distribution of stable type. Same estimate is used for 2006.

Danish Agricultural Advisory Centre (DAAC)

DAAC is the central office for all Danish agricultural advisory services. DAAC carries out a considerable amount of research itself, as well as collecting efficacy reports from the Danish farmers for dairy production, meat production, pig production, etc., to optimise productivity in Danish agriculture. From DAAC data on stable type until 2004, grassing situation and information on application of manure is received.

The Danish Energy Authority

The amount of slurry treated in biogas plants is received from the Danish Energy Authority.

Danish Environmental Protection Agency

Information on the sludge from waste water treatment and the manufacturing industry and the amount applied on agricultural soil is obtained from the Danish Environmental Protection Agency.

Data Storage level 1	1. Accuracy	DS.1.1.2	Quantification of the uncertainty level of every single data value including the reasoning for the specific values.

Uncertainty in the data received is very low due to the very strict environmental laws in Denmark. Standard deviation regarding the numbers of cattle and pigs has been estimated to <0.7 %. For poultry the standard deviation is <2.1 %. For all years, 25-35 % of all holdings are included in the census. The standard deviation for N-excretion between farms is reported as 25 % for dairy cattle and pigs, but due to the large numbers involved in the estimation of the average N-excretion, the average is assumed to be a precise estimate for the Danish agricultural efficacy level.

Data Storage level 1	2.Comparability	DS.1.2.1	Comparability of the data values with similar data from other countries, which are comparable with Denmark, and evaluation of discrepancy.

The Danish N-excretion levels are generally lower than IPCC default values. This is due to the highly skilled, professional and trained farmers in Denmark, with access to a highly competent advisory system.

The feed consumption pr animal is in line with similar data from Sweden, although they are not quite comparable because Denmark is using feeding units (FE) which cannot easily be converted to energy content. Earlier, one feeding unit was defined as one kg of barley. Today, the calculations are more complicated and depend on animal type.

Data Storage level 1	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included by setting down the reasoning behind the selection of datasets.

See DS 1.1.1.

Data Storage level 1	4.Consistency	DS.1.4.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PMs).

External data received are stored in the agricultural directory in NERI's IT system.

Data Storage level 1	6.Robustness	DS.1.6.1	Explicit agreements between the external institution holding the data and NERI about the conditions of delivery.

NERI has established formal data agreements with all institutes and organisations which deliver data, to assure that the necessary data is available to prepare the inventory on time.

Data Storage level 1	7.Transparency	DS.1.7.1	Summary of each dataset including the reasoning for selecting the specific dataset.

Please refer to DS 1.1.1.

Data Storage level 1	7.Transparency	DS.1.7.3	References for citation for any external data set have to be available for any single value in any dataset.

A great deal of documentation already exists in the literature list. A separate list of references is stored in: I:/rosproj/luft_emi/inventory-/2006/4_Agriculture/level_1a_storage/

Data Storage level 1	7.Transparency	DS.1.7.4	Listing of external contacts for every dataset.

Statistics Denmark:

Ole Nielsen (oni@dst.dk) and Karsten K. Larsen (kkl@dst.dk)

Faculty of Agricultural Sciences (University of Aarhus):

Mrs. Hanne Damgaard Poulsen (hannedam.poulsen@agrsci.dk)

Mr. Nick Hutchings (nick.hutchings@agrsci.dk)

The Danish Agricultural Advisory Centre:

Ole Aaes (OEA@Landscentret.dk)

Mr. Eric F. Clausen (EFC@landscentret.dk)

Danish Plant Directorate:

Mr. Troels Knudsen (tkn@pdir.dk)

The Danish Energy Authority:

Mr. Søren Tafdrup (st@ens.dk)

The Danish Environmental Protection Agency:

Mrs. Trine Leth Kølby (trile@mst.dk) and Inge Werther (iw@mst.dk)

Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to type of variability. (Distribution as: normal, log normal or other type of variability).

The Tier 1 methodology is used to calculate the uncertainties for the agricultural sector. The uncertainties are based on expert judgement (Olesen et al. 2001, Poulsen et al. 2001, Gyldenkærne, pers. comm., 2005) and a normal distribution is assumed. Further work will focus on the possibilities to carry out Monte Carlo simulations to improve the outcome from the uncertainty analysis.

Data Processing level 1	1. Accuracy	DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals).

Please refer to DP 1.1.1.

Data Processing level 1	1. Accuracy	DP.1.1.3	Evaluation of the methodological approach using international guidelines.

Denmark has recently worked out a report with a more detailed description of the methodological inventory approach (Mikkelsen et al. 2006). This report has been reviewed by the Statistics Sweden, who is responsible for the Swedish agricultural inventory. Furthermore, data sources and calculation methodology developments are discussed in cooperation with specialists and researchers in different institutes and research sections. As a consequence, both the data and methods are evaluated continually according to the latest knowledge and information.

Data Processing level 1	1. Accuracy	DP.1.1.4	Verification of calculation results using guideline values.

Enteric CH_4 emissions are, in general, lower than the IPCC default values due to the professional way farms are managed in Denmark. Enteric fermentation from dairy cows is high and comparable with North American conditions. Due to the increase in milk production pr dairy cow, there has been an increase in enteric fermentation of CH_4, and it is in line with the conditions in the USA, the Netherlands and Sweden.

The CH_4 emission from manure management is higher than the default IPCC values for Western Europe because of the higher percentage handled as slurry. However, due to the high efficacy at farm level, energy intake is lower pr head and the subsequent CH_4 emission from slurry is, thereby, lower. Denmark uses an MCF factor of 10 % as provided in the 1996 guidelines and not the 39 % in the revision to the 1996 guidelines. For further explanation, see the text in the agriculture chapter (6.3.2).

$Frac_{LEACH}$ is higher than the default IPCC values. $Frac_{LEACH}$ has decreased from 1990 and onwards. In the beginning of 1990s, manure was often applied in autumn. The high values are partly due to the humid Danish climate, with the precipitation surplus during winter causing a downward moment of dissolved nitrogen. The decrease in $Frac_{LEACH}$ over time is caused by sharpened environmental requirements, banning manure application after harvest. As a result, most manure application occurs during spring and summer, where there is a precipitation deficit. The generally accepted leaching values in Denmark are 0.3 for mineral nitrogen and 0.45 for organic-bound nitrogen. These values are based on numerical leaching studies.

Data Processing level 1	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCCC and IPCC.

The Danish emission inventory for the agricultural sector mainly meets the request as set down in the IPCC Good Practice Guidance.

Data Processing level 1	3.Completeness	DP.1.3.1	Assessment of the most important quantitative knowledge which is lacking.

All known major sources are included in the inventory.

Data Processing level 1	3.Completeness	DP.1.3.2	Assessment of the most important cases where access is lacking with regard to critical data sources that could improve quantitative knowledge.

In Denmark, only very few data are restricted (military installations). Accessibility is not a key issue; it is more lack of data.

Data Processing level 1	4.Consistency	DP.1.4.1	In order to keep consistency at a high level, an explicit description of the activities needs to accompany any change in the calculation procedure

The calculation procedure is consistent for all years.

Data Processing level 1	5.Correctness	DP.1.5.1	Show at least once, by independent calculation, the correctness of every data manipulation.

During the development of the model, thorough checks have been made by all persons involved in preparation of the agricultural section.

Data Processing level 1	5.Correctness	DP.1.5.2	Verification of calculation results using time-series.

Time-series for activity data, emission factors and national emission are performed to check consistency in the methodology, to avoid errors, to identify and explain considerable year to year variations.

Data Processing level 1	5.Correctness	DP.1.5.3	Verification of calculation results using other measures.

During the calculations, the results are checked according to the check-list.

Data Processing level 1	5.Correctness	DP.1.5.4	Shows one-to-one correctness between external data sources and the data bases at Data Storage level 2.

Output data to Data Storage Level 2 is checked for correctness according to the check-list.

Data Processing level 1	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described.

All calculation principles are described in the NIR and the documentation report (Mikkelsen et al. 2006).

Data Processing level 1	7.Transparency	DP.1.7.2	The theoretical reasoning for all methods must be described.

All theoretical reasoning is described in the NIR and the documentation report (Mikkelsen et al. 2006).

Data Processing level 1	7.Transparency	DP.1.7.3	Explicit listing of assumptions behind all methods.

All theoretical reasoning is described in the NIR and the documentation report (Mikkelsen et al. 2006).

Data Processing level 1	7.Transparency	DP.1.7.4	Clear reference to dataset at Data Storage level 1.

In the database key ids is used to identify the unique data. The data on DS level 1 is linked to the key id used in the database so a clear reference from DS level 1 to higher levels of both DP and DS is secured.

Data Processing level 1	7.Transparency	DP.1.7.5	A manual log to collect information about recalculations.

Changes compared with the last emissions report are described in the NIR and the national emission changes is given in a table under the section, "Recalculation". The text describes whether the change is caused by changes in the dataset or changes in the methodology used.

Data Storage level 2	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data types at level 2 to data at level 1.

A manual check-list is under development for correct connection between all data types at level 1 and 2.

Data Storage level 2	5.Correctness	DS.2.5.2	Check if a correct data import to level 2 has been made.

A manual check-list is under development for correctness of data import to level 2.

6.8 Recalculation

Improvements and recalculations since the 2008 emission inventory:

Improvements

On basis of the individual review in 2008 some improvements is done to meet the recommendations and proposal

It was strongly recommended to invest in a data base. This is now done and all data set are stored a data base, IAD (Inventory Agriculture Data), based on the model DIEMA. The IAD model complex is build up as a database, where activity data is stored in one database which is linked to a database were the calculations is executed.

It was recommended to improve the data foundation for country specific Y_m and biogas treated slurry. Key model parameters and background data are added.

Subcategories for horses have been extended to 4 subcategories and subcategories for boilers have been extended from 2 to 7 subcategories match the latest listed categories for the Danish norm data system. New stable types for mainly cattle and swine have been added also for matching latest listed categories for the Danish norm data system.

More documentation and a review of inventory reports from comparable countries have been done for the MCF from manure management as recommended by ERT.

$Frac_{LEACH}$ are calculated from the application of two models reported in Børgesen and Grant (2003). A detailed description of the models is, after recommendations from ERT, added to the Annex 3D 1.4.

Recalculations

Compared with the previous reported emission inventory 1990 - 2006, some changes are made. These changes influence the total GHG emission from the agricultural sector by less than 1 % (Table 6.35).

Table 6.35 Changes in GHG emission in the agricultural sector compared with the CRF reported last year.

GHG emission	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Previous inventory, Gg CO_2 eqv.	13 044	12 931	12 637	12 540	12 180	11 938	11 615	11 430	11 433	10 856
Recalculated, Gg CO_2 eqv.	13 011	12 893	12 607	12 477	12 132	11 911	11 575	11 405	11 412	10 826
Change in Gg CO_2 eqv.	-33	-38	-30	-63	-48	-27	-40	-25	-21	-30
Change in pct.	-0.3	-0.3	-0.2	-0.5	-0.4	-0.2	-0.3	-0.2	-0.2	-0.3
Continued	2000	2001	2002	2003	2004	2005	2006			
Previous inventory, Gg CO_2 eqv.	10 607	10 549	10 248	9 997	10 027	9 952	9 605			
Recalculated, Gg CO_2 eqv.	10 591	10 529	10 245	9 976	10 018	9 945	9 603			
Change in Gg CO_2 eqv.	-16	-20	-3	-21	-9	-7	-2			
Change in pct.	-0.2	-0.2	0.0	-0.2	-0.1	-0.1	0.0			

There have been no changes in the methodology.

The most significant inventory changes are mentioned below:

Emission factors for synthetic fertilizers the have been changed to the values given by EMEP/EEA (2009) and recalculations is done for 1990-2006. This results in an increase in N_2O of less than 1 % for the period.

Updated data from The Danish Environmental Protection Agency for the use of sewage sludge as fertilizers for the years 2004-2006 have been received and therefore recalculations. This results in an increase in N_2O of 16 % for the period.

The emission factors for crops are lowered from 5 to 2 % for crops and from 3 to 0.5 % for grass based on a literary survey (Gyldenkærne and Albrektsen, 2009). Recalculations have been done for the years 1990-2006. This results in a decrease in the ammonia emission of 62-64 %. The N_2O emission from atmospheric deposition has decreased by 1-10 % in the period.

Emission factors for fur farming have been raised from 25 to 36 % in agreement with Poulsen, H. D (pers. comm. 2008) and recalculation is done for the years 1990-2006.

Data for dairy cattle and heifer's time on pasture have been lowered with 10 % in 2007. In order to remove time-series inconsistency the data are interpolated for the years 2003-2006.

6.9 Planned improvements

The Danish emission inventory for the agricultural sector largely meets the request as set down in the IPCC Good Practice Guidance. In the years to come and based on the ERT recommendations, some specific improvements, as mentioned below, are planned:

- The documentation of number of horses, sheep and goats on small farms less than 5 ha, which is not included in the annual census from Statistics Denmark.
- In 2007 for the first time we have received data from the Faculty of Agricultural Sciences concerning the contribution of stable type. We are working on a data agreements with the Faculty of Agricultural Sciences to receive data annually.
- As recommended by ERT estimates of CH_4 from enteric fermentation calculated by the tier 2 method described in the IPCC good practice guidance will be made to provide an ongoing QC check.

The work concerning the QA/QC plan and the estimation of uncertainties are continued. The QA/QC plan for the agricultural sector is still under development, but, as a first step, a review of the existing data structure is carried out – see Section 6.7. The further work concerning the uncertainties will focus on the possibilities to bring about improvements by using the Tier 2 methodology, which may improve the outcome from the uncertainty analysis.

References

Aaes, Ole. The Danish Agricultural Advisory Centre, pers. comm.

Bussink, D.W. 1994: Relationship between ammonia volatilisation and nitrogen fertilizer application rate, intake and excretion of herbage nitrogen by cattle on grazed swards. Fertil. Res. 38, 111-121.

Børgesen, C.D. & Grant, R. 2003: Vandmiljøplan II – modelberegning af kvælstofudvaskning på landsplan, 1984 til 2002. Baggrundsnotat til Vandmiljøplan II - slutevaulering. December 2003, Danmarks Jordbrugsforskning og Danmarks Miljøundersøgelser. (In Danish).

CRF, Common Reporting Format: (http://cdr.eionet.eu.int/dk/Air_Emission_Inventories/Submission_EU)

DEA, 2008, Danish Energy Authority: S. Tafdrup. Pers. Comm.

Djurhuus, J. & Hansen, E.M. 2003: Notat vedr. tørstof og kvælstof i efterladte planterester for landbrugsjord – af 21. maj 2003. Forskningscenter Foulum, Tjele. (In Danish).

Dustan, A. 2002: Reviw of methane and nitrous oxid emission factors for manure management in cold climates. JTI – Swedish Institute of Agricultural and Environmental Engineering, Uppsala. Report 299.

EMEP/EEA Guidebook, 2009: Draft version of the new EMEP/EEA Guidebook, version dated September 2008. To be published.

Fenhann, J. & Kilde, N.A. 1994: Inventory of Emissions to the Air from Danish Sources 1972-1992. System Analysis Department – Risø National Laboratory.

Husted, S. 1994: Waste Management, Seasonal Variation in Methane Emission from Stored Slurry and Solid Manures. J. Environ. Qual. 23:585-592 (1994).

Høgh-Jensen, H., Loges, R., Jensen, E.S., Jørgensen, F.V. & Vinther, F.P. 1998: Empirisk model til kvantificering af symbiotisk kvælstoffiksering i bælgplanter. – Kvælstofudvaskning og –balancer i konventionelle og økologiske produktionssystemer (Red. Kristensen E.S. & Olesen, J.E.) s. 69-86, Forskningscenter for Økologisk Jordbrug. (In Danish).

Gyldenkærne, Steen. Researcher at NERI, Departement of Policy Analysis. Pers. Comm.

Gyldenkærne, S. and Albrektsen, R. 2009: Report on the emission of NH_3 and NMVOC emission from agricultural crops. In press.

IPCC, 1997: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Available at http://www.ipccnggip.iges.or.jp/public/gl/-invs6.htm (15-04-2007).

IPCC, 2000: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Available at http://www.ipcc-nggip.iges.or.jp/public/gp/english/ (15-04-2007).

Jarvis, S.C., Hatch, D.J. & Roberts, D.H., 1989a: The effects of grassland management on nitrogen losses from grazed swards through ammonia volatilization; the relationship to extral N returns from cattle. J. Agric. Sci. Camb. 112,205-216.

Jarvis, S.C., Hatch, D.J. & Lockyer, D.R., 1989b: Ammonia fluxes from grazed grassland annual losses form cattle production systems and their relation to nitrogen inputs. J. Agric. Camp. 113, 99-108.

Kristensen, I.S. 2003: Indirekte beregning af N-fiksering - draft, not published. Danmarks JordbrugsForskning. (In Danish).

Kyllingsbæk, 2000: Kvælstofbalancer og kvælstofoverskud i dansk landbrug 1979-1999. DJF rapport nr. 36/markbrug, Dansk Jordbrugsforskning.

Massé, D.I., Croteau, F., Patni, N.K. & Masse, L. 2003: Methane emissions from dairy cow and swine slurries stored at 10ºC and 15ºC. Agriculture and Agri-Food Canada, Canadian Biosystem Engineering, Volume 45 p. 6.1-6.6

Mikkelsen, M.H., Gyldenkærne, S., Poulsen, H.D., Olesen, J.E. & Sommer, S.G. 2006: Emission of ammonia, nitrous oxide and methane from Danish Agriculture 1985-2002. Methodology and Estimates. National Environmental Research Institute. - Arbejdsrapport fra DMU 231: 90 pp. Available at: http://www2.dmu.dk/Pub/AR231.pdf

Møller, H.B. 2003: Pers. comm. Department of Agriculture Engineering, Research Centre Bygholm, Faculty of Agricultural Sciences

Nielsen, L.H., Hjort-Gregersen, K., Thygesen, P. & Christensen, J. 2002: Socio-economic analysis of centralised Biogas Plants - with technical and corporate economic analysis, Rapport nr. 136, Fødevareøkonomisk Institut, Copenhagen, pp 130.

Nielsen, O.-K., Lyck, E., Mikkelsen, M.H., Hoffmann, L., Gyldenkærne, S., Winther, M., Nielsen, M., Fauser, P., Thomsen, M., Plejdrup, M.S., Illerup, J.B., Sørensen, P.B. & Vesterdal, L. 2008: Denmark's National Inventory Report 2008 - Emission Inventories 1990-2006 - Submitted to the European Commission. National Environmental Research Institute, University of Aarhus. 637 pp.

Olesen, J.E., Fenhann, J.F., Petersen, S.O., Andersen, J.M. & Jacobsen, B.H. 2001: Emission af drivhusgasser fra dansk landbrug. DJF rapport nr. 47, markbrug, Danmarks Jordbrugsforskning, 2001. (In Danish)

Olesen, J.E., Jørgensen, H., Danfær, A., Gyldenkærne, S., Mikkelsen, M.H., Asmon, W.A.H. and Petersen, S.O. 2005: Evaluering af mulige tiltag til reduktion af landbrugets metanemissioner. Arbejdsrapport fra Miljøstyrelsen Nr. 11 /2005. Chapter 1 (Allan Danfær): Methane emission from dairy cows. Available at: http://www2.mst.dk/Udgiv/publikationer/2005/87-7614-699-5/pdf/87-7614-700-2.pdf (10-02-2009)

Poulsen, H.D., Børsting, C.F., Rom, H.B. & Sommer, S.G. 2001: Kvælstof, fosfor og kalium i husdyrgødning – normtal 2000. DJF rapport nr. 36 – husdyrbrug, Danmarks Jordbrugsforskning. (In Danish)

Poulsen, Hanne Damgaard. The Faculty of Agricultural Science, Pers. Comm.

Poulsen, H.D. & Kristensen, V.F. 1998: Standards Values for Farm Manure – A revaluation of the Dansih Standards Values concerning the Nitrogen, Phosphorus and Potassium Content of Manure. FAS Report No. 7 - Animal Husbandry. Danish Institute of Agricultural Sciences.

Primé, A. & Christensen, S. 1991: Emission of methane and non-methane volatile organic compounds in Denmark – Sources related to agriculture and natural ecosystems. National Environmental Research Institute. NERI, Technical Report No. 19/1999.

Sommer, S.G., Møller, H.B. & Petersen, S.O. 2001: Reduktion af drivhusgasemission fra gylle og organisk affald ved Biogasbehandling. DJF rapport - Husdyrbrug, 31, 53 pp. (In Danish).

Statistics Denmark - Agricultural Statistic from year 1990 to 2007. Available at: www.dst.dk

7 Land Use, Land Use Change and Forestry (CRF sector 5)

7.1 Overview

The LULUCF sector differs from the other sectors in that it contains both sources and sinks of carbon dioxide. LULUCF are reported in the new CRF format. Removals are given as negative figures and emissions are reported as positive figures according to the guidelines. For 2007 emissions from LULUCF were estimated to be a sink of approximately 1.1 Gg CO_2 or 1.7 % of the total reported Danish emission.

Approximately 2/3 of the total Danish land area is cultivated and only 12.4 per cent are with forest. Together with high numbers of cattle and pigs there is a high (environmental) pressure on the landscape. To reduce the impact an active policy has been adopted to protect the environment. The adopted policy aims at doubling the forested area within the next 80-100 years, restoration of former wetlands and establishment of protected national parks. In Denmark all natural habitats and almost all forests are protected and therefore, in the inventory, no conversions from forest or wetlands into cropland or grassland are made, because in reality this is not occurring to any significant degree.

A full land-use matrix still remains to be carried out for 1990 to 2007. The major part of Denmark has been analysed at this moment, but there still remains some small issues. The analyses are based satellite data and other geographical referenced data.

The emission data are reported in the new CRF format under IPCC categories 5A (Forestry), 5B (Cropland), 5C (Grassland) and 5D (Wetlands). The IPCC categories 5E (Settlements) are not reported as these changes are considered to be negligible despite an expected small increase in the area with settlements. For 5F (Other) no data is available.

Fertilisation of forests and other land is negligible and therefore reported as a total for all fertiliser consumption under the agricultural sector. Drainage of forest soils is not reported. All liming is reported under Cropland because only very limited amounts are used in forestry and on permanent grassland. Field burning of biomass is prohibited in Denmark and therefore reported as not occurring. Biomass burned in power plants is reported in the energy sector.

Table 7.1 gives an overview of the emission from the LULUCF sector in Denmark. Forests are sinks in Denmark of approximately 3 500 Gg CO_2-eqv pr yr except for years with storm damage. Cropland is estimated to have a net emission of 300-2 400 Gg CO_2 pr year. From 1990 and onwards a decrease in the emission from Cropland is estimated due to a higher incorporation of straw (ban of field burning), demands of growing of catch crops in the autumn, a reduced agricultural area, an increase in hedgerows and a reduced consumption of lime. The area with restored wetlands has increased and consequently the accumulation of organic matter has also increased here.

Table 7.1 Overall emission (Gg CO_2) from the LULUCF sector in Denmark, 1990-2007 (Gg).

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
5. Land Use, Land-Use Change and Forestry, CO_2	551.67	-1 688.16	-1 548.54	-1 157.00	-1 617.00	-1 669.23	-1 217.10	-1 179.30	-1 954.14	-1 231.16
A. Forest Land	-2 830.67	-3 009.20	-3 000.80	-3 212.99	-3 102.55	-2 992.51	-3 069.15	-3 162.10	-3 319.98	-3 316.24
B. Cropland	3 287.48	1 228.40	1 361.37	1 969.70	1 401.93	1 232.78	1 767.65	1 909.20	1 297.25	2 015.81
C. Grassland	92.90	90.68	88.92	84.35	81.68	88.58	82.47	71.68	66.83	68.22
D. Wetlands	1.96	1.96	1.96	1.95	1.94	1.93	1.92	1.92	1.77	1.05
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
5. Land Use, Land-Use Change and Forestry, N_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Grassland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry, CO_2-eqv.	551.16	-1 688.67	-1 549.05	-1 157.50	-1 617.51	-1 669.73	-1 217.60	-1 179.80	-1 954.63	-1 231.58

Continued	2000	2001	2002	2003	2004	2005	2006	2007
5. Land Use, Land-Use Change and Forestry, CO_2	1 630.64	-769.20	-1 978.74	-2 290.28	-824.36	161.14	-874.87	-1 127.13
A. Forest Land	-664.25	-3 551.13	-3 827.01	-3 547.21	-3 465.22	-1 796.67	-2 783.33	-2 977.03
B. Cropland	2 227.07	2 712.61	1 779.33	1 190.96	2 579.57	1 888.30	1 840.86	1 779.20
C. Grassland	71.10	74.29	75.93	75.97	73.79	82.52	80.99	84.09
D. Wetlands	-3.28	-4.97	-6.99	-10.00	-12.50	-13.01	-13.39	-13.39
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA.NE	NA.NE	NA.NE
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
5. Land Use, Land-Use Change and Forestry, N_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NA	NA	NA	NA	NA	NA	NA	NA
C. Grassland	NA	NA	NA	NA	NA	NA	NA	NA
D. Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
G. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry, CO_2-eqv.	1 630.22	-769.62	-1 979.16	-2 290.70	-824.78	160.72	-875.29	-1 127.55

7.2 Forest Land

7.2.1 Source category description

Forests and forest management

Danish forests cover only a small part of the country (12.4 %) since the dominant land use in Denmark is agriculture. Forests thus cover about 530.000 ha (=5.300 km^2) with an almost equal distribution between broadleaved and coniferous species. Danish forests are managed as closed canopy forests, and the main objective is to ensure sustainable and multiple-use management. The main management system used to be the clear-cut system, but increasingly, principles of nature-based forest management including continuous cover forestry are being implemented in many forest areas, e.g. the state forests (about ¼ of the forest area). Contrary to the situation in the other Scandinavian countries, forestry does not contribute much to the national economy. Denmark is the only part of the Kingdom with a forestry sector. Greenland and the Faroe Islands have almost no forest. Compared with other sectors, forestry has very low energy consumption.

Forest legislation and policy

The Danish Forest Act protects the main part of the forest area (about 80 %) against conversion to other land uses, and these Danish forests will always remain forest. The objective to ensure sustainable and multiple-use management is laid down in the Forest Act, carbon sequestration being just one of several objectives.

The policy objective most likely to increase carbon sequestration is the 1989 target to double Denmark's forested area within 100 years. The most important measure aiming at achieving this objective is a governmental subsidy scheme established to support private afforestation on agricultural land. Subsidized afforestation areas are automatically protected as forest reserves. Secondly, governmental and municipal afforestation is also taking place. Finally, some private afforestation is taking place without subsidies. The Danish Forest and Nature Agency is responsible for policies on afforestation of state-owned and private agricultural land.

The Forest Act includes an obligation of the Ministry to monitor the health condition of the forest and maintain a comprehensive inventory of their status and trends. The aim of the national inventory should be to improve the understanding and management of the Danish Forests and prove that policy goals are met (Miljøministeriet, 2002). The selected variables should cover the indicators concerning sustainable forest management and meet the data needs for national and international forest statistics.

Green accounting and environmental management are used in the sector as a measure to monitor and reduce its environmental impacts. State forests for example issue yearly green accountings. One of the intentions is to determine whether the use of fossil fuels can be reduced.

Forest statistics and definitions

Since 1881, a Forestry Census has been carried out roughly every 10 years based on questionnaires to forest owners (Larsen and Johannsen, 2002). The two last censuses were carried out in 1990 and 2000. Since the data were based on questionnaires and not field observations, the forest definition may vary slightly but the basic definition of a forest is that the forest area must be minimum 0.5 ha. There was no specific guideline on the crown cover or the height of the trees. Open woodland and open areas within the forest are not included.

In 2002, a new plot-based National Forest Inventory (NFI) was initiated. This type of forest inventory is very similar to inventories used in other countries, e.g. Sweden. The NFI has replaced the Forestry Census. Compared to the Forest Census, the forest definition is more specific and includes a larger variety of areas. It includes *"wooded areas larger than 0.5 ha, that are able to form a forest with a height of at least 5 m and crown cover of at least 10 %. The minimum width is 20 m."* Temporarily non wooded areas, fire breaks, and other small open areas, that are an integrated part of the forest, are also included.

The NFI is a continuous sample based inventory with partial replacement of plots. One fifth of the sample plots are visited every year. Over the five years of the first rotation 2002-2006 more than 7000 plots have been visited and inventoried by the 3 two-person teams travelling from May through September. The fifth and last year of data collection in the first rotation of the inventory was 2006. The third year of the second full inventory is currently planned for 2009.

The inventory acquires information on wood volume by tree species and diameter class, area estimates of forest land by type, stand size, ownership, site quality and stocking. Additional information like changes in the forest area, growth, mortality, timber removals and measures for successful regeneration is also included. The NFI system also gives good estimates of both growth (permanent clusters) and standing volume (all clusters - including the temporary).

The first results from the NFI have been published and cover the period 2002-2006 (Nord-Larsen et al., 2008).

Development in forest area and species distribution 1990-2006

In 1990, the forested area with trees was about 411,000 ha or approximately 10 % of the land area (Statistics Denmark, 1994). Broadleaved tree species made up 35 % and coniferous species made up 65 % of the forest area.

Table 7.2 Total wooded area, temporarily uncovered area and distribution of forested area to main tree species and species categories in 1990 and 2000 (Statistics Denmark, 1994; Larsen and Johannsen, 2002, Nord-Larsen et al., 2008).

Area in ha	1990	2000	2006
Total wooded area	417 089	473 320	526 551
Area temporarily without trees[1]	5 702	4 985	10 595
Broadleaves, total area	143 253	174 385	229 884
Beech	71 764	79 552	71 614
Oak	30 247	43 011	47 005
Ash	10 158	12 681	19 619
Sycamore maple	7 979	9 444	17 779
Other broadleaves	23 105	29 698	73 867
Conifers, total area	268 134	293 950	286 072
Norway spruce	135 010	132 237	101 827
Sitka spruce	35 464	34 223	34 024
Silver fir and other fir	7 001	11 919	13 928
Nordmann's fir	11 841	28 173	20 892
Noble fir	15 115	15 498	10 029
Other conifers	63 703	71 901	36 443
Unknown	-	-	4 907

[1]Area not yet replanted with trees following clear-cutting.

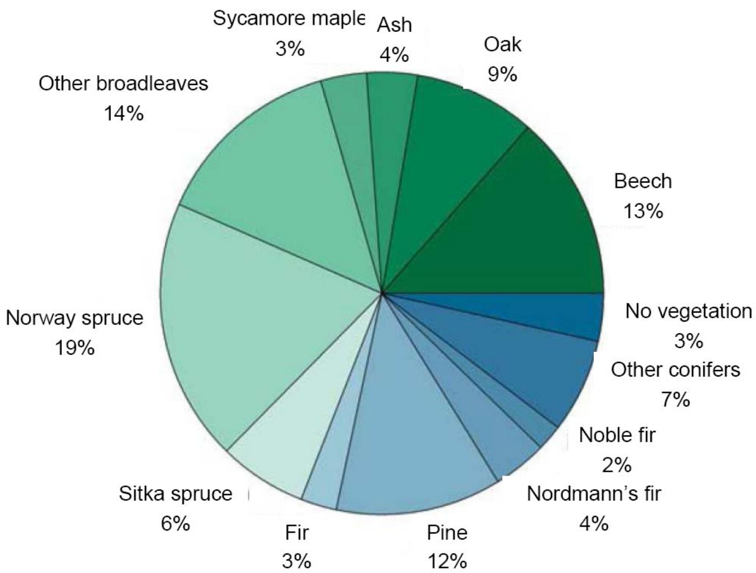


Figure 7.1 Tree species distribution to the total forested area in 2006 (Nord-Larsen et al., 2008).

In 2000, the forested area with trees was 468 000 ha or approximately 11 % of the land area (Larsen and Johannsen, 2002). The number of respondents for this survey was 32 300, which is considerably higher than the number of 22 300 in the 1990 survey. The number of respondents may have caused the changes in the forest area between 1990 and 2000 rather than real changes in the forest area. The increase in forested area is therefore only partly a result of afforestation of former arable land since 1990. Broadleaved tree species made up 37 % and coniferous species made up 63 % of the forest area.

The new plot-based NFI showed that in average for the period 2002-2006, the forested area with trees was 526 552 ha or approximately 12.4 % of the land area (Nord-Larsen et al., 2008). The increase in forest area is for the most part due to inclusion of more small woodlands that were previously not recognized as forest on the properties. The increase in forested area is therefore only partly a result of afforestation of former arable land since 1990. Broadleaved tree species made up 45 % and coniferous species made up 55 % of the forest area.

See Figure 7.1 and Table 7.2 or the distribution to specific tree species and species categories.

7.2.2 Methodological issues

Introduction

The Forest Censuses from 1990 and 2000 have served as sources of removal data (increment) for reporting of GHG emissions from forestry. The Danish Forest and Nature Agency has provided data on state-forest afforestation (based on their internal statistics), municipal afforestation (based on reported municipal statistics), and private afforestation with subsidies (assuming that afforestation was equal to the amount of land approved to receive afforestation subsidies). Statistics Denmark supplied background data for emissions (harvesting).

This report is based on the above-mentioned data, apart from data on removals in 2007 which originate from the new NFI. From 2012 at lastest, the Danish methodology will change as new data become available. Denmark will start to use the stock change method for forests remaining forests based on the first two rotations of the NFI. Methodology for afforestation will also be subject to revision in the coming years.

Retrospectively, it will only be possible to use the stock change method from 2002 and onwards. Removals from 1990 to about 2002 will instead be recalculated based on a thorough GIS analysis of Land Use and Land Use Change for the years 1990 and 2005.

Forest inventory data and reference values used in calculations

Standing stocks of wood in 1990 and 2000, and annual increments for the two periods 1990-99 and 2000-2006 are all obtained from the Forestry Census of 2000 (Larsen and Johannsen, 2002). For 2007, the annual increment is based on the new NFI (Nord-Larsen et al., 2008).

The Forestry Census has been carried out roughly every 10 years and is based on questionnaires to forest owners. Detailed information about the census and the methodology can be found in Larsen and Johannsen (2002), and further documentation is available from Forest & Landscape Denmark, University of Copenhagen[9]. In short, the estimates of standing volume and volume increments in the Forestry Census from 1990 and from 2000 are based on questionnaire information from forest owners on forest area distributed to species and age classes, and information on site productivity. Based on standard yield table functions these input data are used to estimate standing volume and rate of increment for each tree species category.

[9] Contact: Dr. V.K. Johannsen, Forest & Landscape Denmark, University of Copenhagen, Hoersholm Kongevej 11, DK-2970 Hoersholm, Denmark. E-mail: vkj@life.ku.dk

In 1990, the standing stock of wood was 64.8 million m^3, equivalent to 158 m^3 pr ha, distributed with 35 % broadleaved species and 65 % coniferous species. This stock of wood was equivalent to 22 425 Gg C or 82 225 Gg CO_2. In 2000, the standing stock of wood was 77.9 million m^3, equivalent to 166 m^3 pr ha, distributed with 37 % broadleaved species and 63 % coniferous species. This stock of wood was equivalent to 26 803 Gg C or 98 278 Gg CO_2. These two figures cannot be compared directly due to the differing numbers of respondents in the two censuses. The number of respondents in the 2000 survey was 32 300, considerably higher than the number of 22 300 in the 1990 survey.

In 2006, the new plot-based NFI revealed a standing stock of wood of 106.3 mio. m^3, equivalent to 199 m^3 pr ha, distributed with 45 % broadleaved species and 55 % coniferous species. The amount of C in woody biomass (above- and belowground), dead wood, and forest floors is given in Table 7.3. This stock of wood was equivalent to 36 022 Gg C or 132 620 Gg CO_2. The difference to C stocks and species distribution in previous years cannot solely be attributed to a change in the forest area. The larger proportion of broadleaved forest (in terms of area and wood volume) is mainly due to the fact that small broadleaf woodland areas have been neglected in previous forestry censuses and the assignment of main tree species to the forest area have previously been a bit biased towards conifers in case of mixed stands.

Table 7.3 Carbon pools in Danish forests estimated from the first NFI rotation 2002-2006 (Nord-Larsen et al., 2008). Status of first rotation of the NFI.

Carbon pool	Carbon, M tonnes	CO_2, M tonnes	Carbon, tonnes pr ha
Woody biomass	36.169	132.620	67.7
Dead wood	0.327	1.199	0.6
Forest floor	6.699	24.563	12.5

Expansion factors are needed to convert stem volumes for conifers and total aboveground biomass for the broadleaves to total biomass. There is currently no information on applicable expansion factors for Danish conditions, but a thorough national study on Norway spruce and beech will supply valuable information within the next two years. At present, stemwood volumes for conifers are converted to total biomass by an expansion factor of 1.8 based on Schöne and Schulte (1999), and aboveground biomass for broadleaves are converted to total biomass by an expansion factor of 1.2 based on Vande Walle et al. (2001) and Nihlgård and Lindgren (1977). These studies were chosen as basis for expansion factors due to the geographical closeness of study sites (Germany, Sweden and Belgium), and because the studies concerned relevant Danish species like beech, oak and Norway spruce. However, stand management may of course be different from Danish "average" stand management, but variability in management may be even larger within Denmark. The difference between expansion factors for conifers and broadleaves is mainly due to the difference in the type of basic volume data used for the two species categories. The total volume in solid m^3 is converted to dry mass by use of tree species-specific basic wood densities (Moltesen, 1988, see Table 7.4), and carbon content is finally calculated by using a carbon concentration of 0.5 g C pr gram dry mass.

Table 7.4 Basic wood densities for Danish tree species (Moltesen, 1988).

	Wood density (t dry matter pr m^3 fresh volume)
Norway spruce	0.38
Sitka spruce	0.37
Silver fir	0.38
Douglas-fir	0.41
Scots pine	0.43
Mountain pine	0.48
Lodgepole pine	0.37
Larch	0.45
Beech	0.56
Oak	0.57
Ash	0.56
Maple	0.49

The Danish reporting on changes in forest carbon stores mainly considers the biomass of trees. There is at present no systematic information available on changes in soil organic carbon, but pool sizes are given for forest floor and dead wood based on the first rotation of the NFI.

Annual CO_2-sequestration in forests planted before 1990

Net C sequestration in the periods 1990–1999, 2000-2007 was the result of a net increase in standing stock of the existing forests. Net C sequestration in existing forests is the result of relatively low harvest intensity, especially for conifers. The harvesting intensity for broadleaves has also been decreasing since the late 1990s. The high net C sequestration is also partly a result of an uneven age-class distribution with relatively many young stands.

The estimated gross wood increment for the period 2000–2006 is based on the Forestry Census of 2000. Harvesting is not included in estimates of gross wood increment. Mean annual increments (m^3 ha^{-1}) for the categories of tree species for the periods 1990-1999 and 2000-2006 are both provided in the Forestry Census of 2000. The gross annual increment for 1990-99 was estimated at 4.6 Mm^3 pr yr and around 5.2 Mm^3 pr yr for 2000-06. The gross wood increment for 2007 is obtained from the first results of the NFI (Nord-Larsen et al., 2008), with subtraction of the contribution from afforestation.

Data on the annually harvested amount of wood (Figure 7.2) are obtained from Statistics Denmark (http://www.statistikbanken.dk/) for all years 1990-2007. Commercial harvesting was used in the calculations for broadleaved species as wood from thinning operations in young stands is sold as fuelwood and therefore appears in the statistics. For conifers, non-commercial thinning operations are more common. In order to account for this, 20 % were added to the figures for commercial harvests of coniferous wood.

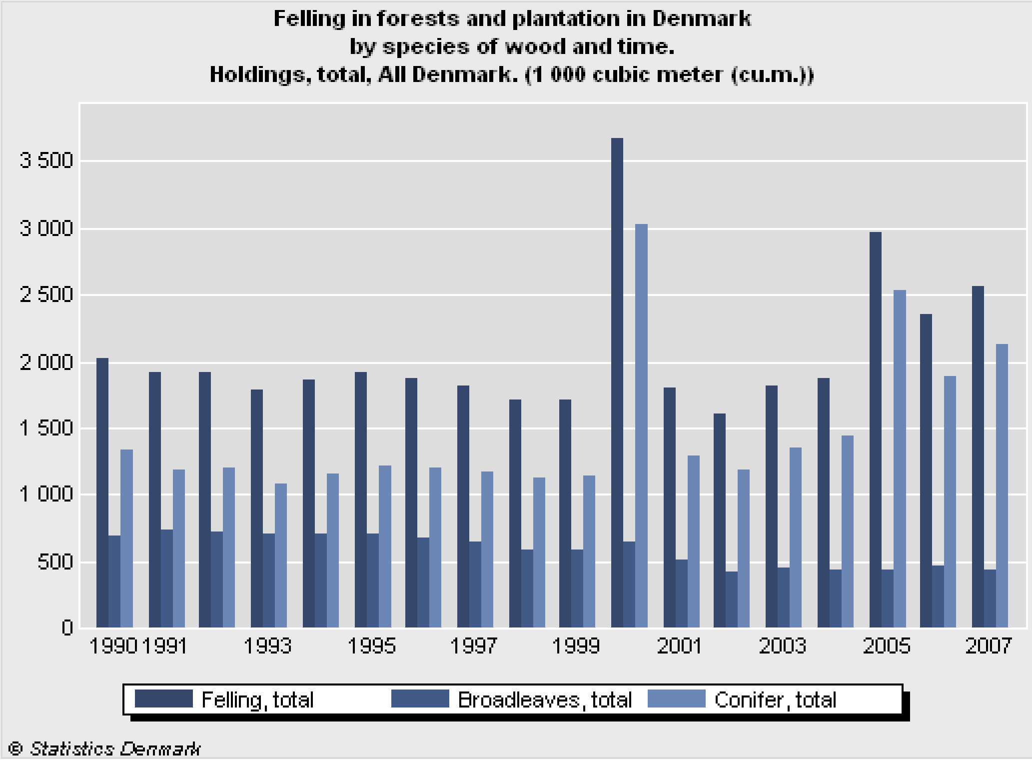


Figure 7.2 The annual harvest of commercial wood (total, broadleaves and conifers) in forests planted before 1990. The peak in 2000 is caused by windthrow of conifers during the storm on Dec. 3, 1999, and the smaller peak in 2005 is caused by windthrow of conifers in the storm Jan. 8, 2005. From Statistics Denmark (http://www.statistikbanken.dk/).

Rates of wood increment and harvesting are converted to carbon and CO_2 removals and emissions by using the expansion factors, basic wood densities and carbon concentration mentioned above.

Table 7.5 Carbon stock changes in the Danish forests in the years 2003, 2004, and 2005. Calculation examples.

Indicator	2003	2004	2005
Area, ha	440 800	440 800	440 800
Annual increment of stands, m^3 pr ha	10.6	10.6	10.6
Annual increment of growing stock (merchantable), m^3	4 796 474	4 796 474	4 796 474
Annual biomass growth of growing stock, tonnes dm	2 080 298	2 080 298	2 080 298
Annual total biomass growth, tonnes dm	3 318 133	3 318 133	3 318 133
C uptake, tonnes	1 659 066	1 659 066	1 659 066
CO_2 uptake, tonnes (removals)	6 083 242	6 083 242	6 083 242
Annually harvested, m^3	2 126 607	2 205 006	3 559 126
Annually harvested merchantable biomass, tonnes dm	890 982	916 526	1 431 262
Annually harvested total biomass, tonnes dm	1 449 985	1 503 806	2 430 066
Annual loss of C with harvested wood, tonnes	724 993	751 903	1 215 033
Annual loss of CO_2 with harvested wood, tonnes (emissions)	2 658 306	2 756 977	4 455 121
Net annual uptake of CO_2, tonnes (net removal)	3 424 936	3 326 265	1 672 380

An example of calculations for three individual years is given in Table 7.5. The table shows the different steps of calculation from annual gross increment and annual harvesting to the net sink for CO_2. A summary of gross uptake of CO_2 since 1990 is given in Table 7.6. Figure 7.3 shows the dynamics in the C balance for broadleaves and conifers, respectively. The resulting net sink for CO_2 in forests existing since 1990 was around 3 000 Gg CO_2 pr yr for the period 1990-1999 and somewhat higher (around 3 500 Gg CO_2 pr yr) for the period 2001-2004, and lower again in 2006-2007 (around 2700 Gg CO_2 pr yr). In the years 2000 and 2005 the sink was much lower than in all other years due to storms. The windthrow in Dec. 1999 made the harvested amount of wood in 2000 more than two times higher than during an average year. The storm-felled amount of wood amounted to 3.6 Mm^3 distributed over about 20 000 ha (Larsen and Johannsen, 2002). In January 2005 a less severe storm also increased the annual harvest significantly compared to "normal" years.

For 2000-2006, the gross uptake of CO_2 was slightly higher than for 1990-1999. This is mainly attributed to the higher number of respondents to the questionnaire of the Forest Census, i.e. the included forest area was larger (440 000 ha in 2000 vs. 411 000 ha in 1990). Annual gross increment pr ha was similar for the two periods (11 m^3 pr ha pr yr). The estimated increment in the period 2000-2006 was adjusted in order to account for the forest damage and changed age distribution caused by the storm in December 1999. Gross increment and consequently gross carbon uptake was negatively affected by the windthrow as the age distribution changed towards low productive reforested stands. The loss of increment is estimated at 182 000 m^3 pr yr for the period 2000-2009.

For 2007 the gross uptake of CO_2 was higher, for the main part due to a larger forest area (530 000 ha) and stock of woody biomass based on the new plot-based NFI. However, harvesting in 2007 was still relatively high compared to the general level for years without windstorms in the period 1990-2007. Consequently, the net annual sink for CO_2 was comparable to that in 2006.

Table 7.6 Data on gross uptake of CO_2, loss of CO_2 due to harvesting (Figure 7.2) and the resulting net annual sink for CO_2 for the period 1990 – 2006 in forests that existed before 1990.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gross uptake of CO_2 (Gg pr yr)	-5 742	-5 742	-5 742	-5 742	-5 742	-5 742	-5 742	-5 742	-5 742	-5 742
Loss of CO_2 in harvested wood (Gg pr yr)	2 911	2 732	2 746	2 537	2 651	2 765	2 695	2 611	2 464	2 475
Net annual sink for CO_2(Gg pr yr)	-2 831	-3 007	-2 996	-3 205	-3 091	-2 977	-3 047	-3 131	-3 278	-3 267

Greenhouse gas source and sink categories	2000	2001	2002	2003	2004	2005	2006	2007
Continued								
Gross uptake of CO_2 (Gg pr yr)	-6 083	-6 083	-6 083	-6 083	-6 083	-6 083	-6 083	-6 594
Loss of CO_2 in harvested wood (Gg pr yr)	5 489	2 618	2 358	2 658	2 757	4 443	3 482	3 824
Net annual sink for CO_2 (Gg pr yr)	-594	-3 465	-3 725	-3 424	-3 326	-1 640	-2 601	-2 770

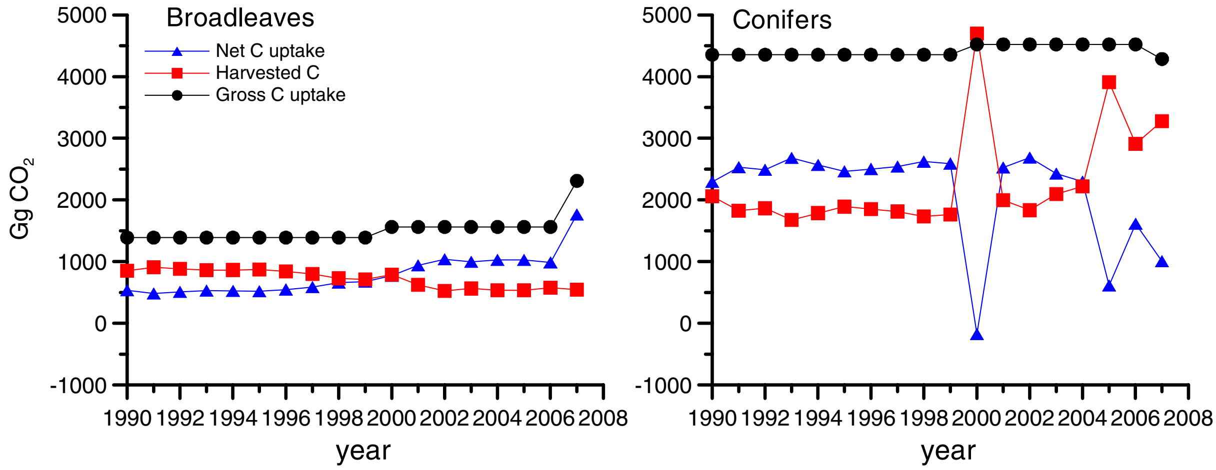


Figure 7.3 The C balance (in Gg CO_2) for broadleaves and conifers in forests planted before 1990. The windthrow incidents for conifers during the storms on Dec. 3, 1999 and Jan. 8, 2005 are clearly visible in data for 2000 and 2005, respectively.

Annual CO_2 sequestration by afforestation of former arable land

In 1989 the Danish Government decided to encourage a doubling of the forested area within a tree generation of approximately 80–100 years (Danish Forest and Nature Agency, 2000). In order to reach this target, an afforestation rate of roughly 4–5 000 ha pr yr was needed, but in reality the afforestation rate has been much lower with an average afforestation rate probably less than 2 000 ha pr yr for the period 1990-2006 (Nord-Larsen et al., 2008). However, only little information on realised afforestation is available. Afforestation is carried out on soils formerly used for agriculture (Cropland). Data on the area afforested by state forest districts, other public forest owners and private land owners receiving subsidies is derived from an evaluation report on afforestation (National Forest and Nature Agency, 2000). Area data for the years 1999-2007 is obtained from the records of the Danish Forest and Nature Agency. The area afforested by private land owners without subsidies is estimated by subtracting the afforestation categories mentioned above from the total area afforested pr yr in the period 1990-99 as recorded in the latest Forestry Census (Larsen and Johannsen, 2002). The Forestry Census included Nordmann's fir plantations for Christmas trees and greenery on arable land as afforestation. These stands made up 40 % of the total area afforested in the period 1990-99. However, the Nordmann's fir plantations were not included in the reported afforested area until 2006. The reason for this was firstly that Nordmann's fir plantations seldom become closed forest as the trees are harvested within a ten year rotation, and secondly changes in the market for Christmas trees may force land owners to revert the land use to agriculture after a few years. However, in agreement with the forest definition of the new NFI, these plantations will be included when afforestation since 1990 is estimated retrospectively based on the new data that will be available next year from the GIS analysis of Land Use and Land Use Change 1990-2005. The preliminarily estimated annually afforested area is specified in Table 7.7.

Table 7.7 Distribution of afforestation area (ha) on different landowners and tree species. Plantations of Nordmann's fir for Christmas trees and greenery are not included in the afforested area.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
						(ha)				
State forests	107	300	562	450	553	396	407	414	146	358
Other publicly owned forests	12	12	12	149	149	141	146	267	101	150
Private forests with subsidies	0	70	70	70	178	178	212	968	547	3 304
Private without subsidies	611	611	611	611	611	611	611	611	611	611
Total area	730	993	1 255	1 280	1 491	1 326	1 376	2 260	1 405	4 423
Broadleaved	320	527	721	738	912	790	833	1 614	912	3 613
Coniferous	410	466	534	542	579	536	543	646	493	810

Greenhouse gas source and sink categories	2000	2001	2002	2003	2004	2005	2006	2007
Continued				(ha)				
State forests	196	175	200	300	200	200	100	365
Other publicly owned forests	182	59	35	83	51	76	64	60
Private forests with subsidies	1 764	1 288	1 497	1 534	463	2 454	3 061	0
Private without subsidies	611	611	611	611	611	611	611	611
Total area	2 753	2 133	2 343	2 528	1 325	3 341	3 836	1 036
Broadleaved	2 115	1 577	1 828	1 972	857	2 841	3 353	546
Coniferous	638	556	515	556	468	500	483	490

The approximate distribution of broadleaved and coniferous tree species is obtained from the Forestry Census of 2000 (Larsen and Johannsen, 2002) for all ownership categories except private landowners receiving subsidies. The tree species distribution for the latter category was estimated using information in the evaluation report on afforestation (Danish Forest and Nature Agency, 2000).

Full carbon accounting is used in a manner by which C sequestration is calculated from area multiplied by uptake. Uptake is calculated using a simple carbon storage model based on the Danish yield tables for Norway spruce (representing conifers) and oak (representing broadleaves) (Møller, 1933). The yield tables used for calculation of carbon stores are valid for yield class 2 (on a scale decreasing from 1 to 4). No distinction is made between growth rates on different soil types. Growth rates are usually relatively high for afforested soils in spite of different parent materials (Vesterdal et al., 2007). This is due to the nutrient-rich topsoil, which is a legacy of former agricultural fertilization and liming. The amounts of carbon sequestered in annual cohorts of afforested areas are summed up in the model to give the total carbon storage in a specific year (see Appendix A2).

The reason for the use of a different methodology for carbon sequestration following afforestation is partly historical. Estimation of C sequestration for afforested lands started in a period with no previous data from a Forestry Census, and it has been maintained to keep a consistent time-series. However, the yield tables used for growth estimates are similar for forests existing before 1990 and afforestation since 1990. When the new NFI and new growth models are introduced in a few years (see 7.2.6), it will be considered to further harmonize the calculation methods.

Wood volumes are converted to carbon stocks by the same method as for forests existing before 1990 except that a higher expansion factor of 2 is used for both species categories. The higher expansion factor is used in recognition of the age-dependency of expansion factors. The stem biomass represents a much lower proportion of the total biomass for age classes 1-10, thus a higher expansion factor is needed. However, studies in other countries indicate that an expansion factor of 2 clearly underestimates the total biomass for age classes 1-10 (Schöne and Schulte, 1999). As there are not yet Danish expansion functions based on age or tree size, it was chosen to use an expansion factor of 2 as a conservative estimate so far. New data will be available within the next two years from a large national investigation of tree biomass to different compartments.

The first thinning operations in the model are done at the age of about 15 years for Norway spruce and 25 years for oak. The year 2007 is thus the third year with thinning operations in coniferous stands afforested since 1990, while there are so far no thinnings or subsequently reported emissions of carbon for broadleaves. Decomposition rates for the various slash components following harvesting may be included in the model, but at present, the carbon stocks in slash is assumed to be released as CO_2 in the year of felling (similar to carbon stored in wood products, i.e. harvesting in existing forests since 1990). Carbon storage in wood products may be included in the accounting by use of a module with turnover rates for the various wood products. This option was not included in the calculations of the figures presented here. For more information see Danish Energy Agency (2000).

Changes in soil carbon pools following afforestation were for the first time been included in the NIR for 2008 covering the period until 2006. The included soil C pool changes only concern C sequestration due to development of forest floors, i.e. the organic layer on top of the mineral soil. We have included C sequestration in this layer because there are results from national scientific projects in afforestation chronosequences (Vesterdal et al., 2002, 2007) as well as a number of studies on forest floor C in stands established by afforestation of cropland (Vesterdal and Raulund-Rasmussen, 1998; Vesterdal et al., 2008). Forest floor C sequestration rates were estimated from age-C stock regressions in afforestation chronosequences or by dividing the forest floor C stock in afforested stands by age in years. The results of these calculations and the average sequestration rates for broadleaves and conifers are given in Table 7.8.

Table 7.8 Distribution of afforestation area (ha) on different landowners and tree species. Plantations of Nordmann's fir for Christmas trees and greenery are not included in the afforested area.

Tree species category	Tree species	Study type	Age (yr)	Forest floor C sequestration (t pr ha pr year)	Source*
Broadleaves	Oak	Chronosequence	29	0.08	1
	Oak	Stand	30	0.02	2
	Oak	Stand	30	0.05	2
	Oak	Stand	30	0.04	2
	Oak	Stand	30	0.02	2
	Oak	Stand	30	0.13	3
	Oak	Stand	40	0.09	3
	Beech	Stand	30	0.09	2
	Beech	Stand	30	0.10	2
	Beech	Stand	30	0.12	2
	Beech	Stand	30	0.13	2
	Beech	Stand	30	0.18	3
	Beech	Stand	40	0.14	3
	Average (SEM)			*0.09 (0.01)*	
Conifers	Norway	Chronosequence	30	0.35	1
	Spruce	Chronosequence	41	0.43	1
		Stand	30	0.21	2
		Stand	30	0.15	2
		Stand	30	0.20	2
		Stand	30	0.30	2
		Stand	30	0.30	3
		Stand	40	0.65	3
	Sitka spruce	Stand	30	0.43	2
		Stand	30	0.24	2
		Stand	30	0.22	2
		Stand	30	0.25	2
	Average (SEM)			*0.31 (0.04)*	

* 1) Vesterdal et al. (2007), 2) Vesterdal & Raulund-Rasmussen (1998), 3) Vesterdal et al. (2008)

We did not account for possible changes in C pools of the mineral soil. Based on chronosequence studies of afforested stands (http://www.sl.kvl.dk/afforest/), no consistent changes have been detected in mineral soil organic matter during the first 30 years following afforestation (Vesterdal et al., 2002; Vesterdal et al., 2007). There is currently too few data available to explore this further, and we do therefore not yet report changes for this pool.

The annual CO_2 uptake and the cumulated CO_2 uptake and afforested area since 1990 are given in Table 7.9 and the accumulated afforestation area and the annual CO_2 uptake is given separately for broadleaved and coniferous species in Figure 7.4. As shown in Table 7.9, annual sequestration of CO_2 in forests established since 1990 has gradually increased to 165 Gg CO_2 in 2006, for further details see Annex A2. The annual CO_2 sequestration will increase much more over the next decades when cohorts of afforestation areas enter the stage of maximum current increment.

Table 7.9 Annual CO_2 uptake in biomass and forest floor (soil), cumulated CO_2 uptake and cumulated afforested area due to afforestation activities 1990 – 2007.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Biomass CO_2 sink (Gg pr yr)	0	-1	-3	-5	-8	-10	-16	-24	-34	-43
Forest floor CO_2 sink (Gg pr yr)	0	-1.3	-2.1	-3.0	-3.9	-4.8	-5.7	-7.0	-7.8	-9.9
Total cumulative CO_2 sink (Gg)	0	-3	-6	-13	-21	-32	-50	-75	-110	-155
Cumulated afforestation area (ha)	730	1 723	2 978	4 258	5 749	7 075	8 451	10 711	12 116	16 539
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Biomass CO_2 sink (Gg pr yr)	-59	-74	-88	-108	-124	-140	-165	-189		
Forest floor CO_2 sink (Gg pr yr)	-11.4	-12.5	-13.7	-15.0	-15.8	-17.3	-19.0	-19.7		
Total cumulative CO_2 sink (Gg)	-215	-290	-379	-488	-613	-755	-921	-1111		
Cumulated afforestation area (ha)	19 292	21 425	23 768	26 296	27 621	30 962	34 798	35 834		

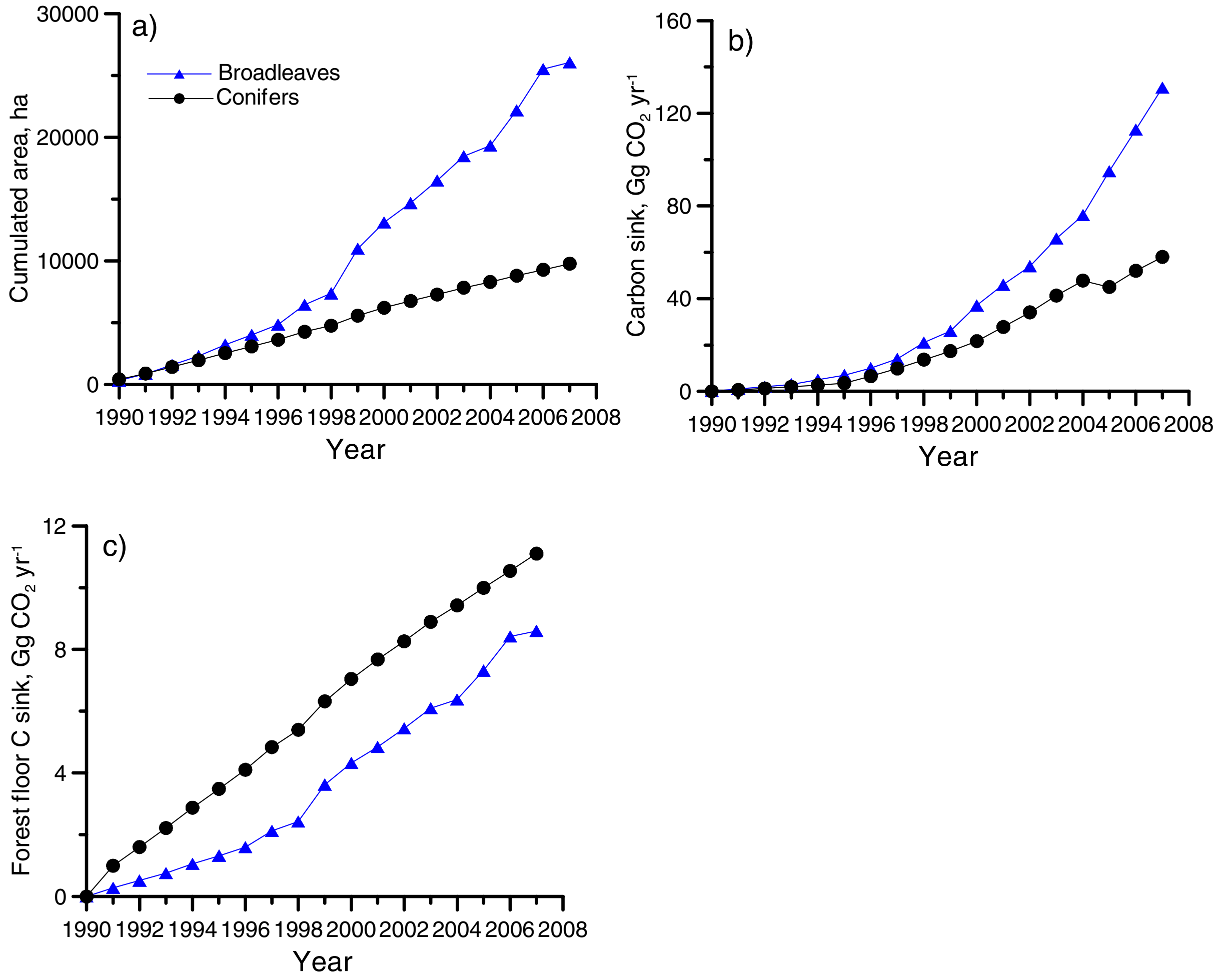


Figure 7.4 a) The cumulated afforested area of broadleaves and conifers and the annual contributions of broadleaves and conifers to the afforestation C sink in b) biomass (in Gg CO_2 yr^{-1}) and c) forest floors (soil, in Gg CO_2 yr^{-1}).

During the Kyoto commitment period 2008–2012 (5 years), it is estimated that the Danish afforestation activities will result in sequestration of 1 375 Gg CO_2. This amount of C results from the afforestation of 48 000 ha of former arable land over the period 1990–2012. The sink capacity is based on a conservative estimate of approximately 2 500 ha of land afforested annually in the period 2007-2012, but it is possible that other instruments in addition to subsidization will make it possible to increase the rate of afforestation and eventually the sequestration of CO_2.

Total contribution of forestry

Table 7.10 shows the figures reported in this NIR report distributed to the land uses *afforestation* and *forests existing prior to 1990*. Afforestation currently contributes little to the total uptake in forestry, but the annual uptake increases as stands enter the stage of maximum rate of increment and as the afforestation area gradually increases.

Table 7.10 Annual CO_2 uptake in total forest area, forests planted before 1990 and in afforestation of former arable land during 1990-2007.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total forest area (Gg CO_2 pr yr)	-2 831	-3 010	-3 001	-3 213	-3 103	-2 992	-3 069	-3 162	-3 320	-3 320
Forests remaining forests (Gg CO_2 pr yr)	-2 831	-3 007	-2 996	-3 205	-3 091	-2 977	-3 047	-3 131	-3 278	-3 267
Afforestation since 1990 (Gg CO_2 pr yr)	0	-3	-5	-8	-12	-15	-22	-31	-42	-53
(% of total)	<0.1	0.1	0.2	0.2	0.4	0.5	0.7	1.0	1.3	1.6
Greenhouse gas source and sink categories	2000	2001	2002	2003	2004	2005	2006	2007		
Continued										
Total forest area (Gg CO_2 pr yr)	-664	-3 551	-3 827	-3 547	-3 466	-1 798	-2 785	-2 979		
Forests remaining forests (Gg CO_2 pr yr)	-594	-3 465	-3 725	-3 424	-3 326	-1 640	-2 601	-2 770		
Afforestation since 1990 (Gg CO_2 pr yr)	-70	-86	-102	-123	-140	-158	-184	-209		
(% of total)	10.7	2.4	2.7	3.5	4.1	8.7	6.7	7.0		

7.2.3 Uncertainties and time-series consistency

Uncertainty of the reported sinks

As the Forest Census was an investigation of the total forest area, there are not statistical uncertainties implied due to sampling. Uncertainties were instead related to the number and type of respondents, and several other issues: The values of site productivity refer to fully stocked stands with no border effects and with a given thinning regime. However, the stands are not fully stocked. The estimates are based on 90 % stocking but it may be lower. The very fragmented shape of the Danish forest area results in many borders and hence a reduction in the actual productivity on the area as a whole. Furthermore, the yield table functions are based on a certain frequency of thinning, which in turn affect the standing volume. With the changing conditions for the forestry sector, these prescriptions are not followed, which in turn may lead to deviations, both positive and negative, from the estimated volume and increment. Further details and alternative estimates can be found in Johannsen (2002) and Dralle et al. (2002).

Other factors also contribute to uncertainty of the reported sinks. As previously mentioned, the lack of national biomass expansion factors or better expansion functions makes the calculation step from biomass to total biomass the probably most critical in terms of uncertainty. Basic densities of wood from different tree species are better documented and the C concentration is probably the least variable parameter in the calculations.

In recognition of the difficulties in analyses of uncertainty, the estimated uptake of CO_2 in the forestry sector must be treated with caution.

The possibilities to assess the uncertainty of various estimates have improved considerably with implemtation of the new plot-based National Forest Inventory. The 95 % confidence interval of the estimated forest percentage (12.4 %) and average stem volume (199 m^3 pr ha) have been calculated to be 11.9-12.9 % and 194-204 m^3 pr ha, respectively (Nord-Larsen et al., 2008). However, a thorough analysis of the implications for the uncertainty for the estimates of sinks due to afforestation and forestry yet has to be performed. It will take place in conjunction with the planned retrospective recalculations and the change from the default method to the stock change method.

Time-series consistency

The forest areas in 1990 and 2000 were not the same for forests existing before 1990 (411 000 ha and 440 000 ha, respectively). This is due to the nature of the Forestry Census, i.e. there were different numbers of respondents in 1990 and 2000. An inconsistency of the time-series occurs again in 2007 where the estimated forest area is based on the new plot-based NFI (mean value 2002-2006: 526 550 ha) subtracted the afforested area 1990-2004, resulting in a total area of forests remaining forests of 498 950 ha for 2007.

We are aware that this is a problem. The difference in gross uptake of CO_2 between 1990-1999 and 2000-2006 is almost solely due to the difference in numbers of respondents to the questionnaire (i.e. forest area) as annual gross increment pr ha was similar for the two periods. As mentioned previously, the new plot-based NFI has estimated a slightly larger forest area than the forestry census. However, as mentioned below (Section 7.2.6), we prefer to avoid recalculations of the present data based on the new NFI due to the coming large area revisions based on the special land use matrix project currently being carried out in connection with the coming Kyoto Protocol reporting. This project will establish the land-use matrix including changes based on satellite images, aerial photos and databases. The project will elaborate forest maps for 1990, 2005 and 2012 and the project will also outline a procedure for updating of these maps. This is necessary in order to be able to apply the same forest definition (FAO-TBFRA) in 1990 as that used in the commitment period.

7.2.4 Source specific QA/QC and verification

QA for the area of existing forests was carried out by Statistics Denmark for the years 1990-2006, and QA for afforestation area is mainly carried out by the Danish Forest and Nature Agency, as this organisation is responsible for the administration of subsidies. Harvesting data to support estimates of emissions from forests existing before 1990 are derived from Statistics Denmark. The QA of harvesting data is therefore placed under QA within Statistics Denmark. Spreadsheets are in secure files at Danish Centre for Forest, Landscape and Planning. After the planned recalculations and methodological changes have taken place, QA/QC will be carried out by Forest & Landscape Denmark.

7.2.5 Source-specific recalculations

Since the submission to UNFCCC in April 2008 we have carried out a few small recalculations.

The increase in C stock of living biomass was corrected for the year 1999 (378 Gg C to 379 Gg C). The decrease in C stock in living biomass for conifers in forests remaining forests was corrected for the years 2005 and 2006. The reason for this is an update of harvesting figures at Statistics Denmark. There is only a slight difference between previously and currently reported net removals, i.e from 1672 Gg CO_2 to 1640 Gg CO_2 for 2005 and from 2574 to 2601 Gg CO_2 for 2006.

For cropland converted to forest land, we reported forest floor C sequestration for the fist time in the NIR from 2008, regarding the period 1990-2006. We have moved this C sink from "Net carbon stock change in soils" to "Net carbon stock change in dead organic matter" for the years 1990-2006. This would be the correct column for reporting as we understand the term "soil" as mineral soil without the organic material accumulated in the forest floor.

7.2.6 Source-specific planned improvements

Forest areas

A work is ongoing to reconstruct the land use matrix by 1990 and 2005 by use of databases, satellite photos and aerial photos. The land use matrix will give more accurate estimates of forest areas (remaining forest since 1990 and afforestation) and improve consistency in time-series. In the future, a land use matrix for 2012 will also be elaborated, and the NFI will to some extent provide activity data for ground-truth verification of the GIS data.

Coarse woody debris and understorey vegetation

The NFI supports reporting of more carbon pools than previously. Coarse woody debris and understorey vegetation is monitored and carbon stock changes will be estimated when the second round of the NFI has been completed.

Forest floors

Unfortunately soil sampling has not been included as part of the NFI so far. However, simple measurements of forest floor thickness in each plot will enable estimation of carbon stock changes in the litter pool according to IPCC GPG when the second round of the NFI has been completed. Existing national data on forest floor depth/mass relationships can be used to support these estimations.

Soil

Better information on C stock changes of Danish forest soils is foreseen for the commitment period. A national project is being performed to resample forest soils in a 7x7 km grid (106 forest plots and 26 afforested cropland plots). The main aim is to document that Danish forest soils are not a source for CO_2 emissions, as Denmark apply the non-source principle for litter and mineral soil pools under the Kyoto Protocol.

Biomass expansion functions

A weakness in the Danish biomass carbon estimates is the lack of national biomass expansion factors or functions. However, national data on aboveground biomass expansion functions for Norway spruce and beech will be available two years due to an ongoing project.

7.3 Cropland

The total Danish agricultural area of approximately 2.7 million ha can relate to approximately 700 000 individual fields, which again is located at 220 000 land parcels. This gives an average field size of less than four ha. The actual crop grown in each land parcel is known from 1998 and onwards. Since 1990 has the agricultural area decreased from 2.78 million ha to 2.66 million.

7.3.1 Source category description

The main sources/sinks on Cropland are land use, establishing of hedgerows and liming. Table 7.11 shows the development in the agricultural area from 1990 to 2007 (Statistics Denmark). In Denmark a continuous decrease of 6-12 000 ha pr yr in the agricultural area is observed. A part of the area is used for reforestation, settlements, nature conservation etc., but no clear picture is available yet. From 2004 to 2005 an increase in the agricultural area is given in the statistics from Statistics Denmark. This is primarily the area with grass in rotation and permanent grassland which has increased. This is due to a change in how the data are collected by Statistics Denmark and not a real change in the agricultural area. The abovementioned area is the cropped area including set-a-side and does not include small unused strips and land under hedge rows. Then the final land use matrix has been established next year the agricultural area for which there will be accounted for under the Kyoto protocol art. 3.4 will increase accordingly to include these areas.

Table 7.11 Agricultural areas in Denmark 1990-2006, ha.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(ha)									
Annual crops (CM) [1]	2 236 535	2 220 206	2 201 380	2 003 085	1 890 130	1 969 275	1 982 494	2 048 044	2 016 386	1 958 262
Grass in rotation (CM)	306 325	308 789	317 246	355 019	395 993	310 568	329 496	307 065	339 597	323 909
Permanent grass (GM)	217 235	212 030	207 932	197 229	191 000	207 122	192 851	167 600	156 260	159 530
Horticulture – vegetables (CM)	16 428	15 994	16 747	15 771	12 886	12 915	11 053	9 554	10 202	10 523
Horticulture – permanent (CM)	7 892	7 944	8 975	8 255	8 665	8 367	8 457	7 874	7 505	7 683
Set-a-side (CM)	3 861	4 694	4 047	159 200	221 326	217 801	191 683	147 877	141 900	184 141
Total	2 788 276	2 769 657	2 756 327	2 738 559	2 720 000	2 726 048	2 716 034	2 688 014	2 671 850	2 644 048

Continued	2000	2001	2002	2003	2004	2005	2006	2007
	(ha)							
Annual crops (CM) [1]	1 938 633	1 954 491	1 971 961	1 950 019	1 971 615	1 953 306	1 951 598	1 923 448
Grass in rotation (CM)	330 834	326 553	292 566	302 896	284 064	342 417	361 351	352 640
Permanent grass (GM)	166 261	173 702	177 546	177 635	172 536	192 968	189 384	196 630
Horticulture – vegetables (CM)	10 803	9 616	8 903	9 933	9 763	9 557	10 071	9 978
Horticulture – permanent (CM)	8 010	8 447	7 976	8 330	7 816	8 237	8 083	8 322
Set-a-side (CM)	192 441	202 757	206 555	208 893	199 510	200 751	190 020	171 743
Total	2 646 982	2 675 566	2 665 507	2 657 706	2 645 304	2 707 236	2 710 507	2 662 761

[1]CM refers to that the area is treated under Cropland Management. GM refers to Grassland Management.

7.3.2 Methodological issues

Based on the GIS analysis on the Land Parcel Information from 1998 is the agricultural area distributed between mineral soils and organic soils and subdivided into cropland and permanent grassland. Table 7.12 and 7.13 shows the main result from the GIS analysis. It can be seen, as expected, that set-a-side, grass in rotation and permanent grass is more common on organic soils than on mineral soils. The percentage distribution in Table 7.13 is used as parameters when estimating the land use between different categories for all years between 1990 and 2006.

Table 7.12 The distribution of crops between organic and mineral soils in 1998 according to the GIS-analysis. The figures are given in ha. The figures are slightly different from Table 7.11 due to different data sources and calculation methodologies.

Soil type	Annual crops in rotation	Set-a-side	Grass in rotation	Permanent grass	Total
Organic	82 191	16 056	24 885	27 864	150 997
Mineral	2 098 396	126 777	214 053	114 944	2 554 169
Total	2 180 587	142 833	238 938	142 808	2 705 166

Table 7.13 The distribution of organic soils and mineral soils in per cent in 1998.

Soil type	Annual crops in rotation	Set-a-side	Grass in rotation	Permanent grass	Total
Organic	54	11	16	18	100
Mineral	82	5	8	5	100

Table 7.14 The percentage distribution of the agricultural area used in the emission model.

Soil type	Annual crops in rotation	Set-a-side	Grass in rotation	Permanent grass
Organic	3.8	11.2	10.4	19.5
Mineral	96.2	88.8	89.6	80.5
Total	100.0	100.0	100.0	100.0

Furthermore the organic soils are divided in shallow and deep organic soils. 38 % of the organic soils are according to the Danish soil classification deep organic soils (Sven Elsnap Olesen, DIAS, pers. comm).

7.3.3 Emission from mineral soils

A 3-pooled dynamic soil model has been developed (Petersen 2003, Petersen et al. 2002, 2005, Gyldenkærne et al. 2005) to calculate the soil carbon dynamics in relation to the Danish commitments to UNFCCC. C-TOOL is used for both cropland and grassland. Due to the fragmented Danish landscape with small areas with permanent grassland, changes in C stock in grassland are included in the emission from Cropland (5.B). The latest review has addressed this. It has not been possible to split the emission from grassland on mineral soils into category 5.B and 5.C in the current submission. This will be made in the next submission where a major revision of the inventory for the LULUCF sector will be made.

C-TOOL is run on a county based level (average 250 000 ha), where all different crops grown in that area are taken into account, annual reported crop yield, the amount of crop residues returned to soil (data from Statistics Denmark), roots, amount of solid manure and slurry in the specific county based on output from the DIEMA-model (see the agricultural sector) for the different counties. C-TOOL is a 3-pooled dynamic model, where the approximate average half-live times for the three different pools are 0.6-0.7 years, 50 years and 600-800 years. The main part of biomass returned to soil each year is in the first and easiest degradable pool. C-TOOL is parameterised and validated against long-term field experiments (100-150 years) conducted in Denmark, UK (Rothamsted) and Sweden and is “State-of-art”.

The Danish soil classification is divided into mineral soils and organic soils. Danish organic soils are defined as soils having >10 % SOM in contradiction to the IPCC definition where organic soils has >20 % SOM. The modelling with C-TOOL is performed under the assumption that the soils above 10 % SOM, but below 20 % SOM can be treated as mineral soils. In most models this may lead to overestimated decay rates, but as the realized decay of the utilised model falls with rising C to N ratio, the decay rate presumably is within realistic boundaries also for the mineral soils with high SOM content. This matter should be investigated further though.

C-TOOL is initiated with data from 1980 and run multipliable times until stability, before the emissions from 1980 and onwards was calculated. Actual monthly average temperatures are used as temperature driver. The main drivers in the degradation of soil biomass are temperature and humidity. The Danish climate is quite humid with winter temperatures around zero degrees Celsius and hence is the importance of soil humidity on the model outcome low in contradiction to temperature, which has a high effect on the emission. As mentioned, when the major part of the biomass is returned to the soil it is quite easily degradable. Warm winters with unfrozen soils in connection with high inputs of biomass will therefore, as a result, yield high emissions from the soil compared to more cold years, which will yield low emissions. E.g. the peaks in 1990, 1998 and 2000 are due to high harvest yields and normal temperatures, whereas the peak in 1993 (see Figure 7.6) is due to a normal harvest year but with very low temperatures with low degradation rates. However, the modelled emissions are found to be the most realistic emissions estimates for Denmark.

In the most recent years (1999-2007), there have been very warm winters in Denmark. In 18 out of the last 20 years has the annual average temperature been above the average temperature from 1961 to 1990.

Year 2007 was the warmest year ever registered in Denmark with an average temperature of 9.5 °C or 1.8 °C above the average from 1961 to 1990. The modelled CO_2-emission from the mineral soils shows that the mineral soils this year was not able to retain the high loss obtained in 2006 but remained at the same low level as in 2006 (Figure 7.5 and Table 7.15). This is due to a combination of a slightly higher yield in 2007 than 2006 and that the high loss in 2006 can be linked to a high loss in the easily degradable soil carbon pool giving less readily degradable SOM to be degraded in 2007. The losses from soils are quite high in these years and higher than expected if having used average standard temperatures for 1961-90. If average temperatures were used the model calculation would show an increase in the soil C stock.

As described in the agricultural sector the Danish farmers has faced increased demands for lower environmental impact since the mid 1980s. This includes, among others, ban on field burning and increased demands for winter green crops (winter cereals and autumn sown catch crops such as grass and rape) to reduce leaching of nitrogen and ban on autumn application of animal manure. This change in agricultural praxis has influence on the C stock in soil in the longer term. The general effect on the C stock in soil is that the 1980s showed a decrease in the C stock. In the 1990s the C stock seems to have been stabilised and in future a small increase in the C-stock is expected, although it depends on how big the global warming will be in near future.

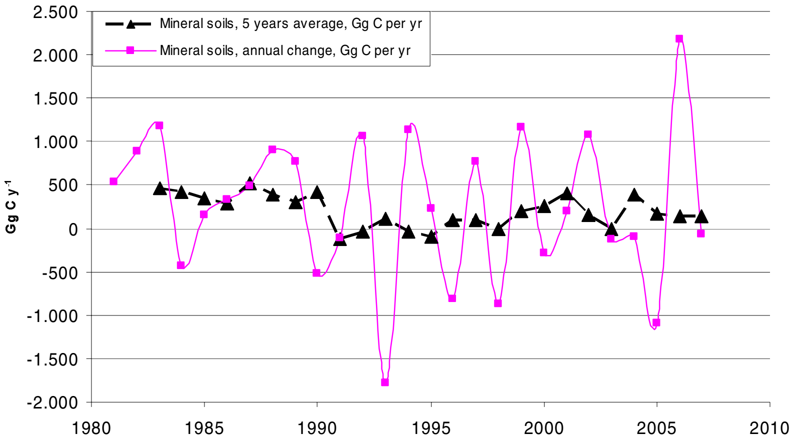


Figure 7.5 Modelled total annually emission and five-year average from all mineral soils in Denmark, Gg C pr yr from 1980 to 2007. Positive values are loss of carbon (emission) and negative values are carbon sequestration.

Table 7.15 Modelled carbon stock (0-100 cm) in mineral soils from 1980 to 2007. Positive emissions are loss of carbon and negative values are carbon sequestration.

Year	Carbon stock, Gg C	Emission, Gg C pr yr	Emission, Five-year average, Gg C pr yr
1980	431.297071		
1981	430.765166	0.531905	
1982	429.874044	0.891122	
1983	428.696583	1.177461	0.4653804
1984	429.127762	-0.431179	0.4242988
1985	428.970169	0.157593	0.3446512
1986	428.643672	0.326497	0.2892132
1987	428.150788	0.492884	0.5283182
1988	427.250517	0.900271	0.3931418
1989	426.486171	0.764346	0.3050134
1990	427.00446	-0.518289	0.4197582
1991	427.118605	-0.114145	-0.1167984
1992	426.051997	1.066608	-0.0414664
1993	427.834509	-1.782512	0.107693
1994	426.693503	1.141006	-0.0316664
1995	426.465995	0.227508	-0.09099
1996	427.276937	-0.810942	0.0918138
1997	426.506947	0.76999	0.0967486
1998	427.37544	-0.868493	-0.006296
1999	426.20976	1.16568	0.1956316
2000	426.497475	-0.287715	0.255924
2001	426.298779	0.198696	0.4051602
2002	425.227327	1.071452	0.1536626
2003	425.349639	-0.122312	-0.045556
2004	425.441447	-0.091808	0.3888734
2005	426.52656	-1.085113	0.1625176
2006	424.354412	2.172148	0.146139a
2007	424.414739	-0.060327	0.1450082a

[a]based on projected C input climatic conditions for 2008 and 2009.

Table 7.15 shows the modelled annual emissions and five-year average. To reduce the interannual variability in the reporting to UNFCCC the recommended five-year average is used (IPCC, 2004, Section 4.2.3.7 p 4.23).

Verification

A national Danish soil sampling program was initiated in 1987 on approximately 600 agricultural fields scattered throughout Denmark on all soil types. Resampling was made in 1998 in 320 plots. A new resampling has taken place late autumn in 2008 and another one will take place in 2013 to verify the model predictions made by C-TOOL. From 1987 to 1998 a decrease in soil C was found on pig farms and on farms without animal husbandry. On cattle farms an increase in soil C was registered, probably due to high manure application rates and a high percentage of grass in the rotation (grass has a large amount of root residues). An up scaling to the whole Danish area yields a very uncertain and not significant increase in soil C of two tonnes C pr ha from 110 tonnes pr ha to 112 tonnes pr ha (0-50 cm depth) in the same period, indicating that the output from C-TOOL is in line with the soil samples.

7.3.4 Emission from organic soils

Organic soils are defined as having >20 % OM. The emission from organic soils is estimated from the actual land use of the organic soils in four groups: annual crops, set-a-side, grass in rotation and permanent grassland. Only emission from organic soils on grassland is reported under Grassland (Table 5.C). Emissions from grassland on mineral soils are calculated with C-TOOL and included in Cropland, but will in future submissions be reported under Grassland.

The emission factors for organic soils are shown in Table 7.16. Negative values indicates a built up of organic matter. Wet organic soils are defined as having a water table between 0 and 30 centimetres. The carbon dioxide emission factor from the organic soils is based on emission data from Denmark, UK, Sweden, Finland and Germany, adjusted for differences in annual mean temperature to the average Danish climate (Svend E. Olesen, DIAS, 2005). E.g. data from southern Finland are adjusted with a factor of 2 and data from central Germany with a factor of 0.6.

Table 7.16 Emission factors for organic soils. Negative values indicates a built up.

				Emission factor, t C pr ha pr yr			
	% organic soils[1]	% with deep organic soils	% wet soils	Dry shallow	Dry deep	Wet shallow	Wet Deep
Annual crops	3.8	38	0	5	8	0	0
Grass in rotation	11.2	38	0	5	8	0	0
Set-a-side	10.4	38	26	3	4	-0.5	-0.5
Permanent grass (drained)	19.5	38	26	3	4	-0.5	-0.5

[1]Percentage of the total area from the annual survey from Statistics Denmark classified as organic

Emissions of nitrous oxide from organic soils are estimated from degradation of organic matter and the C:N-ratio in the organic matter. Figure 7.6 shows the C:N-ratio for 160 different soils. Hence for organic soils are used a C:N-ratio of 20. The IPCC Tier 1 value of 1.25 % is used as emission factor.

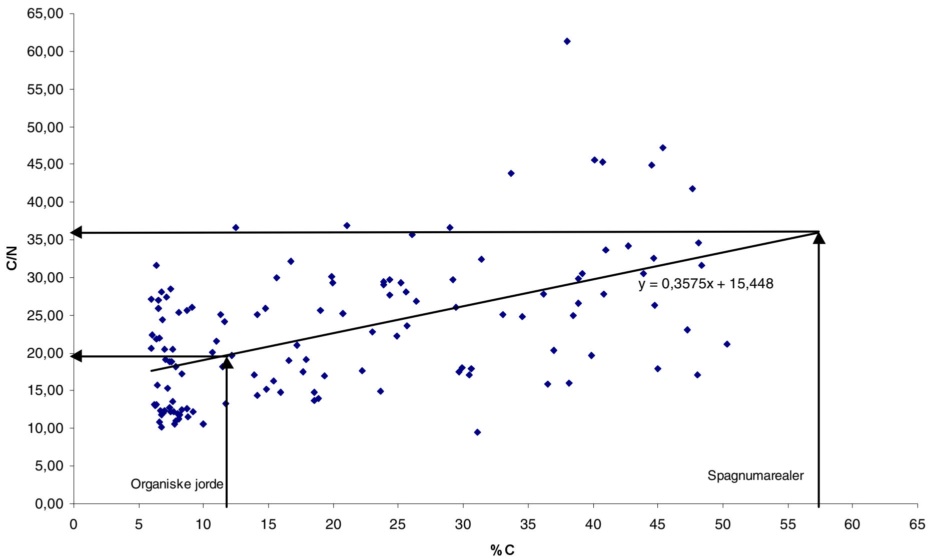


Figure 7.6 C:N-ratio in organic soils in relation to soil carbon content (Olesen 2004).

The estimated emissions from organic soils are given in Table 7.17. The approximately area distribution are shown in Table. 7.12 and the emission factors are given in Table 7.16. For 1990 to 2007 the different classes are given as a fixed percentage of the total annual area from Statistics Denmark. The differences between years are due to inter-annual changes in the area given by Statistics Denmark. A completely new soil map for the organic soils covering whole Demark are currently under development and will be finished for the 2011 submission.

Table 7.17 Emissions from organic soils 1990 to 2006.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
						(Gg)				
Cropland, Gg C pr yr	288	287	288	289	294	278	282	279	285	278
Grassland, Gg C pr yr	25	25	24	23	22	24	22	20	18	19
Total organic soils	313	312	312	312	316	302	305	299	303	297
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
				(Gg)						
Cropland, Gg C pr yr	279	279	272	273	269	283	288	282		
Grassland, Gg C pr yr	19	20	21	21	20	23	22	23		
Total organic soils	298	300	293	294	290	304	310	305		

7.3.5 Horticulture

Permanent horticultural plantations are reported separately under Cropland (Table 5.B). Permanent horticulture is only a minor production in Denmark. The total area for different main classes is given in Table 7.18. Due to the limited area and small changes between years the CO_2 removal/emission is calculated without a growth model for the different tree categories. Instead the average stock figures are used in Table 7.18 multiplied with changes in the area to estimate the annual emissions/removals. Perennial horticultural crops account for approximately 0.07 % of the standing C-stock.

The factors for estimating the C-stock in perennial horticulture are given in Table 7.19. Expansion factors and densities are the same as used in forestry (Section 7.2).

Table 7.18 Areas with perennial fruit trees and – bushes, C stock and stock changes from 1990-2007.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Apples, ha	2 726	2 462	3 006	2 209	2 061	1 658	1 854	1 697	1 660	1 623
Pears, ha	351	497	436	438	328	545	469	430	555	431
Cherries and Plumes, ha	2 200	2 200	2 200	2 222	2 641	2 854	3 023	2 794	2 791	2 956
Black currant, ha	1 269	1 486	2 091	1 919	2 351	1 827	1 783	1 531	1 280	1 411
Other, ha	250	250	250	449	337	348	343	323	235	272
Total, ha	6 796	6 895	7 983	7 237	7 718	7 232	7 472	6 775	6 521	6 693
C_t, stock, Gg	64.846	62.530	70.859	60.303	62.637	59.485	63.356	58.079	57.540	58.381
Stock change, Gg pr yr	-0.406	2.316	-8.329	10.557	-2.334	3.152	-3.871	5.277	0.540	-0.842
CO_2-emission, Gg pr yr	-1.489	8.492	-30.541	38.708	-8.558	11.556	-14.194	19.348	1.978	-3.086

Continued	2000	2001	2002	2003	2004	2005	2006	2007
Apples, ha	1 679	1 783	1 574	1 624	1 673	1 751	1 645	1 812
Pears, ha	441	469	420	457	439	416	413	465
Cherries and Plumes, ha	3 002	2 903	2 871	2 967	2 513	2 132	2 128	2 167
Black currant, ha	1 492	1 850	1 939	2 028	1 976	2 000	1 846	1 855
Other, ha	412	376	384	448	756	848	774	887
Total, ha	7 026	7 381	7 188	7 524	7 816	8 237	8 083	8 322
C_t, stock, Gg	60.135	61.368	58.121	60.316	56.759	54.025	52.047	55.269
Stock change, Gg pr yr	-1.754	-1.233	3.247	-2.195	3.556	-2.734	-1.979	3.223
CO_2-emission, Gg pr yr	-6.430	-4.519	11.905	-8.048	13.040	-10.025	-7.255	11.816

Table 7.19 Parameters used to estimate the C-stock in perennial horticulture (Gyldenkærne et al. 2005).

	Apples, old	Apples, new	Pears, old	Pears, new	Cherries and Plumes	Black currant	Other fruits bushes
Stem diameter, m	0.09	0.07	0.07	0.05	0.09	0.042	0.042
Height, m	3.00	3.00	3.00	3.00	4.00	1.00	1.50
Numbers, ha^{-1}	1905	2700	1250	2300	1000	4500	3000
Form figure	1.20	1.20	1.20	1.20	1.20	1.00	1.00
Volume, m^3 ha^{-1}	43.63	37.41	17.32	16.26	30.54	6.23	6.23
Expansion factor	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Density, t m^{-3}	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Biomass, t ha^{-1}	29.32	25.14	11.64	10.93	20.52	4.19	4.19
C content, t C t^{-1} $biomasse^{-1}$	0.50	0.50	0.50	0.50	0.50	0.50	0.50
C, t ha^{-1}	14.66	12.57	5.82	5.46	10.26	2.09	2.09
C, t ha^{-1} (average)	13.61		5.64		10.26	2.09	2.09

7.3.6 Hedgerows

Since the beginning of the early 1970s governmental subsidiaries have been given to increase the area with hedgerows to reduce soil erosion. Annually financial support is given to approximately 600-800 km of hedgerow pr year. Only C-stock changes in subsidised hedgerows are included in the inventory, not private erections. In 1990 75 % of the old single-rowed Sitca-spruce hedgerows were replaced with 3- to 6-rowed broad-leaved hedges. In 2004 only 20 % is replacements and the remaining is new hedges cf. Table 7.20. The figures are converted from kilometres to hectares according to the type of hedgerow. A simple linear growth model has been made to calculate the sink/removal from hedgerows. The parameters are given in Table 7.21. New hedgerows account for approximately 0.7 % of the standing accounted C-stock. In 1990 there was a net emission because the removed hedgerows were 12-15 meters tall Sitca-spruce. From 1994 there has been a net sink in the new hedgerow due to increasing area and the decreasing replacing rate.

Table 7.20 Areas with new hedgerows, C stock and stock changes 1990-2006. (De danske Plantningsforeninger, 2004 and update).

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Replaced, %	75	75	75	75	77	36	27	32	30	28
Replaced, km	696	830	804	706	610	291	278	351	307	279
Replaced, ha	174	207	201	177	152	73	70	88	77	70
New hedges, ha	464	553	536	471	460	482	610	628	576	579
Removed hedge, Gg C y-1	29	34	33	29	25	12	11	14	13	11
Sink in new hedge, Gg C y-1	-22	-24	-25	-27	-28	-30	-32	-34	-35	-37
Stock in new hedges, Gg C	155	179	204	231	259	289	320	354	389	427
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Replaced, %	27	25	23	22	20	20	26	15		
Replaced, km	292	298	63	187	110	101	104	67		
Replaced, ha	73	74	16	47	28	25	26	17		
New hedges, ha	626	682	207	474	320	287	230	269		
Removed hedge incl. thinning, Gg C pr yr	12	12	3	8	5	19	21	21		
Sink in new hedge, Gg C pr yr	-39	-41	-42	-43	-44	-45	-46	-33		
Stock in new hedges, Gg C	466	507	549	592	640	674	707	740		

Table 7.21 Parameters used for estimation of C in hedgerows (De danske Plantningsforeninger, 2004).

	Old hedges (1-row.)	New hedges (3-6 row.)
Wooden Stock, m^3 pr ha	480	260
Density, broad-leaved	0.56	0.56
Density, spruce	0.37	0.37
Density used in the calculations	0.38	0.50
Above ground biomass, m^3 pr ha	182	130
Expansion factor	1.80	1.20
Biomass, m^3 pr ha	328	156
t C pr t biomass	0.50	0.50
t C pr ha hedgerow	164	78
Year from plantation to first thinning	-	25
Thinning, per cent	-	45
Year between thinning	-	10

7.4 Grassland

The area with grassland is defined as the area with permanent grass given in the annual census from Statistics Denmark (Table 7.11). In 2007 196 630 ha is reported as permanent grassland. Based on the GIS analysis it is concluded that 18 347 ha are organic and the remaining grassland is on mineral soils. Emissions/sinks from grassland on mineral soils are included in cropland mineral soils. For the organic soils a CO_2-emission from drained areas with a water table below 30 cm is assumed. For areas with a water table between 0 and 30 cm a built up of organic matter is assumed (Table 7.16).

Table 7.17 shows the annual emissions given for grassland on organic soils. The emission from grassland is reduced from 25.3 Gg CO_2-C in 1990 to 22.9 Gg in 2007 due to a reduced area with permanent grass.

7.5 Wetland

Wetland includes land for peat extraction and re-established anthropogenic wetlands. Naturally occurring wetlands are not included in the inventory.

7.5.1 Wetlands with peat extraction

The area with peat extraction in Denmark is rather small. In 1990 the open area was estimated to 1 067 ha decreasing to 885 ha in 2006. All areas are nutrient poor raised bogs. The emission from the open area is calculated according to the standard approach for nutrient poor areas with an emission factor of 0.5 t C ha pr ha pr yr. Because the underlying default factor is mainly based on Finish data, a higher emission factor than recommended is chosen. This is in accordance with the difference in temperatures between Denmark and Finland (see Section 7.3). The nitrous oxide emission from peat land is estimated from the total N-turnover multiplied with a standard emission factor of 1.25 %. The C:N-ration in the peat is estimated to 36 in an analysis from the Danish Plant Directorate (PDIR 2004). Hence the N_2O emission is estimated to 0.546 kg N_2O pr t C. Due to changes in the Reporter in 2007 is it now possible to include a reduced CH_4-emission from the drained wetlands. This is included for all years from 1990 with a default factor of 20 kg CH_4 pr ha pr yr.

Table 7.22 Annual emissions from the surface area where peat extraction takes place, Gg C pr yr and N_2O pr yr.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Emission, Gg C pr yr	0.533	0.535	0.535	0.531	0.528	0.527	0.524	0.524	0.522	0.442
Emission, Mg N_2O pr yr	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Emission, Gg CH_4 pr yr	-0.028	-0.029	-0.029	-0.028	-0.028	-0.028	-0.028	-0.028	-0.028	-0.024
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Emission, Gg C pr yr	0.442	0.442	0.442	0.442	0.442	0.442	0.442	0.442		
Emission, Mg N_2O pr yr	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24		
Emission, Gg CH_4 pr yr	-0.024	-0.024	-0.024	-0.024	-0.024	-0.024	-0.024	-0.024		

7.5.2 Re-establishment of wetlands

In order to reduce leaching of nitrogen to lakes, rivers and coastal waters Denmark has actively re-established wetlands since 1997. In total 541 different areas ranging from 0.1 ha up to 2 180 ha have been reported to NERI. The total area converted to wetlands up to the year 2003 is 4 792 ha and 3 767 ha with raised water table. In 2004 1 622 ha re-established wetlands and 318 ha with raised water tables were reported. In 2005 only 413 ha was re-established and no areas with raised water table. Currently there are no programs subsidising the establishment of wetlands and hence only small areas are converted. It has been difficult to obtain data for 2007 and therefore an estimate of 0 ha has been used although some small areas may have been converted. This data will be validated further in future. See section 7.11. The total area with converted wetlands included is now 11 202 ha of which 8 189 ha have been estimated to be on agricultural land.

The area with raised water table will be unsuitable for annual cropping and protected by the legislation against future changes. Figure 7.7 shows the distribution of the areas in Denmark in 2003.

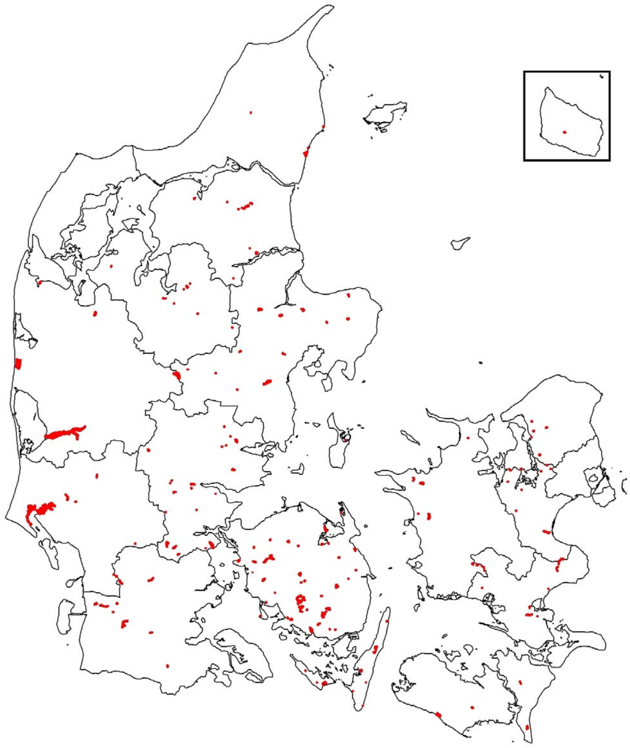


Figure 7.7 Areas with established wetlands and increased water tables from 1997 to 2003.

For areas converted before 2004 a detailed vector-map is available. Due to the reconstruction on the Danish municipalities all GIS maps will, in future, be collected by a single unit. When the reconstruction is complete an updated map will be constructed. The GIS-analysis shows that only part of the area is former cropland and that the distribution between mineral and organic soils differs (Table 7.23 and 7.24). In wetlands 68 % of the area is former cropland or grassland and in the areas with raised water table 81 % is former cropland or grassland. Furthermore it can be seen that there is a higher percentage of grassland in the areas with raised water table. Moreover, these areas have a higher percentage with organic soils. Only the areas with annual crops, set-a-side, grass in rotation and permanent grassland are included in the emission estimates in the inventory. The parameters used to estimate the emission are given in Table 7.16.

Table 7.23 Area classification of the established wetlands in ha.

	Area, total	Agricultural area: Annual crops	Set-a-side	Permanent grassland	Grass in rotation	Total	Per cent
Dry mineral soil	2 441	1 155	325	367	225	2 072	85
Dry organic	2 223	1 072	432	296	106	1 906	86
Wet mineral	551	46	28	70	41	185	33
Wet organic	521	58	56	74	7	195	38
Other	676	12	7	8	4	31	4
Total	6 414	2 342	849	814	383	4 389	68

Table 7.24 Area classification where the water table has been raised in ha.

	Area, total	Agricultural area: Annual crops	Set-a-side	Permanent grassland	Grass in rotation	Total	Per cent
Dry mineral soil	1 646	475	286	507	160	1 427	87
Dry organic	931	225	132	356	80	793	85
Wet mineral	1 003	37	17	627	89	770	77
Wet organic	399	21	29	190	49	289	72
Other	96	9	4	14	3	30	32
Total	4 075	767	468	1 695	380	3 310	81

The net-accumulation of C, with a standard sink factor of 0.5 t C ha pr year for the former agricultural area is included in the CRF-Table 5.D. The total annual net - build up from anthropogenic wetlands in 2007 - is estimated to 4.09 Gg C (only former cropland and grassland are included) (Table 7.25). The decreased oxidation of organic matter of the organic soils (due to the re-wetting) is included in Table 5.B and 5.C as a decreased total area. Until a full matrix for the Danish area is performed there will be some inconsistency in the total area.

Table 7.25 Increase in carbon sink in anthropogenic established wetlands, 1990-2006, Gg C pr yr.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Net sink. Gg G pr yr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	-0.16
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Net sink. Gg G pr yr	-1.34	-1.80	-2.35	-3.17	-3.84	-3.99	-4.09	-4.09		

7.6 Settlements

A land use matrix has not been established yet and hence no data on settlements and other built-up areas is given. A thoroughly analysis on the development in the built-up area will be made in 2009 and reported in the next submission. C-stocks in settlements are not estimated. The annual changes in C-stock in settlements are assumed to be negligible, but because no estimates have been made the changes are reported as NE in the CRF Table 5.E.

7.7 Other

C-stocks in other types of land are not estimated. Because of high nutrients loads to natural habitats it is expected that there is an increase here in the C stock, but no figures are available at the moment and no estimates have been made, therefore it is reported as NE in the CRF Table 5.F. It is expected that an estimate will be available for the next submission.

7.8 Liming

Liming of agricultural soils has taken place for many years. The Danish Agricultural Advisory Centre (DAAC) has published the lime consumption for agricultural purposes annually since 1960 (Table 7.26). DAAC are collecting data from all producers and importers. By legislation all producers and importers are obligated to have their products analysed for acid neutralisation content. The analysis is carried out by the Danish Plant Directorate and published annually (PDIR 2004). The published data from DAAC are corrected for acid neutralisation contents for each product and thus given in pure $CaCO_3$. For that reason there is no need to differ between lime and dolomite as made in the guidelines, as this has already been included in the background data. The data from DAAC includes all different products used in agriculture, including e.g. $CaCO_3$ from the sugar refineries.

The amount of lime used in private gardens has been estimated from the main supplier to private gardens. According to the company (Kongerslev Havekalk A/S, pers. comm.) they are responsible for 80 % of the sale to private gardens. Their sales figures have been used to estimate the total consumption in private gardens. Furthermore the figures are corrected for acid neutralisation capacity according to the data from the Danish Plant Directorate. This gives an approximate amount of 2 300 tonnes $CaCO_3$ pr yr in private gardens. This figure has been used for all years.

Only a very little amount of lime is applied in forests (<0.5 %) and on permanent grassland. Therefore all liming is included in the inventory under cropland (CRF Table 5(IV). The amount of C is calculated according to the guidelines where the carbon content is 12/100 of the $CaCO_3$. It is assumed that all C disappear as CO_2 the same year as the lime is applied.

The amount of lime used for agricultural purposes has declined with 70 % since 1990. From 2006 to 2007 the consumption in agriculture has decreased slightly from 440 300 t $CaCO_3$ to 436 300 t. 500 000 t $CaCO_3$ is expected to be the lowest consumption needed to maintain appropriate pH values in the Danish agricultural soils at the moment. The main reason for the reduced lime consumption is a decreased need for acid neutralisation due to less SO_X deposition in Denmark and a reduced consumption of fertilisers containing ammonium. The inter-annual variation is primarily due to weather conditions (if it is possible to drive in the fields) and the economy in agriculture.

Table 7.26 Lime application on cropland and grassland and in forests, 1990-2006.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Agriculture, 1000 t $CaCO_3$	1 283	1 049	810	695	832	1 125	891	1 065	571	600
Private gardens, 1000 t $CaCO_3$	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Total, 1000 t $CaCO_3$	1285.3	1051.3	812.3	697.3	834.3	1127.3	893.1	1067.1	573.1	602.3
Total, Gg C pr yr	-154.2	-126.2	-97.5	-83.7	-100.1	-135.3	-107.2	-128.1	-68.8	-72.3
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Agriculture, 1000 t $CaCO_3$	590	454	528	512	356	497	438	434		
Private gardens, 1000 t $CaCO_3$	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3		
Total, 1000 t $CaCO_3$	592.3	455.9	530.0	514.3	358.3	499.3	440.3	436.3		
Total, Gg C pr yr	-71.1	-54.7	-63.6	-61.7	-43.0	-59.9	52.8	52.4		

7.9 Uncertainties

A Tier 1 uncertainty analysis has been made for part of the LULUCF sector cf. Table 7.27. The latest review recommended including uncertainty estimates for all sectors. Simple uncertainty estimates of the forest sectors have been included.

The uncertainty in the activity data for the agricultural sector is rather low. The highest uncertainty is associated to the emission factors. Especially the emission/sink from mineral soils and organic soils has a high influence on the overall uncertainty.

The LULUCF sector contributes to a large extend to the total estimated uncertainty. In recognition of the difficulties in analyses of uncertainty, the estimated uptake of CO_2 in the forestry sector must be treated with caution. However, the assessment of uncertainty will improve significantly from the 2009 submission when the new National Forest Inventory can supply the first national estimate of stocks of wood, increment and harvest based on a design with permanent sampling plots and partial replacement. The new design will enable an assessment of uncertainty related to inventory data.

Table 7.26 Tier 1 uncertainty analysis for LULUCF for 2007.

		Emission/sink, Gg CO_2-eqv.	Activity data, %	Emission factor, %	Combined uncertainty	Total uncertainty, %	Uncertainty 95%, Gg CO_2-eqv.
5. LULUCF		-1127.5				15.6	175.8
5.A Forests		-2977.0				19.3	575.7
Broadleaves, Forest remaining forest	CO_2	-1762.9	20	20	28.3	28.3	498.6
Conifers, Forest remaining forest	CO_2	-1005.7	20	20	28.3	28.3	284.4
Broadleaves, Land converted to forest	CO_2	-139.6	20	20	28.3	28.3	39.5
Conifers, Land converted to forest	CO_2	-68.9	20	20	28.3	28.3	19.5
5.B Cropland		1587.2				30.2	479.7
Mineral soils	CO_2	531.7	10	20	22.4	22.4	118.9
Organic soils	CO_2	1032.9	10	50	51.0	51.0	526.7
Hedgerows	CO_2	-95.1	5	20	20.6	20.6	19.6
Perennial horticultural	CO_2	-11.8	10	10	14.1	14.1	1.7
Peat for horticultural use	CO_2	129.5	10	50	51.0	51.0	66.0
5.C.Grassland		84.1				51.0	42.9
Organic soils	CO_2	84.1	10	50	51.0	51.0	42.9
5.D Wetlands		-13.8				44.9	6.2
Land for peat extraction	CO_2	1.6	10	50	51.0	51.0	0.8
Land for peat extraction	N_2O	0.1	10	100	100.5	100.5	0.1
Land for peat extraction	CH_4	-0.5	10	100	100.5	100.5	0.5
Reestablished wetlands	CO_2	-15.0	10	50	51.0	51.0	7.7
Liming	CO_2	192.0	5	50	50.2	50.2	96.5

7.10 Recalculation

Recalculations have been made for mineral soils in 2005 and 2006 due to the chosen methodology where a five-year average is used. The amount of used lime in 2006 has been corrected from 407.300 tonnes to 440.300 tonnes. T

7.11 Planned improvements

To document the emissions and the carbon stock changes in LULUCF sector a 72 million DDK grant has been given for research and documentation purposes. This includes:

- Establishing of a land use matrix for all sectors based on remote sensing and vector maps
- A new map of the organic soils
- Danish emission factors for CH_4, N_2O and CO_2 from the organic agricultural soils
- Soil sampling in agricultural soil grid for verification of changes in soil C stock from 1987 to 1998 and to 2008. A resampling is planned again in 2013
- Establishing of a soil sampling network in forests containing app. 1000 sampling plots.
- Further validation of C-TOOL which is used in agricultural mineral soils
- Establishing of Danish Biomass Expansion Factors (BEF) for Norwegian spruce, beech and oak.

The land use matrix, results from the agricultural sampling plots and BEF factors will be available for the 2010 submission. The emission factors for organic soils and the new map of organic soils will be available for the 2011 submission.

Due to the reconstruction of the Danish counties a new reporting tool will be developed based on regional ecozones, which will be up scaled to cover the entire area of Denmark.

Lime in animal fodder deposited via manure in the field will be incorporated in future.

7.11.1 QA/QC and verification

A general QA/QC plan for the land-use sector is under development. For forestry the formal QA/QC plan is not yet implemented. This will take place in 2008. The following Points of Measures (PM) are taken into account.

Data Storage level 1	1. Accuracy	DS.1.1.1	General level of uncertainty for every data set including the reasoning for the specific values

The area estimates for cropland and grassland are very precise due to unrestricted access to detailed data from EUs Integrated Administration and Control System (IACS) on agricultural crops on field level and the use of the vector based Land Parcel Information System (LPIS). This access includes both Statistics Denmark and NERI. The total uncertainty in the crop data is estimated by Statistics Denmark to be <0.5 %. Together with detailed soil maps this gives a unique possibility to estimate the agricultural crops on different soil types and hence track changes in land use. However, IACS and LPIS are only available from 1998 and onwards, and estimates for 1990 are therefore more uncertain. The QA of crop data is made by Statistics Denmark. Data on hedgerows are based on subsidised hedgerows and QA is carried out by "Landsforeningen af Plantningsforeninger" who is responsible for the administration of the subsidiaries. The uncertainty in the number of plants used for the hedgerows is not estimated but is assumed to be very low because of the subsidised system. The re-establishment of wetlands is based on vector maps received from every county in Denmark. The uncertainty is not estimated but assumed to be very low due to the subsidised system.

Emissions from areas other than forestry, cropland, grassland, peat mines and re-established wetlands are not included. Denmark still needs to make a full land-use matrix from 1990 and onwards. This work almost finished and will be available for the next submission.. Natural areas such as heath land, natural wetlands etc. are thus not included in the current inventory.

The amount of lime used is more uncertain. Data is collected by DAAC from all suppliers and importers and published every year in "Planteavlsorientering." The collected data is assumed to be very reliable. No uncertainty analysis has been made, but it is assumed that it is in the range of 5-10 %. The emission factor may be overestimated due to expected leaching of CO_3^{--}, however no data are available on this issue.

A range of experts from the Faculty of Agricultural Sciences are repeatedly involved in discussions and report writings on topics related to the inventory.

Data Storage level 1	1. Accuracy	DS.1.1.2	Quantification of the uncertainty level of every single data value including the reasoning for the specific values.

Data Storage level 1	2.Comparability	DS.1.2.1	Comparability of the data values with similar data from other countries, which are comparable with Denmark and evaluation of discrepancy.

No comparison of the activity data with other countries has been made.

Data Storage level 1	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included by setting up the reasoning for the selection of data sets

See DS.1.1.1

Data Storage level 1	4.Consistency	DS.1.4.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PM's)

The original data files are stored at NERI in I:/rosproj/luft_emi-/inventory/2007/5_LULUCF/level_1a_storage/

Data Storage level 1	6.Robustness	DS.1.6.1	Explicit agreements between the external institution of data delivery and NERI about the condition of delivery

Signed formal agreements on data delivery have been made with the Statistics Denmark, The Danish Plant Directorate, Danish Agricultural Advisory Centre and Faculty of Agricultural Sciences.

The signed formal agreements are stored in: I:/rosproj/luft_emi-/inventory/allyears

No formal agreement has been made with "Landsforeningen de Danske Plantningforeninger" on data delivery. However, "Landsforeningen de Danske Plantningforeninger" are under public administration and thus are all data and maps directly available.

Due to the reorganisation on the Danish counties no formal agreements have been made on data delivery for vector based field maps on re-established wetlands because this part of the public sector is currently under reconstruction. This issue will be sought solved in 2009.

Data Storage level 1	7.Transparency	DS.1.7.1	Summary of each data set including the reasoning for selecting the specific data set

Please refer to DS.1.1.1

Data Storage level 1	7.Transparency	DS.1.7.3	References for citation for any external data set have to be available for any single number in any data set.

Much documentation already exists in the literature list. A separate list of references is stored in I:/rosproj/luft_emi/inventory/2004/5_LULUCF/level_1a_storage/

Data Storage level 1	7.Transparency	DS.1.7.4	Listing of external contacts to every data set

External contacts are:

Statistics Denmark: Karsten K. Larsen (kkl@dst.dk)

Landsforeningen De danske Plantningsforeninger: Helge Knudsen (laeplant@post7.mail.dk)

DAAC: Torkild S.Birkmose (tsb@landscentret.dk)

FAS: Bjørn Molt Pedersen (BjornM.Pedersen@agrsci.dk)

FAS: Jørgen E. Olesen (JorgenE.Olesen@agrsci.dk)

FAS: Hanne Damgaard Poulsen (HanneD.Poulsen@agrsci.dk)

Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to type of variability (Distribution as: normal, log normal or other type of variability)

In the uncertainty calculations a normal distribution of all activity data as well as for the emission factors is assumed. In many cases where data on emission factors are scare the uncertainty is based on expert judgement made by the involved institutions and persons.

Data Processing level 1	1. Accuracy	DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals)

The uncertainty assessment for LULUCF is given in the NIR. The uncertainty assessment for forestry will be improved next year when a full NFI has been made. In the documentation reports the size of the variation is normally given.

Data Processing level 1	1. Accuracy	DP.1.1.3	Evaluation of the methodological approach using international guidelines

The methodological approach is mostly scientifically state-of-art methods, however, in some cases the IPCC emission factors are chosen when it not has been possible to estimate more scientifically correct country specific values.

Data Processing level 1	1. Accuracy	DP.1.1.4	Verification of calculation results using guideline values

Emission factors and growth functions has only briefly been compared with IPCC guidelines.

Data Processing level 1	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCCC and IPCC.

The LULUCF inventory is made according to the IPCC-GPG on LULUCF, 2004.

Data Processing level 1	3.Completeness	DP.1.3.1	Assessment of the most important missing quantitative knowledge

Emissions and sinks in forest soils are not included in the inventory. Funding has been given to establish a soil sampling grind for the forest. Soil sampling will take place in 2008-2010.

Lime used in feeding stuff is not covered in the inventory, neither in the guidelines. Due to the high number of animals in Denmark, with optimised feeding, large quantities of $CaCO_3$ are applied to the soil through manure. A model for this is under development.

Natural habitats, natural wetlands, settlements and other land are not included in the inventory. At the moment no data are available.

Data Processing level 1	3.Completeness	DP.1.3.2	Assessment of the most important missing accessibility to critical data sources that could improve quantitative knowledge

In Denmark only very few data are restricted (military installations). Accessibility is not a key issue, it is more lack of data.

Data Processing level 1	4.Consistency	DP.1.4.1	In order to keep consistency at a higher level an explicit description of the activities needs to accompany any change in the calculation procedure

The calculation procedure is consistent for all years.

Data Processing level 1	5.Correctness	DP.1.5.1	Shows at least once by independent calculation the correctness of every data manipulation

During the development of the model thoroughly checks have been made by all persons involved in the LULUCF section.

Data Processing level 1	5.Correctness	DP.1.5.2	Verification of calculation results using time-series

During the development of inventory thoroughly checks of the time-series have been made by all persons involved in the LULUCF section.

Data Processing level 1	5.Correctness	DP.1.5.3	Verification of calculation results using other measures

During the calculations the results are checked according to the check-list.

Data Processing level 1	5.Correctness	DP.1.5.4	Shows one to one correctness between external data sources and the data bases at Data Storage level 2

Output data to Data Storage Level 2 is checked for correctness according to the check-list.

Data Processing level 1	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described

All calculation principles are described in the NIR and the documentation report (Gyldenkærne et al. 2005).

Data Processing level 1	7.Transparency	DP.1.7.2	The theoretical reasoning for all methods must be described

All theoretical reasoning is described in the NIR and the documentation report (Gyldenkærne et al. 2005).

Data Processing level 1	7.Transparency	DP.1.7.3	Explicit listing of assumptions behind all methods

All theoretical reasoning is described in the NIR and the documentation report (Gyldenkærne et al. 2005).

Data Processing level 1	7.Transparency	DP.1.7.4	Clear reference to data set at Data Storage level 1

A clear reference in the DP level 1 to DS level 1 is under construction.

Data Processing level 1	7.Transparency	DP.1.7.5	A manual log to collect information about recalculations

A manual log is constructed in the separate spread sheets.

Data Storage level 2	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data type at level 2 to data at level 1

A manual check list is under development for correct connection between all data types at level 1 and 2.

Data Storage level 2	5.Correctness	DS.2.5.2	Check if a correct data import to level 2 has been made

A manual check list is under development for correctness of data import to level 2.

References

Danish Energy Agency (2001). Denmark's Greenhouse Gas Projections until 2012. Ministry of Environment and Energy, Danish Energy Agency. ISBN 87-7844-213-3. Available at: http://www.ens.dk/graphics/Publikationer/Klima_UK/ReportGHG5dk_3May2001.pdf

Danish Forest and Nature Agency (2000). Evaluering af den gennemførte skovrejsning 1989–1998. Miljø- og Energiministeriet, Skov- og Naturstyrelsen, 2000. [Evaluation of afforestation areas 1989-1998. Ministry of Environment and Energy, National Forest and Nature Agency, 2000.] ISBN: 87-7279-241-8.

De danske Plantningsforeninger, 2004. Mr. Helge Knudsen, personal comm.

Dralle, K., Johannsen, V.K., Larsen, P.H. (2002). Skove og plantager 2000. Skoven 8: 339-344.

Gyldenkærne, S. Münier, B, Olesen, J.E., Olesen, S.E. Petersen, B.M. and B.T. Christensen, 2005 Opgørelse af CO2-emissioner fra arealanvendelse og ændringer i arealanvendelse LULUCF (Land Use, Land Use Change and Forestry), Metodebeskrivelse samt opgørelse for 1990 – 2003, Arbejdsrapport fra DMU 213, 81 s. Available at: http://www.dmu.dk-/Udgivelser/Arbejdsrapporter/Nr.+200-249/

Danmarks Statistikbank: http://www.statistikbanken.dk/. Data on annually harvested roundwood in the period 1990-2002.

Johannsen, V.K. (2002) Dokumentation af beregninger i forbindelse med Skovtælling 2000. Skovstatistik, Arbejdsnotat nr. 6, Skov & Landskab. 156 pp. [Documentation of calculations in Forestry Census 2000. Forest Statistics Working Paper No. 6, Forest & Landscape, Hørsholm, Denmark]

Larsen, P.H. and Johannsen, V.K. (2002) (eds.). Skove og Plantager 2000. [Forestry Census 2000]. Statistics Denmark, Skov & Landskab, Danish Forest and Nature Agency. ISBN 87-501-1287-2.

Miljøministeriet (2002). Danmarks Nationale Skovprogram. Miljøministeriet, Skov- og Naturstyrelsen. Available at: http://www.sns.dk/udgivelser/2002/87-7279-452-6/danmarks_nationale_skovprogram.pdf

Moltesen, P. (1988). Skovtræernes ved. [The wood of forest trees]. Skovteknisk Institut, Akademiet for Tekniske Videnskaber. ISBN 87-87798-52-2.

Møller, C.M. (1933). Bonitetsvise tilvækstoversigter for Bøg, Eg og Rødgran i Danmark. [Yield tables for different site classes of beech, oak and Norway spruce in Denmark]. Dansk Skovforenings Tidsskrift 18.

Nihlgård, B. and Lindgren, L. (1977). Plant biomass, primary production and bioelements of three mature beech forests in South Sweden. Oikos 28: 95-104.

Nord-Larsen, T., Johannsen, V.K., Jørgensen, B.B., Bastrup-Birk, A. (2008). Skove og plantager 2006, Skov & Landskab, Hørsholm,. 185pp. [Forests and plantations 2006 – the new National Forest Inventory]. http://www.sl.life.ku.dk/upload/sp2006.pdf

PDIR 2004, Gødninger m.m. Fortegnelse over deklarationer, producenter og importører 2004. Available at: http://www.pdir.dk/Files/Filer/Virksomheder/Goedning/Oversigt/Pjo/Fortegnelse_2004.doc

Petersen, B.M., Olesen, J.E. & Heidmann, T., 2002. A flexible tool for simulation of soil carbon turnover. Ecological Modelling 151, 1-14.

Petersen, B.M., 2003. C-TOOL version 1.1. A tool for simulation of soil carbon turnover. Description and users guide. Available at: http://www.-agrsci.dk/c-tool Danish Institute of Agricultural Sciences, Denmark. 39 pp. (C-TOOL can be downloaded from this site).

Petersen, B.M., Berntsen, J., Hansen, S. & Jensen, L.S., 2005. CN-SIM - a model for the turnover of soil organic matter. I. Long-term carbon and radiocarbon development. Soil Biology & Biochemistry 37, 359-374.

Schöne, D. and Schulte, A. (1999). Forstwirtschaft nach Kyoto: Ansätze zur Quantifizierung und betrieblichen Nutzung von Kohlenstoffsenken. Forstarchiv 70: 167-176.

Statistics Denmark (1994). Forests 1990. ISBN 87-501-0887-5.

Vande Walle I., Mussche, S., Samson, R., Lust, N. and Lemeur, R. (2001). The above- and belowground carbon pools of two mixed deciduous forest stands located in East-Flanders (Belgium). Ann. For. Sci. 58: 507-517.

Vesterdal, L. and Raulund-Rasmussen, K. 1998. Forest floor chemistry under seven tree species along a soil fertility gradient. Canadian Journal of Forest Research 28: 1636-1647.

Vesterdal, L., Ritter, E., and Gundersen, P. (2002). Change in soil organic carbon following afforestation of former arable land. For. Ecol. Manage. 169: 137-143.

Vesterdal, L., Rosenqvist, L., van der Salm, C., Hansen, K., Groenenberg, B.-J. & Johansson, M.-B. (2007) Carbon sequestration in soil and biomass following afforestation: experiences from oak and Norway spruce chronosequences in Denmark, Sweden and the Netherlands. In: Heil, G., Muys, B. & Hansen, K. Environmental Effects of Afforestation in North-Western Europe - From Field Observations to Decision Support. Springer, Plant and Vegetation 1: 19-52.

Vesterdal, L., Schmidt, I.K., Callesen, I., Nilsson, L.O., Gundersen, P., 2008. Carbon and nitrogen in forest floor and mineral soil under six common European tree species. Forest Ecol. Manage. 255: 35-48.

8 Waste Sector (CRF sector 6)

8.1 Overview of the Waste sector

The waste sector consists of the CRF source category 6.A Solid Waste Disposal on Land, 6.B. Wastewater Handling, 6.C. Waste Incineration and 6.D. Other.

For 6.A. Solid Waste Disposal on Land CH_4 emissions are considered in the following as a result of calculations in continuation of previously used and reported methodology. Analysis and investigations have been initiated as a result of the 2007 in-country review; refer to details below.

For 6.B. Wastewater Handling, the CH_4 and N_2O emissions were introduced in the inventory submissions for the first time in 2005 based on survey of available input data and methodological development in 2004-2005 as described Thomsen, M. & Lyck, E., 2005 and in the NIR in 2005 (Illerup et al, 2005). There were some smaller methodological revisions in the submission in 2006 (Illerup et al., 2006). In the 2007 submission no revisions were introduced. For the 2008 submission minor revisions were introduced related to the calculation of the Gross methane emissions. For this submission no further revisions were included.

For the CRF source category 6.C. Waste Incineration, the emissions are included in the energy sector since all waste incinerated in Denmark is used in energy production.

For the source sector 6.D. "Other" emissions from combustion of biogas in biogas production plants was included (mentioned as Gasification of biogas in the CRF tables) for the years 1994-2005 where these emissions existed. Emissions from this activity are not occurring in 2006 and 2007. Furthermore, reported CO_2 emissions from this activity for the years 1994-2005 was removed in the 2008 submissions due to the fact that CO_2 emissions only shall be included if they derive from non-biological or inorganic waste sources (refer footnote on CRF Table 6).

In Table 8.1, an overview of the emissions is presented. The emissions are taken from the CRF tables and are presented as rounded figures.

Table 8.1 Emissions for the waste sector, Gg CO_2 equivalents.

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
6 A. Solid Waste Disposal on Land	CH_4	1 335	1 359	1 369	1 383	1 345	1 301	1 291	1 231	1 190	1 215
6 B. Wastewater Handling	CH_4	126	123	121	127	152	177	202	248	253	237
6 B. Wastewater Handling	N_2O	88	83	73	91	92	85	69	65	66	62
6 D Other	CH_4+N_2O	NO	NO	NO	NO	0.001	0.003	0.003	0.003	0.025	0.031
6. Waste	Total	1 548	1 565	1 564	1 601	1 589	1 563	1 563	1 544	1 508	1 514
Continued		2000	2001	2002	2003	2004	2005	2006	2007		
6 A. Solid Waste Disposal on Land	CH_4	1 215	1 209	1 155	1 178	1 084	1 043	1 028	1 063		
6 B. Wastewater Handling	CH_4	217	231	310	300	275	262	248	256		
6 B. Wastewater Handling	N_2O	65	57	58	50	53	51	50	47		
6 D Other	CH_4+N_2O	0.029	0.019	0.022	0.025	0.020	0.016	NO	NO		
6. Waste	Total	1 498	1 498	1 523	1 528	1 412	1 355	1 326	1 366		

6.A. Solid Waste Disposal on Land is the dominant source in the sector with contributions in the time-series varying from 75.8 % (2002) to 87.6 % (1992) of the total emission, given in CO_2 equivalents, originating from the waste sector. In 2007, the contribution is 77.8 %. Throughout the time-series, the emissions are decreasing due to a reduction in the amount of waste deposited.

6.B. Wastewater Handling. For this source, CH_4 contributes the most to the sectoral total, varying between contributions of 7.8 % (1992) to 20.4 % (2002). In 2007 the contribution is 18.7 %. In absolute terms, the CH_4 emission from this source displays a slightly overall increasing trend in the time-series 1990-2007. This trend is explained by an increase in industrial contribution to the amount of organic degradable waste in the influent wastewater, a decrease in the final sludge disposal category "combustion" and the small recovery of methane potential by biogas production. N_2O from this source contributes with between 3.8 % (2006) to 5.8 % (1994) of the sectoral total. In 2007 the contribution is 3.5 %. In absolute terms, N_2O emissions decrease over the time-series. The decrease is due to technical upgrading of wastewater treatment plants resulting in a decrease in effluent wastewater loads, determining the indirect emission of N_2O, which is the major contributor to the emission of N_2O.

As a result, the sectoral total in CO_2 equivalents decreases throughout the time-series. For the absolute figures, given in Table 8.1, the emission in 2007 compared to 1990 has decreased 11.8 %.

8.2 Solid Waste Disposal on Land (CRF Source Category 6A)

8.2.1 Source category description

For many years, only managed waste disposal sites have existed in Denmark. Unmanaged and illegal disposal of waste is considered to play a negligible role in the context of this category.

The CH_4 emission from solid waste disposal on land at managed Solid Waste Disposal Sites (SWDS) constitutes in 2007 a key category according to level and trend as in 2006. In 2005 it was a key category to level only. Before 2005 it was a key category with regard to level and trend. The emission estimates for the CH_4 emission is decreasing with 20.4 % from 1990 to 2007.

A quantitative overview of this source category is shown in Table 8.2 with the amounts of landfilled waste, the annual CH_4 gross emissions from the waste, the CH_4 collected at landfill sites and used for energy production, the amount of CH_4 gas oxidised and the resulting emissions for the years 1990-2007. The amount of waste and the resulting CH_4 emission can be found in the CRF tables submitted as well.

In general, the amount of deposited waste has decreased markedly throughout the time-series. This is a result of action plans by the Danish government called the "Action plan for Waste and Recycling 1993-1997" and "Waste 21 1998-2004". The latter plan had, inter alia, the goal to recycle 64 %, incinerate 24 % and deposit 12 % of all waste. The goal for deposited waste was met in 2000. Further, in 1996 a municipal obligation to assign combustible waste to incineration was introduced. In 2002, the Danish Government set up new targets for the year 2008 for waste handling in a “Waste Strategy 2004-2008” report. According to this strategy, the target for 2008 is a maximum of 9 % of the total waste to be deposited. In the waste statistics report for the year 2004, data shows that this target was met, since 7.7 % of total waste was deposited in 2004 (Danish Environmental Protection Agency, 2006a). Further in 2005 the amount decreased compared to 2004 and was only 6.9 % of the total waste amount (DEPA 2006b). In 2006 and 2007 the contribution decreased further to 6.5 and 6.4 %, respectively.

The decrease in the emission throughout the time-series is marked, but much less so than the decrease in the amount of waste deposited. This is due to the time involved in the processes generating the CH_4, which is reflected in the model used for emission calculation.

Table 8.2 Waste amounts in landfills and their CH_4 emissions 1990-2007.

Year	Waste	Annual gross emission	Biogas Collected	Gas oxidized	Annual Net Emission	
	kt	kt CH_4	kt CH_4	kt CH_4	kt CH_4	kt CO_2-eqv
1990	3 175	71.1	0.5	7.1	63.6	1 335
1991	3 032	72.6	0.7	7.2	64.7	1 359
1992	2 890	73.9	1.4	7.2	65.2	1 369
1993	2 747	74.9	1.7	7.3	65.9	1 383
1994	2 604	75.8	4.6	7.1	64.1	1 345
1995	1 957	76.3	7.4	6.9	62.0	1 301
1996	2 507	76.5	8.2	6.8	61.5	1 291
1997	2 083	76.3	11.1	6.5	58.6	1 231
1998	1 859	76.1	13.2	6.3	56.6	1 190
1999	1 467	75.7	11.5	6.4	57.8	1 215
2000	1 482	75.3	11.0	6.4	57.9	1 215
2001	1 300	74.0	10.0	6.4	57.6	1 209
2002	1 174	72.3	11.2	6.1	55.0	1 155
2003	966	70.2	7.9	6.2	56.1	1 178
2004	1 000	68.3	11.0	5.7	51.6	1 084
2005	957	66.7	9.7	5.5	51.3	1 077
2006	976	65.2	7.9	5.4	51.5	1 081
2007	956	63.8	7.7	5.5	50.6	1 063

Disposal of waste takes place at 134 registered sites (year 2001, DEPA 2006b). The organic part of the deposited waste at these sites generates CH_4 gas, of which some is collected and used as biogas in energy-producing installations at 26 sites (DEPA, 2003).

8.2.2 Methodological issues

Activity data and emission factors

The data used for the amounts of municipal solid waste deposited at managed solid waste disposal sites is (according to the official registration) worked out by the Danish Environmental Protection Agency (DEPA) in the so-called ISAG database (DEPA 1996a, 1998a, 1999a, 2001a, 2001b, 2002a, 2004a, 2004b, 2005a, 2006a, 2006b, 2008 and 2009). The registration of the amounts of waste deposited takes place in the ISAG database in the following waste categories:

- Domestic Waste
- Bulky Waste
- Garden Waste
- Commercial & Office Waste
- Industrial Waste
- Building & Construction Waste
- Sludge
- Ash & Slag

However, for CH_4 emission estimates, a division of waste types is needed in categories with data for the Degradable Organic Carbon (DOC) content. For the following categories, investigations of DOC content etc. have been carried out for Danish conditions:

- Waste food
- Cardboard
- Paper
- Wet cardboard and paper
- Plastics
- Other combustible
- Glass
- Other, not combustible

The Danish investigation shows that the waste types contain the fraction of DOC as shown in Table 8.3.

Table 8.3 Fraction of DOC in waste types.

Waste Type	DOC-fraction of Waste
Waste food	0.20
Cardboard	0.40
Paper	0.40
Wet cardboard and paper	0.20
Plastics	0.85
Other combustible	0.20 - 0.57
Glass	0

Since the Danish solid waste disposal sites (SWDSs) are well-managed, it is assumed that a methane correction factor of 1 can be used (IPCC 2000, page 5.9, Table 5.1). Furthermore, 0.50 is used as the fraction of DOC dissimilated, which is considered good practice (IPCC 2000, page 5.9). Finally, the fraction of CH_4 in landfill gas is taken as 0.45 (IPCC 2000, page 5.10). These parameters lead to the calculation of a "general emission factor" for DOC as shown in Table 8.4. In the model formulation in this table oxidisation (in sub layers) has been kept and now been put to 0 - as compared to previous submission 0.10 - following the advice from reviewers, further on this in the text below.

Table 8.4 Calculation of general emission factor for DOC.

Parameter	Description	Input	Calculation
A	fraction of DOC oxidised in sub layers	0	
1 – a = b	fraction of DOC not oxidised in sub layers		1
C	fraction of DOC dissimilated	0.50	
b • c	fraction of DOC emitted as gas		0.50
D	fraction of gas emitted as CH_4	0.45 (as C)	
b • c • d	fraction of DOC emitted as CH_4		0.225 (as C)
b • c • d • (12 + 4 • 1) /12	fraction of DOC emitted as CH_4 =emf for DOC		0.30 (as CH_4)

DOC: Degradable Organic Carbon.

Combining Table 8.3 and Table 8.4 give emission factors for waste types, Table 8.5.

Table 8.5 DOC-fraction and fraction of waste emitted as CH_4 according to waste types.

Waste type	DOC-fraction of waste (1)	Fraction of waste emitted as CH_4 emf (2)
Waste food	0.2	0.060
Card-board	0.4	0.120
Paper	0.4	0.120
Wet card-board and paper	0.2	0.060
Plastics	0.85	0.255
Other combustible	0.20 - 0.57	0.060 - 0.171
Glass	0	0
Other not combustible	0	0

Column (2) is column (1) multiplied by emf for DOC (= 0.30).

"Other Combustible" varies in DOC-fraction according to ISAG waste types.

Unit of column (2) is "fraction". Example: 1 tonne of waste food: 60 kg of CH_4 is emitted.

The emission estimates are built upon a composition of the deposited waste, as shown in Table 8.6, and are according to Danish investigations.

Table 8.6 ISAG waste types and their content of waste types, fractions.

Materiale fractions in	Waste food	Card-Board	Paper	Wet Card-board and paper	Plastics	Other combu-stible	Glass	Metal	Other not combu-stible	Sum
Domestic Waste	0.379	0.017	0.128	0.264	0.068	0.034	0.017	0.047	0.047	1.00
Bulky Waste		0.078	0.233		0.047	0.457	0.085	0.085	0.016	1.00
Garden Waste						0.760			0.240	1.00
Commercial & office Waste	0.252	0.311	0.039	0.107	0.049	0.097	0.049	0.049	0.049	1.00
Industrial Waste	0.062	0.019	0.070	0.015	0.012	0.058	0.037	0.183	0.543	1.00
Building & constr. Waste						0.070			0.930	1.00
Sludge						0.290			0.71	1.00
Ash & slag									1.00	1.00

Table 8.6 forms the connection between the ISAG data (left column) and waste type (upper row) where emission factors have been calculated (Table 8.5). This composition is kept for the whole time-series.

The emission factors for the ISAG waste types are then calculated as the weighted average according to Table 8.5 and Table 8.6. The result is shown in Table 8.7.

Table 8.7 Emission factor for ISAG waste types, kg CH_4 pr kg waste.

	ISAG Waste Type							
	Domestic Waste	Bulky Waste	Garden Waste	Commercial & office Waste	Industrial Waste	Building & Construct. Waste	Sludge	Ash & Slag
Weighted emission factor	0.0753	0.1040	0.0570	0.0875	0.0245	0.00841	0.0496	0.0

The detailed explanation on the composition of waste and the methodology to obtain emission factors in this section of the NIR report has also been given, since the parameters in the CRF format are found not to be fully descriptive for the Danish data and for the methodology used.

The review team on the 2005 submission of data and the 2005 NIR pointed out that a more correct way to model the process of CH_4 emission in a landfill, as regards the recovery and the oxidation factor, is to use the oxidation factor after recovery. The recommendation of the review team has been implemented since the 2007 submission, refer e.g. Table 8.2 and text below.

The model and its results

The CH_4 emission estimates from SWDSs are based on a First Order Decay (FOD) model suited to Danish data availability and conditions and according to an IPCC Tier 2 approach. The input parameters for the model are yearly amounts of waste, as reported to the ISAG database, and the emission factors according to Table 8.7. In the model, the half-life time of the carbon of 10 years is used, corresponding to:

$k = \ln 2/10 = 0.0693\ year^{-1}$ (refer IPCC 2000, page 5.7)

which is in line with values mentioned in IPCC 2000, and close to the, default value of 0.05, IPCC 2000.

The time lag factor has been filled in the CRF-format as NA, but is fact zero in a unit of years since the model used accounts for emissions from waste the same year as the waste is deposited.

The model calculations are not performed pr landfill site, but for all waste deposited at all sites.

The yearly amounts of the different waste types and their emission factors are used to calculate the yearly potential emission. From the potential emission, the annual gross emission is calculated using the model. The CH_4 captured by biogas installations at some of the sites is subtracted from this emission. The amounts of CH_4 captured are according to the Danish energy statistics. Further, CH_4 gas oxidised is subtracted. The result is annual net emissions. The waste amounts and the calculated CH_4 emissions are shown in Table 8.8.

Table 8.8 Amounts of waste and CH_4 emissions for 1990-2006.

Year	Domestic Waste	Bulky Waste	Garden Waste	Commercial & office Waste	Industrial Waste	Building & construction Waste	Sludge	Ash & slag	Waste Total	Potential emission	Annual Gross Emission	Biogas collected	Annual net emission before oxidation	Annual net emission after ox. 0.1
	Kt									Kt CH_4				
1990	198.9	250.7	85.2	109.3	822.4	951.4	222.1	535.0	3 175.1	94.7	71.1	0.5	70.6	63.6
1991	198.7	259.0	70.7	120.0	824.3	804.3	193.3	562.0	3 032.3	93.0	72.6	0.7	71.9	64.7
1992	198.4	267.3	56.1	130.7	826.2	657.2	164.6	589.0	2 889.6	91.3	73.9	1.4	72.4	65.2
1993	198.2	275.7	41.6	141.3	828.1	510.1	135.8	616.0	2 746.8	89.7	74.9	1.7	73.2	65.9
1994	198.0	284.0	27.0	152.0	830.0	363.0	107.0	643.0	2 604.0	88.0	75.8	4.6	71.2	64.1
1995	190.0	286.0	17.0	128.0	779.0	321.0	101.0	135.0	1 957.0	83.0	76.3	7.4	68.8	62.0
1996	132.0	275.0	6.0	135.0	822.0	317.0	117.0	703.0	2 507.0	79.3	76.5	8.2	68.3	61.5
1997	83.0	248.0	6.0	170.0	707.0	264.0	130.0	475.0	2 083.0	73.3	76.3	11.1	65.1	58.6
1998	98.0	234.0	20.0	161.0	746.0	266.0	124.0	210.0	1 859.0	73.6	76.1	13.2	62.9	56.6
1999	117.0	239.0	3.0	164.0	582.0	224.0	126.0	12.0	1 467.0	70.6	75.7	11.5	64.3	57.8
2000	85.0	264.0	7.0	152.0	611.0	269.0	94.0	0.0	1 482.0	69.5	75.3	11.0	64.3	57.9
2001	50.0	180.0	3.0	150.0	583.0	260.0	64.0	10.0	1 300.0	55.4	74.0	10.0	64.0	57.6
2002	37.0	161.0	4.0	137.0	520.0	229.0	48.0	38.0	1 174.0	48.8	72.3	11.2	61.1	55.0
2003	24.0	143.0	4.0	131.0	379.0	170.0	55.0	60.0	966.0	41.8	70.2	7.9	62.3	56.1
2004	11.0	132.0	5.0	140.0	452.0	172.0	42.0	46.0	1 000.0	41.7	68.3	11.0	57.3	51.6
2005	11.9	164.5	5.4	152.4	352.2	207.7	34.6	28.0	956.7	43.7	66.7	9.7	57.0	51.3
2006	13.5	156.4	5.7	150.8	375.3	203.9	39.4	30.6	975.5	43.7	65.2	7.9	57.2	51.5
2007	19.0	146.2	6.4	160.4	364.1	171.9	43.4	44.4	955.6	43.6	63.9	7.7	56.2	50.6

The total waste amount in Table 8.8 is the sum of the different waste types and thereby includes Industrial Waste, Building and Construction Waste. The total waste amount is reported as the activity data for the Annual Municipal Solid Waste (MSW) at SWDSs in the CRF Table 6.A. In so doing and in referring to the discussion of waste amounts in IPCC 2000, page 5.8, it is clear that these amounts are not really characteristics of the term "Municipal Solid Waste". Furthermore, it should be noted that these amounts are used to calculate the amount of waste produced pr capita in the Table 6A,C of the CRF and that these pr capita amounts may not, therefore, be comparable with those used by other parties using different approaches.

The implied emission factor (IEF) in the CRF tables reflects an aggregated emission factor for the model. This IEF has increased through the time-series from 1990 to 2003, despite the general decreasing trend in the amount of waste. This is due to the model, where emissions from the waste deposited are being calculated to take place in years after the actual year of deposition. From 2004 to 2007 the IEF and the amount of waste have decreased slightly

As mentioned in the section above, the review team pointed out that a more correct way to model the process of CH_4 emission in a landfill, as regards the recovery and the oxidation factor, is to use the oxidation factor after recovery. This suggestion is implemented in submissions since 2007.

This method now used for oxidation corresponds to the assumption that the oxidation takes place in the top layers of the landfills. Since the Danish solid waste disposal sites (SWDSs) are well-managed, it is assumed that 10 % of the CH_4 produced by the waste is oxidised (OX = 0.1; refer IPCC 2000, page 5.10). Furthermore, an analysis has been carried out on the introduction of individual half-life times for the emissions of CH_4 from the waste sectors used, Table 8.9.

Table 8.9 Analyses of CH_4 emissions for 1990-2006 using individual half-life time for waste sectors.

	Domestic Waste	Bulky Waste	Garden Waste	Commercial & Office Waste	Industrial Waste	Building & construction Waste	Sludge	Ash & Slag	Total Annual Gross CH_4 emission KT
Half-life time (year)	4	23	7	12	17	17	4		
Year				CH_4 emission ktonnes					
1990	13.8	9.9	6.2	3.9	10.7	6.9	13.9	0.0	65.4
1991	14.0	10.4	6.0	4.3	11.1	6.9	13.2	0.0	65.9
1992	14.1	11.0	5.8	4.7	11.5	6.8	12.4	0.0	66.3
1993	14.3	11.5	5.4	5.1	11.8	6.7	11.5	0.0	66.4
1994	14.4	12.0	5.1	5.6	12.2	6.6	10.5	0.0	66.3
1995	14.4	12.5	4.7	5.9	12.4	6.4	9.6	0.0	66.0
1996	13.7	13.0	4.3	6.2	12.7	6.3	9.0	0.0	65.2
1997	12.5	13.4	3.9	6.7	12.9	6.1	8.6	0.0	64.2
1998	11.7	13.7	3.6	7.1	13.1	6.0	8.2	0.0	63.5
1999	11.2	14.1	3.3	7.5	13.2	5.8	7.9	0.0	63.0
2000	10.4	14.5	3.0	7.9	13.3	5.7	7.4	0.0	62.1
2001	9.4	14.6	2.8	8.1	13.3	5.5	6.7	0.0	60.4
2002	8.3	14.6	2.5	8.4	13.3	5.4	6.0	0.0	58.6
2003	7.3	14.7	2.3	8.5	13.1	5.2	5.5	0.0	56.6
2004	6.3	14.6	2.1	8.7	13.0	5.1	5.0	0.0	54.8
2005	5.4	14.7	1.9	9.0	12.9	4.9	4.4	0.0	53.3
2006	4.7	14.7	1.8	9.2	12.7	4.8	4.0	0.0	52.1
2007	4.2	14.8	1.7	9.5	12.6	4.7	3.8	0.0	51.3

Comparing Table 8.9 with Table 8.8, it can be seen that the emissions using individual half-life times are smaller for the whole time-series. The difference increases from 8.1 % in 1990 to 20.1 % in 2005 and 2006 and 19.8 in 2007. Please note that this comparison is for annual gross emission (not net emission). This approach, including considerations with regard to the size of half-life times, will be analysed in more depth in the future based on references etc. in IPCC 2006.

During the in-country review in 2007 on the 2006 submission the composition of the waste during the time-series was discussed. Few large scale investigations of waste composition exist. The study on which the composition used here is based on waste composition in 1985, Table 8.6. It was agreed upon with the reviewers that the composition should be further studied and analysed. In the NIR 2008 a first attempt to show the sensitivity of the FOD-model to the waste composition was presented. In this NIR this analysis has ben carried out for the time-series 1990-2007. Based on a estimate on how composition may have changed from 1985 to 2007 a model version where the change in emission factor for the individual waste types was interpolated linearly between the composition in 1985 and the estimate of the composition in 2007.

In Table 8.10 is shown estimates of the percentage changes of the composition from 1985 to 2007 and in Table 8.11 is shown the composition in 2007 resulting from the estimated changes. In Table 8.10 the waste type “Other not combustible” is not shown, since the way this version of the model has been made the change for this type is not an input parameter, but is a result of the other estimates to make the fraction sum become one, refer Table 8.11.

Table 8.10 An estimate of changes in fraction for ISAG waste types from 1985 (Table 8.6) to 2007.

Material fractions in	Waste-Food	Card-Board	Paper	Wet Cardboard and paper	Plastics	Other combustible	Glass	Metal
Domestic Waste	-90	+30	+30	+30	+50	+10	+30	+20
Bulky Waste		+10	-30		+50	+10	-30	+10
Garden Waste						+30		
Commercial & office Waste	-90	+20	+30	+20	+50	+10	0	0
Industrial Waste	-90	+20	+30	+20	+50	+10	0	0
Building & constr. Waste						+20		
Sludge						+20		
Ash & slag								

Table 8.11 ISAG waste types and their content (fraction) of waste types for 2007.

Material fractions in	Waste-food	Card-Board	Paper	Wet Card-board and paper	Plastics	Other combusti-ble	Glass	Metal	Other not combus-tible	Sum
Domestic Waste	0.038	0.022	0.166	0.343	0.102	0.037	0.022	0.056	0.056	1.00
Bulky Waste		0.085	0.163		0.070	0.503	0.060	0.094	0.026	1.00
Garden Waste						0.988			0.012	1.00
Commercial & office Waste	0.025	0.373	0.050	0.128	0.073	0.107	0.049	0.049	0.147	1.00
Industrial Waste	0.006	0.022	0.091	0.017	0.019	0.064	0.037	0.183	0.559	1.00
Building & constr. Waste						0.084			0.916	1.00
Sludge						0.348			0.652	1.00
Ash & slag									1.000	1.00

In the choice of percentage changes on the composition of waste between 1985 and 2007 is reflected a large reduction of Waste food and a pronounced increase in Plastics, refer Table 8.10.

In Table 8.12 is shown the Gross emission of CH_4 calculated with the model formulated as just explained and half lifetime 10 years. In the table this result is compared with the model with fixed composition and used for the CRF-reporting.

Table 8.12 Result of calculation of Gross emissions CH_4 with model based on changing waste composition and the model with fixed composition.

Year	Annual Gross emissions ktonnes CH_4			Per cent
	Fixed 1985 composition	Changing composition 1985-2007	Diff	Diff
1984	57,0	57,0	0,0	0,0
1985	60,1	60,1	0,0	0,0
1986	62,9	62,9	0,0	-0,1
1987	65,3	65,4	-0,1	-0,1
1988	67,5	67,7	-0,2	-0,3
1989	69,5	69,7	-0,3	-0,4
1990	71,1	71,5	-0,4	-0,5
1991	72,6	73,1	-0,5	-0,7
1992	73,9	74,4	-0,6	-0,8
1993	74,9	75,6	-0,7	-0,9
1994	75,8	76,6	-0,8	-1,0
1995	76,3	77,2	-0,9	-1,1
1996	76,5	77,5	-1,0	-1,3
1997	76,3	77,4	-1,1	-1,4
1998	76,1	77,3	-1,2	-1,6
1999	75,7	77,0	-1,3	-1,7
2000	75,3	76,7	-1,4	-1,9
2001	74,0	75,5	-1,5	-2,0
2002	72,3	73,8	-1,5	-2,1
2003	70,2	71,8	-1,6	-2,3
2004	68,3	70,0	-1,6	-2,4
2005	66,7	68,4	-1,7	-2,5
2006	65,2	66,9	-1,8	-2,7
2007	63,9	65,7	-1,8	-2,9

It is seen from Table 8.12 that the difference is small, which shows that the calculation of the model is rather robust against changing composition of the waste seen in combination with the half life time of 10 years.

In Annex 3.E, further details on the model for the CH_4 emission from solid deposited waste are given.

8.2.3 Uncertainties and time-series consistency

Uncertainty

The parameters considered in the uncertainty analyses and the estimated uncertainties of the parameters are shown in Table 8.10. The reference is IPCC 2000, page 5.12, Table 5.2. For all uncertainties, symmetric values based on maximum numeric values are estimated as the uncertainties for the whole inventory is a Tier 1 approach to be summed up in the IPCC 2000, Table 6.1. Uncertainties are estimated on parameters, which are mostly used in factors for multiplication, so that the final uncertainty is estimated with Equation 6.4 in the IPCC 2000.

As regards the uncertainty given in the IPCC 2000, for the methane generation constant, k, (-40 %, +300 %), this uncertainty cannot be included in simple equations for total uncertainties, such as IPCC 2000, Equations 6.3 and 6.4. The reason is that k is a parameter in the exponential function for the formula for emission estimates. The FOD model has, therefore, been run with the k-values representing those uncertainties (-40 %: k=0.0416 (half-life time, 16 years), +300 %: k=0.2079 (half-life time, 3.33 years) as compared to the k=0.069 (half-life time, 10 years) used in the present model. Based on these runs on potential emissions, mean differences on calculated CH_4 emissions for 1990-2004 are found to be from – 17.3 % to +7.8 %.

The final uncertainty on the emission factor is based on uncertainty estimates in Table 8.13 and, by means of the GPG Equation 6.4, is calculated as:

Uncertainty of emission factor total % = SQRT($50^2+30^2+10^2+10^2+17.3^2$) = 62.6 %

Table 8.13 Uncertainties for main parameters of emissions of CH_4 for SWDS.

Parameter	Uncertainty %	Note
The Waste amount sent to SWDS MSWT*MSWF	10	Since the amounts are based on weighing at the SWDS the lower value in IPCC 2000, is used
Degradable Organic Carbon DOC	50	
Fraction of DOC dissimilated	30	
Methane Correction Factor	10	
Methane recovery and Oxidation Factor	10	see the text
Methane Generation Rate Constant	17.3	see the text

Time-series consistency and completeness

Registration of the amount of waste has been carried out since the beginning of the 1990s in order to measure the effects of action plans. The activity data is, therefore, considered to be consistently long enough to make the activity data input to the FOD model reliable. For further information on activity data, refer to Annex 3.E.

The consistency of the emissions and the emission factor is a result of the same methodology and the same model used for the whole time-series. The parameters in the FOD model are the same for the whole time-series. The use of a model of this type is recommended in IPCC 1997 and 2000. The half-life time parameter used is within the intervals recommended by in IPCC 2000.

As regards completeness, the waste amounts used, as registered in the ISAG system, do not only include traditional Municipal Solid Waste (MSW), but also non-MSW as Industrial Waste, Building and Construction Waste and Sludge. The composition of these waste types is, according to Danish data, used to estimate DOC values for the waste types (refer IPCC 2000, page 5.10).

8.2.4 QA/QC and verification

QA/QC-procedure

In previous reviews it was recommended to improve the description. In the review of the 2005 NIR it was acknowledged that this effort has taken place and has improved the NIR. It is the intention to publish a sector report for the Waste Sector. The main effort has, however, centred on improving the description in the NIR.

A proposal for formal agreements with regard to data deliverance has been put forward to DEPA concerning provision of annual waste amounts. However, such an agreement has not yet been signed. Since it is a statutory requirement that waste amounts are reported to DEPA, the agreement may potentially not be required (refer to the remarks under DS.1.3.1). DEPA makes a yearly report on the reception of the registrations, etc.

In general terms, for this part of the inventory, the Data Storage (DS) Level 1 and 2 and the Data Processing (DP) Level 1 can be described as follows:

Data Storage Level 1

The external data level refers to the placement of original data for amounts of waste categories or fractions. These categories/fractions are linked to data on waste types with known content of degradable organic carbon, see Section 8.2.2. Data for CH_4 recovery are used. Further (external) data are parameters to the FOD model. For further details on the external data, refer to the table below.

Table 8.14 Details on external data.

File or folder name	*Description*	*AD or Emf.*	*Reference*	*Contacts*	*Data agreement/Comment*
	Report on 2007 amounts according to the waste fractions	Activity data	Danish Environmental Protection Agency (DEPA), Waste Statistics (Affaldsstatistik)	Unit for Soil and Waste	The amounts are registered due to statutory requirements
Basic Data	Dataset for energy-producing SWDS	CH4 recovery data	The Danish Energy Authority (DEA)	Peter Dal	Prepared due to the obligation of DEA
swds_fod_model.xls	Excel file with the FOD model	Parameters of the FOD model	IPCC 1997 and 2000	Erik Lyck	

Data Processing Level 1

This level, for SWDS, comprises a stage where the external data are treated internally, preparing for the input to the NERI First Order of Decay model, see Section 8.2.2. The model runs are carried out and the output stored.

Data Storage Level 2

Data Storage Level 2 is the placement of selected output data from the FOD model as inventory data on SNAP levels in the Access (CollectER) database.

8.2.4.1 Points of measurement

The present stage of QA/QC for the Danish emission inventories for SWDS is described below for DS and DP level 1 Points of Measurement (PMs). This is to be seen in connection with the general QA/QC description in Section 1.6 and, especially, 1.6.10 on specific description of PMs common to all sectors, general to QA/QC.

Data Storage level 1	1. Accuracy	DS.1.1.1	General level of uncertainty for every dataset including the reasoning for the specific values

With regard to the general level of uncertainty, the amounts in waste fractions/categories are rather certain due to the statutory environment for these data, while the distribution of waste fractions according to waste type and their content of DOC is more uncertain. It is generally accepted that FOD models for CH_4 emission estimates offer the best and the most certain way of estimation. The half-lifes in the FOD models are an important parameter with some uncertainty.

Data Storage level 1	1. Accuracy	DS.1.1.2	Quantification of the uncertainty level of every single data value including the reasoning for the specific values.

The uncertainties of the DEPA data are not available in the DEPA reporting. The uncertainties are taken from IPCC 1997 and 2000. A special uncertainty/sensitivity analyses connected to the uncertainty/variation of the half-life parameter is carried out. DEA data on CH_4 recovery are considered to be precise. Refer to Section 8.2.3 on uncertainty.

Data Storage level 1	2.Comparability	DS.1.2.1	Comparability of the data values with similar data from other countries, which are comparable with Denmark, and evaluation of discrepancy.

Only some comparison of Danish data values from external data sources with corresponding data from other countries has been carried out in order to evaluate discrepancies. For many countries SWDS waste amounts do not – as for the Danish data – include waste from industrial sources, which presents a difficulty with regard to comparison.

Data Storage level 1	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included by setting down the reasoning behind the selection of datasets.

The following external data sources are used for the inventory on SWDS (refer also to the table above):

- Danish Environmental Protection Agency, ISAG database: amounts of the various waste fractions deposited (refer to Section 8.2.2).
- A Danish investigation on the waste types in waste fractions and the content of degradable organic carbon in waste types.
- Danish Energy Authority: Official Danish energy statistics: CH_4 recovery data.

The selection of sources is obvious. The ISAG database is based on statutory registrations and reporting from all Danish waste treatment plants for all waste entering or leaving the plants. Information concerning waste in the previous year must be reported to the DEPA each year, no later than 31 January. Registration is made by weight. For recovery data, the DEA registers the energy produced from plants where installations recover CH_4. for the energy statistics.

For the parameters of the FOD model, references are made to IPCC 1997 and 2000.

Data Storage level 1	4.Consistency	DS.1.4.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PMs).

The origin of external activity data has been preserved as much as possible. The starting year for the FOD model used is 1960, using historic data for waste quantities. Since 1994, data is according to the Danish ISAG reporting system. For further information on the origin of activity data, refer to Annex 3E. Files are saved for each year of reporting. In this way changes to previously received data is reflected and explanations are given.

The FOD model and its parameters have been used consistently, throughout the time-series, refer to Section 8.2.3.

Data Storage level 1	6.Robustness	DS.1.6.1	Explicit agreements between the external institution holding the data and NERI about the conditions of delivery.

It is a statutory requirement that amounts of waste are reported annually to DEPA, no later than January 31 for the previous year which corresponds well with the inventory development. No explicit agreement has yet been made.

Data Storage level 1	7.Transparency	DS.1.7.1	Summary of each dataset including the reasoning for selecting the specific dataset

The summary of the dataset can be seen in Table 8.8 in Section 8.2.2. For the reasoning behind the selection of the specific dataset, refer to DS 1.3.1.

Data Storage level 1	7.Transparency	DS.1.7.3	References for citation for any external dataset have to be available for any single value in any dataset.

These references exist in the description given in the Section 8.2.2.1, under methodological issues.

Data Storage level 1	7.Transparency	DS.1.7.4	Listing of external contacts for every dataset

The following list shows the person responsible and contact information for delivery of data:

Danish Environmental Protection Agency: Lene Graversen (LGR@MST.DK) and Lone Lykke Nielsen (LLN@MST.DK)

Danish Energy Authority: Peter Dal (pd@ens.dk)

Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to type of variability. (Distribution as: normal, log normal or other type of variability)

Tier 1 uncertainty calculations are made. The use of the Tier 1 methodology presumes a normal distribution of activity data and emission factor variability. The extent to which this requirement is fulfilled still needs to be elaborated. The uncertainty on the half-life time cannot be implemented on a Tier 1 level and a special assessment has been given, see DS.1.1.2.

Data Processing level 1	1. Accuracy	DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals)

The uncertainty assessment has been given in Section 8.2.3. The uncertainty on the half-life time cannot be implemented on a Tier 1 level and a special assessment has been given, see DS.1.1.1.

Data Processing level 1	1. Accuracy	DP.1.1.3	Evaluation of the methodological approach using international guidelines

An evaluation of the methodological approach, in comparison with the Tier 1 level, has been made, see Section 8.2.4. This shows that the emissions from waste estimated according to the default methodology from IPCC 1997 and 2000 will deviate considerably from those in this submission, also since the waste amounts estimated in the latter methodologies deviate from those used for Denmark.

Data Processing level 1	1. Accuracy	DP.1.1.4	Verification of calculation results using guideline values

From the evaluation carried out, see DP.1.1.3, it is clear that no direct verification can be carried out, since the method is a Tier 2 method, in accordance with IPCC 1997 and 2000.

Data Processing level 1	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by the UNFCCC and IPCC.

The calculation used is a Tier 2 methodology from IPCC 1997 and 2000.

Data Processing level 1	3.Completeness	DP.1.3.1	Assessment of the most important quantitative knowledge which is lacking.

There is no quantitative knowledge in the methodology on either (1) the shift over time in waste types within waste fractions and in DOC content in waste types or (2) possible individual conditions relating to the SWD sites. On going research might change this lack. In this NIR the sensitivity of the model with regards to waste composition has been preliminary investigated.

Data Processing level 1	3.Completeness	DP.1.3.2	Assessment of the most important cases where access is lacking with regard to critical data sources that could improve quantitative knowledge.

There is no direct data to elucidate the points mentioned under DP.1.3.1.

Data Processing level 1	4.Consistency	DP.1.4.1	In order to keep consistency at a high level, an explicit description of the activities needs to accompany any change in the calculation procedure.

There is no change in calculation procedure during the time-series and the activity data is, as far as possible, kept consistent for the calculation of the time-series.

Data Processing level 1	5.Correctness	DP.1.5.1	Show at least once, by independent calculation, the correctness of every data manipulation.

The model has been checked to give the results to be expected on fictive input data, se Annex 3E.

Data Processing level 1	5.Correctness	DP.1.5.2	Verification of calculation results using time-series

The time-series of activities and emissions in the FOD-model output, in the SNAP source categories and in the CRF format have been prepared. The time-series are examined and significant changes are checked and explained. Comparison is made with the previous year's estimate and any major changes are verified.

Data Processing level 1	5.Correctness	DP.1.5.3	Verification of calculation results using other measures

The correct interpretation in the model of the methodology and the parameterisation has been checked, refer DP.1.5.1.

Data Processing level 1	5.Correctness	DP.1.5.4	Shows one-to-one correctness between external data sources and the databases at Data Storage level 2

Data transfer control is made from the external data sources and to the SNAP source categories at level 2. This control is carried on further to the aggregated CRF source categories.

Data Processing level 1	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described

The calculation principle and equations are described in Section 8.2.2. Further transparency comes as a consequence of using Tier 2 method of IPCC 1997 and 2000.

Data Processing level 1	7.Transparency	DP.1.7.2	The theoretical reasoning for all methods must be described

The theoretical reasoning is described in Section 8.2.2 and, due to the used of the Tier 2 method inIPCC 1997 and 2000, is also described in these IPCC reports.

Data Processing level 1	7.Transparency	DP.1.7.3	Explicit listing of assumptions behind all methods

The assumption is that the emissions can be described according to a FOD model as described in IPCC 1997 and 2000 for SWDS. Furthermore, it is assumed that this FOD model can be run with the parameters as they are listed in Section 8.2.2.

Data Processing level 1	7.Transparency	DP.1.7.4	Clear reference to dataset at Data Storage level 1

Refer to the table at the start of this Section (8.2.4).

Data Processing level 1	7.Transparency	DP.1.7.5	A manual log to collect information about recalculations

Recalculation changes in the emission inventories are described in the NIR. The logging of the changes takes place in the yearly model file.

Data Storage level 2	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data types at level 2 to data at level 1

The full documentation for the correct connection exists through the yearly model file, its output and report files made by the CollectER database system.

Data Storage level 2	5.Correctness	DS.2.5.2	Check if a correct data import to level 2 has been made

This check is performed, comparing model output and report files made by the CollectER database system, refer to DS.2.5.1.

Suggested QA/QC plan for SWDS

The following points are a list of QA/QC tasks to be considered directly in relation to the SWDS part of the Danish emission inventories:

Data at storage level 1

- A further comparison with external data from other countries in order to evaluate discrepancies.
- Agreement on the data deliverance consistency and stability.
- Investigations into the possibility of obtaining data on variations in waste fraction composition and DOC content in the time-series.

Data processing level 1

More work on uncertainty calculations.

Further evaluation of FOD modelling with half-life time depending on individual waste types.

QA on evaluation and verification

It is good practice, and a QA procedure, to compare the emission estimates included in the inventories with the IPCC default methodology.

In Table 8.15, default methodology is presented using the IPCC 1997 or IPCC 2000, as appropriate. The parameters (on the pages in IPCC 1997 and 2000) used are referred to in the table. As seen against the calculation of DOC in the default methodology, the Danish data is not suited for direct use. Referring to the formula in the IPCC 2000, p5.9, it is assumed (referring to Table 8.6, above) that A comprises "Cardboard", "Paper" and "Wet Cardboard and Paper"; that B comprises "Plastic", "Other Combustible" and "Other not Combustible"; and that C comprises "Waste Food". A mean fraction of these categories was calculated for use in the default methodology.

Table 8.15 IPCC default methodology for CH_4 emissions from SWDS for 1990-2007. Notation: IPCC 2000: GPG and IPCC 1997: GL.

Parameter	Reference		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	Population	1000 cap	5 135	5 146	5 162	5 181	5 197	5 216	5 251	5 275	5 295	5 314
MSW	Waste generation rate GL Table 6-1	Kg pr cap pr day	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26
MSWT	Waste generation GL Table 6-1	Gg pr yr	2 362	2 367	2 374	2 383	2 390	2 399	2 415	2 426	2 435	2 444
MSWF	Fract. of waste to SWDS GL Table 6-1		0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
MCF	Methan Corr Factor GPG p 5.8		1	1	1	1	1	1	1	1	1	1
DOC	Degr Organic C GPG p 5.9		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
DOCF	Fract DOC diss GPG p 5.9		0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
F	Fraction CH_4 in gas GPG p5.10		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lo	Methan gener. pot GPG p5.8		0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
R	Danish Energy statistics	Gg CH_4 pr yr	0.5	0.7	1.4	1.7	4.6	7.4	8.2	11.1	13.2	11.5
OX	Oxid. Factor GPG p5.10		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
CH_4 emission		Gg CH_4 pr yr	29.7	29.6	29.0	28.8	26.3	23.9	23.5	20.9	19.2	20.9
Continued			2000	2001	2002	2003	2004	2005	2006	2007		
	Population	1000 cap	5 330	5 349	5 368	5 384	5 398	5 410	5 427	5 476		
MSW	Waste generation rate GL Table 6-1	Kg pr cap pr day	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26		
MSWT	Waste generation GL Table 6-1	Gg pr yr	2 451	2 460	2 469	2 476	2 482	2 488	2 496	2 518		
MSWF	Fract. of waste to SWDS GL Table 6-1		0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20		
MCF	Methan Corr Factor GPG p 5.8		1	1	1	1	1	1	1	1		
DOC	Degr Organic C GPG p 5.9		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19		
DOCF	Fract DOC dissimilated GPG p 5.9		0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55		
F	Fraction CH_4 in gas GPG p5.10		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		
Lo	Methan gener. pot GPG p5.8		0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07		
R	Danish Energy statistics	Gg CH_4 pr yr	11.0	10.0	11.2	7.9	11,0	9,7	7,9	7,7		
OX	Oxid. Factor GPG p5.10		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		
CH_4 emission		Gg CH_4 pr yr	21.4	22.4	21.4	24.4	21.8	23,0	24,7	25,2		

The table shows that the default methodology underestimates the amounts of waste deposited and the CH_4 emissions by a factor of 2-3. The reason for this is that the default methodology does not seem to include Industrial Waste, which is deposited in considerable quantities in Denmark, Table 8.8.

A further option in the default methodology is to include the total waste amount registered with the waste generation rate for total waste, and include the fraction of waste deposited to SWDS, Table 8.16. The fraction as well as the generation rate for total waste is included in the CRF Table 6 A "Additional Information".

Table 8.16 As Table 8.15 but with ISAG registered waste amounts and fraction of waste deposited to SWDS. Notation: IPCC 2000: GPG and IPCC 1997: GL.

Parameter	Reference		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	Population	1000 cap	5 135	5 146	5 162	5 181	5 197	5 216	5 251	5 275	5 295	5 314
MSW	Waste generation rate ISAG	kg pr cap pr day	5.4	5.5	5.6	5.7	5.9	6.0	6.7	6.7	6.3	6.3
MSWT	Waste generation	Gg pr yr	10 169	10 403	10 637	10 871	11 105	11 466	12 912	12 857	12 233	12 233
MSWF	Fract. of waste to SWDS ISAG		0.30	0.28	0.27	0.25	0.23	0.24	0.20	0.16	0.15	0.12
MCF	Methan Corr Factor GPG p 5.8		1	1	1	1	1	1	1	1	1	1
DOC	Degr Organic C GPG p 5.9		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
DOCF	Fract DOC dissimilated GPG p 5.9		0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
F	Fract CH_4 in gas GPG p5.10		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lo	Methan generation potential GPG p5.8		0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
R	Danish Energy statistics	Gg CH_4 pr yr	0.5	0.7	1.4	1.7	4.6	7.4	8.2	11.1	13.2	11.5
OX	Oxid. Factor GPG p5.10		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
CH_4 emissions		Gg CH_4 pr yr	194.9	187.4	178.9	170.2	158.7	168.8	157.4	121.2	105.2	83.3
Continued			2000	2001	2002	2003	2004	2005	2006	2007		
	Population	1000 cap	5 330	5 349	5 368	5 384	5 398	5 410	5 427	5 476		
MSW	Waste generation rate ISAG	kg pr cap pr day	6.7	6.5	6.7	6.4	6.8	7.2	7.8	7.7		
MSWT	Waste generation	Gg pr yr	13 031	12 768	13 105	12 614	13 359	14 210	15 459	15 476		
MSWF	Fract. of waste to SWDS ISAG		0.11	0.10	0.09	0.08	0.08	0.08	0.06	0.06		
MCF	Methan Corr Factor GPG p 5.8		1	1	1	1	1	1	1	1		
DOC	Degr Organic C GPG p 5.9		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19		
DOCF	Fract DOC dissimilated GPG p 5.9		0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55		
F	Fract CH_4 in gas GPG p5.10		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		
Lo	Methan generation potential GPG p5.8		0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07		
R	Danish Energy statistics	Gg CH_4 pr yr	11.0	10.0	11.2	7.9	11.0	9.7	7.9	7.7		
OX	Oxid. Factor GPG p5.10		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		
CH_4 emissions		Gg CH_4 pr yr	81.5	72.4	65.2	57.2	55.4	53.9	56.7	55.9		

The result of this adjusted default methodology is CH_4 emissions, which in the beginning of the time-series represent highly overestimated emissions and in the later part of the time-series represent somewhat overestimated emissions compared with the results of the FOD model. One explanation is that the FOD model reflects the ongoing process over the years with regard to the generation of CH_4 from waste deposited in previous years, while the default method only estimates emissions reflecting the waste deposited the same year.

Recalculations

For the submissions in 2009, recalculations have been carried out in relation to the final submission in 2008 of inventories for the years 2004-2006. The recalculation represents updates in the energy statistics on the uptake of CH_4 by installations at SWDSs for energy production. Further, for 2004-2005 rounding of data for waste amounts was removed in the model. The recalculation implies an increase in emissions of 2.5 and 4.0 % for 2004 and 2005 respectively.

Planned improvements

In response to the expert review team on the in-country review for the 2006 submissions, the methodology has been investigated with regards to the sensitivity for the composition of waste. Having more information on the actual recent composition of waste, investigations are planned to combine the revised model with waste type individual half-life time. References in IPCC 2006 Guidelines will be analysed in this context.

Finally further QA/QC analyses will be taken into consideration.

8.3 Wastewater Handling (CRF Source Category 6B)

8.3.1 Source category description

This source category includes an estimation of the emission of CH_4 and N_2O from wastewater handling. CH_4 is emitted from anaerobic treatment processes, while N_2O may be emitted from anaerobic as well as aerobic processes. Until 2002, the Danish Environmental Protection Agency (DEPA) has published data on 'wastewater from municipal and private wastewater treatment plants' (WWTPs) in a report series with the same title. The data in this report series includes an overview of influent wastewater parameters and influent wastewater loads of, e.g. organic degradable carbon at Danish WWTPs. Furthermore, wastewater treatment processes and categories and final sludge disposal categories for sewage sludge are included. Information and data are reported at national level. In another report series with the title 'Point sources', which is published as part of the National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environment (NOVANA), data on effluent quality parameters have been reported (DEPA, 1994, 1996b, 1997, 1998b, 1999b, 2001d, 2002b, 2003a, 2004d and 2005b). Newest published data in a report on point sources in 2007 includes activity data on nitrogen in effluents for 2005 and 2006 (ASEP, 2007), while data on the final disposal categories and influent wastewater load of organic carbon has not been reported since 2004. The influent load of organic carbon reported for 2006 was extracted from a database on wastewater quality parameters held by the Agency for Spatial and Environmental Planning that is part of the Ministry of the Environment available at www.miljoeportalen.dk (cf. Table 8.25).

The CH_4 emission from wastewater handling constitutes in 2007 a key category to trend (cf. Annex 1) as it did in 2006. Before 2006 this category did not include any key categories. In the key category trend analysis for 2007, it of minor importance being number 27 of 29 trend key categories and contributes with 0.4 % of the national total. (cf. Annex 1). The emission estimates for the CH_4 emission from wastewater handling is increasing with 104 % from 1990 to 2007 mainly caused by the industrial influent load which have increase from zero to 40.5 % from 1990 to 2004.

Methane emission

The net emission of CH_4 is calculated as the gross emission minus the amount of CH_4 potential not emitted; i.e. recovered and flared or used for energy production (Thomsen & Lyck, 2005). The not emitted methane potential is calculated as the amount of sludge used for biogas (and thus included in the CO_2 emission from the energy production) or combusted (and thus included in the calculation of CO_2 emission from the combustion processes). A summary of the calculated methane potentials of final disposal categories constituting the summed up not emitted methane potential, the gross and resulting net emission of CH_4 from 1990 to 2007 is given in Table 8.17.

Table 8.17 CH_4 emissions recovered and flared or used for energy production, total methane potential not emitted, gross and net emission data, Gg.

Year	CH_4, external combustion	CH_4, internal combustion	CH_4,combustion and reuse	CH_4, biogas	CH_4 potential not emitted	CH_4, gross	CH_4, net [1]
1990	2.39	4.67	1.20	0.24	8.51	14.49	5.98
1991	2.41	4.60	1.34	0.27	8.62	14.46	5.84
1992	2.43	4.52	1.49	0.30	8.73	14.51	5.78
1993	2.44	4.44	1.63	0.32	8.84	14.91	6.07
1994	2.46	4.36	1.78	0.35	8.95	16.20	7.24
1995	2.47	4.29	1.92	0.38	9.06	17.49	8.43
1996	2.49	4.21	2.07	0.40	9.17	18.79	9.62
1997	2.19	4.42	1.23	0.46	8.29	20.10	11.81
1998	2.52	4.05	2.36	0.45	9.39	21.42	12.03
1999	2.25	4.29	2.67	0.55	9.76	21.04	11.28
2000	3.64	3.12	3.61	0.51	10.88	21.22	10.34
2001	2.74	4.28	3.19	0.43	10.63	21.65	11.02
2002	1.91	3.47	2.87	0.41	8.65	23.43	14.78
2003	2.07	4.13	3.08	0.44	9.73	24.03	14.30
2004	2.07	4.13	3.23	0.44	9.87	22.96	13.08
2005	2.07	4.13	3.37	0.44	10.02	22.47	12.45
2006	2.07	4.13	3.52	0.44	10.16	21.99	11.82
2007	2.07	4.13	3.66	0.44	10.31	22.49	12.18

Based on the figures, the percent methane potential not emitted as methane due to combustion, i.e. ((CH_4, external combustion + CH_4, internal combustion)/CH_4 potential not emitted) x 100 %, has deceased from 83

% to 60 % throughout the period, 1990-2007. A decrease in internal and external combustion is accompanied by an increase in combustion processes included in the production and reuse of sludge from 14 % to 36 % of the total recovered methane potential.

Nitrous oxide emission

The emission of N_2O from wastewater handling is calculated as the sum of contributions from wastewater treatment processes at the WWTPs and from sewage effluents. The emission from effluent wastewater, i.e. indirect emissions, includes separate industrial discharges, rainwater-conditioned effluents, effluents from scattered houses, from mariculture and fishfarming. In Table 8.18, the contribution to the total emission of N_2O from effluents is given in Columns 2 to 6. The total N_2O emission from effluents is given in Column 7, the contribution from direct N_2O emission in Column 8 and the total N_2O emission, i.e. the sum of indirect and direct N_2O emissions, is given in the last column.

Table 8.18 N_2O emission from effluents from point sources, from wastewater treatment processes and in total, tonnes.

Year	N_2O, effluent from separate industry discharges	N_2O, rainwater conditioned effluent	N_2O, effluent from scattered houses	N_2O, effluent from maricul-ture and fish farming	N_2O, effluent from municipal and private WWTPs	N_2O, effluents in total	N_2O,WWTP, direct	N_2O,WWTP, direct and indirect [1]
1990	-	-	-	-	265	265	17	283
1991	-	14	-	-	237	252	17	269
1992	-	14	-	-	205	219	17	237
1993	40	16	20	27	170	273	20	293
1994	43	19	19	26	161	268	29	297
1995	39	14	18	27	140	238	37	275
1996	27	10	18	24	100	180	44	224
1997	28	13	18	23	76	158	52	210
1998	22	15	16	20	81	154	56	209
1999	14	15	15	22	81	147	57	204
2000	14	12	15	43	73	157	55	212
2001	13	12	16	28	66	134	48	183
2002	12	16	15	23	71	137	51	188
2003	8	11	15	18	57	109	52	161
2004	7	13	15	21	63	119	52	172
2005	7	10	14	19	60	111	53	163
2006	7	13	14	17	57	109	53	161
2007	5	11	14	16	54	100	53	153

* - activity data are not reported in the national statistics

The direct emission trend increases slightly, reaching a stable level from 1997 onwards. The decrease in the indirect emission from wastewater effluent is due to the technical upgrading of the WWTPs and the resulting decrease in wastewater effluent nitrogen loads. The indirect emission, which is the major contributor to the emission of nitrous oxide, is not expected to decrease much more in future, as effluent reduction of N compared to the influent load has increased from 65 % in 1993 to 80 % in 2004 (Thomsen & Lyck, 2005).

Regarding the time trend in indirect N_2O emission from 1990 to 2007 has decreased 62 % N_2O, and the direct N_2O emission has increased 67 %. In absolute figures the indirect emission is a major contributor and the resulting total N_2O emission has decreased 46 % from 1990 to 2007.

8.3.2 Methodological issues

A country-specific methodology has been developed for estimating CH_4 and N_2O emissions for wastewater handling in Denmark as described in Thomsen and Lyck, 2005. This section is divided into methodological issues related to the CH_4 and N_2O emission calculations, respectively.

Activity data and emission factors used in the estimation of CH_4 emissions

The methodology developed for this submission for estimating emission of methane from wastewater handling follows the IPCC Guidelines (IPCC, 1997) and IPCC Good Practice Guidance (IPCC, 2000).

According to the IPCC GL, the emission should be calculated for domestic and industrial wastewater and the resulting two types of sludge, i.e. domestic and industrial sludge. However, the information available for the Danish wastewater treatment systems does not fit into the above categorisation as a significant fraction of the industrial wastewater is treated at centralised municipal wastewater treatment plants (WWTPs) and the data available for the total organic waste (TOW) does not differentiate between industrial and municipal sewage sludge. Assuming that the characteristics of the TOW in domestic and industrial wastewater are similar, the division into emissions from domestic and industrial sewage sludge may be derived by subtracting the industrial contribution to the total emissions corresponding to the percent contribution given in Table 8.19.

Activity data used for calculating the Gross emission of Methane

From 1990 to 1998, the IPPC default methodology for household wastewater has been applied by accounting and correcting for the industrial influent load (Thomsen & Lyck, 2005). TOW activity data used for calculating the gross emission are given in Table 8.19.

Table 8.19 Total degradable organic waste (TOW) calculated by use of the default IPCC method corrected for contribution from industry to the influent TOW and country-specific data.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Contribution from industrial inlet BOD	2.5	2.5	2.5	5.0	13.6	22.2	30.8	39.4	48	41
Population (1000)	5 140	5 153	5 170	5 188	5 208	5 228	5 248	5 268	5 287	5 305
TOW [Gg] -; corrected IPPC method*	96.62	96.39	96.71	99.42	107.97	116.59	125.28	134.02	142.80	-
TOW [Gg] - country-specific data	-	-	-	-	-	-	-	-	-	140.25

	2000	2001	2002	2003	2004	2005	2006	2007
Contribution from industrial inlet BOD	42	38	38	37	40.5	40.5	40.5	40.5
Population (1000)	5 322	5 338	5 351	5 384	5 398	5 411	5 427	5 447
TOW [Gg] - corrected IPPC method*	-	-	-	-	-	-	146.59	149.93
TOW [Gg] - country-specific data	141.49	144.36	156.18	160.21	153.06	149.83	2006	2007

*TOW = (1+I/100) x (P x D_{dom}), where P is the Population number and D_{dom}= 18250 kg BOD pr 1000 persons pr yr.

**Data for 2005 are not available and has been reported as the average between TOW data reported for 2004 and 2006, respectively. Data for 2007 are estimated based on a constant contribution from the industry and an increase derived from the populationnumber. Data will be updated when data from all the counties of Denmark have been reported.

The gross emission of CH_4 is calculated by using the TOW data given in Table 8.19 multiplied by a country-specific emission factor (EF) derived as described in the next section.

Emission factor used for calculating the Gross emission of Methane

The emission factor (EF) is found by multiplying the maximum methane producing capacity (Bo) with the fraction of BOD that will ultimately degrade anaerobic, i.e. the methane conversion factor (MCF). The default value for Bo, given in the IPCC (2002) of 0.6 kg CH_4 pr kg BOD is used.

The fraction of sludge (in dry weight (dw) or wet weight (ww)) treated anaerobic is used as an estimate of the "fraction of BOD that will ultimately degrade anaerobically". This fraction is set equal to MCF. By doing so it is assumed that all of the sludge treated anaerobic is treated 100 % anaerobic and no weighted MCF is calculated. The per cent sludge that is treated anaerobic, aerobic and by additional different stabilisation methods are given in Table 8.20.

Table 8.20 Stabilisation of sludge by different methods in tonnes dry weight, dw, and wet weight, ww, respectively; DEPA 1989, 1999, 2001and 2003 a.

		Biological		Chemical		EF (IPCC 1996)
Year**	Units	Anaerobic	Aerobic	Other	Total	[kg CH_4 pr kg BOD]*
1987	Sludge amount in Tonnes dw	52 401	24 364	48 760	125 525	
1997		65 368	66 086	19 705	151 159	
1999		65 268	70 854	19 499	155 621	
2000		68 047	69 178	21 677	158 902	
2001		70 992	68 386	18 638	158 016	
2002		63 500	58 450	18 071	140 021	
1987	Sludge amount in % of total dw	41.7	19.4	38.9	100	0.25
1995		32	41	27	100	0.19
1996		32.7	41	26.3	100	0.20
1997		43.2	43.7	13.1	100	0.26
1999		41.9	45.5	12.5	100	0.25
2000		42.8	43.5	13.7	100	0.26
2001		45	43.3	11.7	100	0.27
2002		45	42	13	100	0.27
1997	Sludge amount in Tonnes ww	363 055	648 686	149 028	1 160 769	
1999		336 654	829 349	271 949	1 437 952	
2000		459 600	1 110 746	321 427	1 891 773	
2001		494 655	1 217 135	330 229	2 042 019	
2002		262 855	8 27 703	279 911	1 370 469	
1997	Sludge amount in % of total ww	31.3	55.9	12.8	100	0.19
1999		23.4	57.7	18.9	100	0.14
2000		24.3	58.7	17.0	100	0.15
2001		24.2	59.6	16.2	100	0.15
2002		19.2	60.4	20.4	100	0.12

*EF=Bo*MCF, where MCF equals the per cent amount of sludge treated anaerobic divided by 100 and Bo 0.6 kg CH_4 pr kg BOD.

For comparison both the emissions factors based on wet weight and dry weight are given in Table 8.20 in the last column. The emission factor calculated from the dry weight fractions is fairly constant from year 1997 to 2002. It seems reasonable to assume a constant emission factor of 0.26 kg CH_4 pr kg BOD based on the dry weight fraction of sludge treated anaerobic and an emission factor of 0.15 kg CH_4 pr kg BOD based on the wet weight fraction of sludge treated anaerobic. The emission factor based on wet weight is used for calculating the gross CH_4 emission since it seems the most appropriate to use when combined with BOD data in the emission calculation procedure.

The uncertainty in the fraction of wastewater treated anaerobic is judged by the average and spread of average of data given above. Both anaerobic fraction data based on wet and dry weight are included. The uncertainty is estimated to be 28 %.

Activity data used for calculating the not emitted methane potential

Of the total influent load of organic wastewater, the separated sludge has different final disposal categories. The fractions that are used for biogas, combustion or reuse including combustion include methane potentials that are either recovered or emitted as CO_2. The estimated methane potentials of these fractions have been subtracted from the calculated (theoretical) gross emission of CH_4 as given in the summary Table 8.17.

Therefore, to arrive at the net emission of methane from the Danish WWTPs, the recovered, flared or otherwise not emitted methane potential needs to be quantified. Available activity data for calculating the recovered and flared CH_4 potential (theoretical negative methane emission) is given in Table 8.21.

Table 8.21 Sludge in percent of the total amount of sludge and tonnes dry weights (dw) according to disposal categories of relevance to CH_4 recovery.

Unit	Year**	Combustion internal	Combustion external	Biogas	Other*
Percent	1987		24.6		18.5
	1997	15.5	6.2	1.5	0.8
	1999	7.4	14.8	1.9	9.1
	2000	15.0	9.2	1.6	14.4
	2001	14.8	6.3	1.0	11.3
	2002	11.4	4.4	0.9	10.0
Total tonnes dw	1987	23 330	11 665		7 667
	1997	23 500	9 340	2 338	1 211
	1999	23 008	9 845	2 972	14 140
	2000	11 734	23 591	*2 476*	22 856
	2001	23 653	14 532	1 588	17 883
	2002	15 932	6 120	1 262	13 989

*The category “Other” represents sludge which is combusted and reused.

**The Danish EPA has not released Data for 2003 to 2006.

Emission factor used for calculating the not emitted methane potential

The IPCC GPG background paper (2003) estimates the maximum methane producing capacity to be 200 kg CH_4 pr tonnes raw dry solids, which is also the emission factor (EF), as the methane conversion factor (MCF) is equal to unity for biogas process (EF= B_o * MCF). The fraction of the gross CH_4 emission, not emitted in reality, is then the dry weight of the biogas category multiplied by an EF of 200 kg CH_4 pr tonnes raw dry solids. The same EF is used for calculating the theoretical methane potential not emitted by the remaining disposal categories (cf. Thomsen & Lyck, 2005).

Overall time trends

Based on the available data, simple linear regression of the methane potentials of the four disposal categories, given in Table 8.21, has been performed. These regression estimates together with the country-specific calculations forms the basis for the results given in Table 8.17 (Thomsen & Lyck, 2005).

Time trends of the gross emission, the methane potential not emitted and the resulting net emission of methane, i.e. the last three columns of Table 8.17, is shown in Figure 8.1.

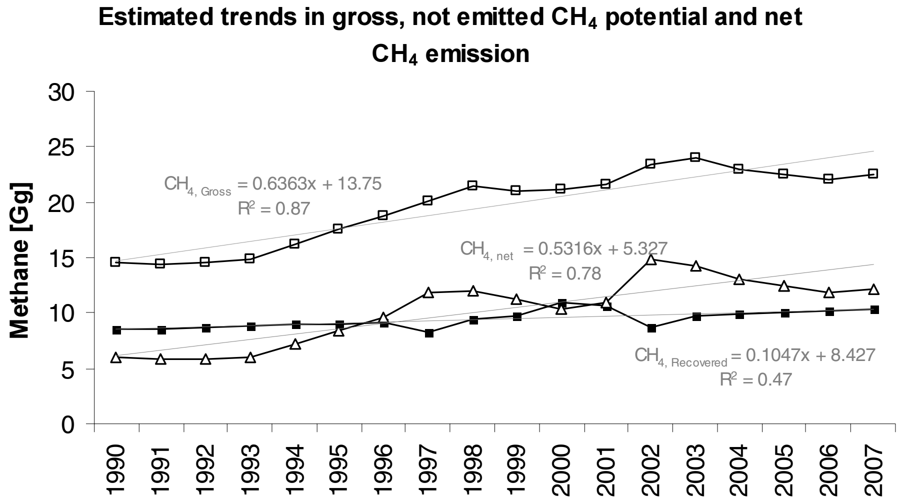


Figure 8.1 Estimated time trends for the gross emission of methane (open squares), methane potential not emitted; i.e. sum of columns 2 to 5, or column 6, in Table 8.13 (black squares) and net emission of methane (open triangles).

The three grey regression lines represent approximations of the calculated gross and net methane emissions and not emitted methane potential for the time period 1990 to 2007. Figure 8.1 shows that the net emission of methane on average increases 0.53 Gg pr year, as a result of the increase in the gross emission of, on average, 0.64 Gg pr year, and a minor increase in the amount of methane potential not emitted by 0.11 Gg pr year. The increasing trend in the net emission is a result of the industrial influent load of TOW, which has increased from an average of 2.5 % in 1990 to an average contribution of 39.4 % in the years from 1999 to 2004. At present, the reported data by the Danish EPA are considered having reached a constant level corresponding to a constant input load from the industry to the centralised WWTPs of 40.5 % (cf. Table 8.19).

It should be mentioned that varying amounts of inflowing rainwater, as well as outflowing water, may contribute to "noise" or fluctuation in the time trend of the TOW used for calculating the gross emission of methane 1999 to 2004. Time trends of the not emitted methane potential are difficult to interpret due to temporal changes in the individual final disposal categories contributing to the not emitted methane potential (cf. Thomsen & Lyck, 2005).

Methodological issues related to the estimation of N2O emissions

While CH_4 is only produced under anaerobic conditions, N_2O may be generated by nitrification (aerobic processes) and denitrification (anaerobic processes) during biological treatment. Starting material in the influent may be urea, ammonia and proteins, which are converted to nitrate by nitrification. Denitrification is an anaerobic biological conversion of nitrate into dinitrogen. N_2O is an intermediate of both processes. Danish investigation indicates that N_2O is formed during aeration steps in the sludge treatments process as well as during anaerobic treatments; the former contributing most to the N_2O emissions during sludge treatment (Gejlsberg et al., 1999).

Method used for calculating the direct N_2O emission

A methodology for estimating the direct emission of N_2O from wastewater treatment processes has been derived (cf. Thomsen & Lyck, 2005).

The direct emission from wastewater treatment processes is calculated according to the equation:

$$E_{N_2O,WWTP,direct} = N_{pop} \cdot F_{connected} \cdot EF_{N_2O,WWTP,direct}$$

where N_{pop} is the Danish population, $F_{connected}$ is the fraction of the Danish population connected to the municipal sewer system (0.9) and $EF_{N2O.WWTP.direct}$ are the emission factors given in Table 8.17.

Activity data and EF for calculating the direct N_2O emission

The EF is derived from a factor of 3.2 g N_2O pr capita pr yr (Czepiel, 1995) multiplied by a correction factor of 3.52 to account for the industrial influent load. The correction factor of 3.52 is derived from the difference in average nitrogen influent load at large and medium-sized WWTPs, divided by the influent load at large-size WWTPs. This approach is based on the assumption that the large-size WWTPs receive industrial wastewater while the medium size operators mainly receive wastewater from households (cf. Thomsen & Lyck, 2005).

Until better data is available, simple regression of the relation between industrial influent load in percent and the EF is used for the years 1990 to 1997, after which the industrial contribution to the influent load is assumed constant and the EF of 10.8 g N_2O pr capita pr yr is used in the calculations. The influent load of nitrogen is assumed to increase in a similar way to the industrial influent loads of BOD given in percent in Table 8.22. The estimated Danish emission factors, as a function of the increase in industrial influent load in the Danish WWTPs, are given in Table 8.22.

Table 8.22 EF and activity data used for calculating the direct emission of N_2O from wastewater treatment processes at Danish WWTPs.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N-population (1000)	5 135	5 146	5 162	5 181	5 197	5 216	5 251	5 275	5 295	5 314
F-connected fraction	0.870	0.869	0.867	0.870	0.870	0.874	0.875	0.882	0.891	0.879
Industrial load, %	2.5	2.5	2.5	5.0	13.6	22.2	30.8	39.4	48.0	41.0
Danish EF gN_2O pr person pr yr	3.8	3.8	3.8	4.2	6.2	7.8	9.4	11.0	11.7	12.0
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
N-population (1000)	5 330	5 349	5 368	5 384	5 398	5 411	5 427	5 447		
F-connected fraction	0.878	0.877	0.879	0.879	0.881	0.881	0.9	0.9		
Industrial load, %	42.0	38.0	38.0	37.0	40.5	40.5	40.5	40.5		
Danish EF gN_2O pr person pr yr	11.5	10.0	10.4	11.3	10.8	10.8	10.8	10.8		

The industrial loads of wastewater influent loads given in Table 8.22 for years 1990-2003 have been estimated from the original and registered data (Thomsen & Lyck, 2005). For the years 1990 to 1992, the industrial influent load is set to an average of 2.5 %. From the years 1993 to 1997, the percentages are assumed to increase linear as shown in Table 8.22. The Danish emission factors are based on a regression of percent industrial loads versus the corrected emission factors (Thomsen & Lyck, 2005). The average fraction of industrial nitrogen influent is considered constant from the year 1999 and forward. This is consistent with a fairly constant fraction of industrial wastewater influent from 1999 and forward.

Methodology – Indirect emissions - from sewage effluents

The IPCC default methodology only includes N_2O emissions from human sewage based on annual pr capita protein intake. The methodology only accounts for nitrogen intake, i.e. faeces and urine. Not included are industrial nitrogen input and non-consumption protein from kitchen, bath and laundry discharges. The default methodology used for the 10 % of the Danish population that is not connected to the municipal sewage system, is multiplied by a factor 1.75 to account for the fraction of non-consumption nitrogen (Sheehle and Doorn, 1997). For the remaining 90 % of the Danish population, national activity data on nitrogen in discharge wastewater is available. This data is used in combination with the default methodology for the 10 % of the Danish population not connected to the municipal sewer system. 10 % is added to the effluent N load to account for the WWTPs not included in the statistics (DEPA 1994, 1996, 1997, 1998, 1999, 2001, 2002 and 2003). The formula used for calculating the emission from effluent WWTP discharges is:

$$E_{N_2O,WWTP,effluent} = \left[\left(P \cdot F_N \cdot N_{pop} \cdot F_{nc} \cdot F\right) + \left(D_{N,WWTP} + \left(D_{N,WWTP} \cdot 0.1\right)\right)\right] \cdot EF_{N_2O,WWTP,effluent} \cdot \frac{M_{N_2O}}{2 \cdot M_N}$$

where P is the annual protein pr capita consumption pr person pr year.

F_N is the fraction of nitrogen in protein. i.e. 0.16 (IPCC (1997) GL, p 6.28)

N_{pop} is the Danish population

F_{nc} is the fraction of the Danish population not connected to the municipal sewer system, i.e. 0.1

F is the fraction of non-consumption protein in domestic wastewater. i.e. 1.75 (Sheehle and Doorn, 1997)

$D_{N.WWTP}$ is the effluent discharged sewage nitrogen load (with 10 % added to account for data not included in the statistics)

$EF_{N2O.WWTP.effluent}$ is the IPCC default emission factor of 0.01 kg N_2O-N pr kg sewage-N produced (IPCC (1997) GL, p 6.28)

M_{N2O} and M_{N2O} are the mass ratio i.e. 44/28 to convert the discharged units in mass of total N to emissions in mass N_2O

Activity data used for calculation of the indirect N_2O emission

In Table 8.23, activity data refers to the effluent discharged sewage nitrogen load ($D_{N,\,WWTP,}$).

Table 8.23 Discharges* of nitrogen from point sources, tonnes.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Separate industrial discharges				2 574	2 737	2 471	1 729	1 800	1 428	863
Rainwater conditioned effluent		921	882	1 025	1 207	867	629	800	968	975
Scattered houses				1 280	1 210	1 141	1 143	1 123	997	972
Mariculture and fish farming				1 737	1 684	1 735	1 543	1 494	1 241	1 418
Municipal and private WWTPs	16 884	15 111	13 071	10 787	10 241	8 938	6 387	4 851	5 162	5 135
Continued	2000	2001	2002	2003	2004	2005	2006	2007		
Separate industrial discharges	897	812	752	509	469	441	441	315		
Rainwater conditioned effluent	762	758	1 005	685	827	622	856	690		
Scattered houses	979	1 005	968	957	931	919	907	890		
Mariculture and fish farming	2 714	1 757	1 487	1 162	1 335	1 225	1 078	1031		
Municipal and private WWTPs	4 653	4 221	4 528	3 614	4 027	3 825	3 623	3444		

Data for 2007 are based on regression form the existing data set (personal communication: Karin Dahlgren Laursen, Agency for Spatial and Environmental Planning).

Overall time trends

The trends in the direct N_2O emission from WWTPs, the indirect emission from wastewater effluent and the total, as summarised in Table 8.14, are presented graphically in Figure 8.2.

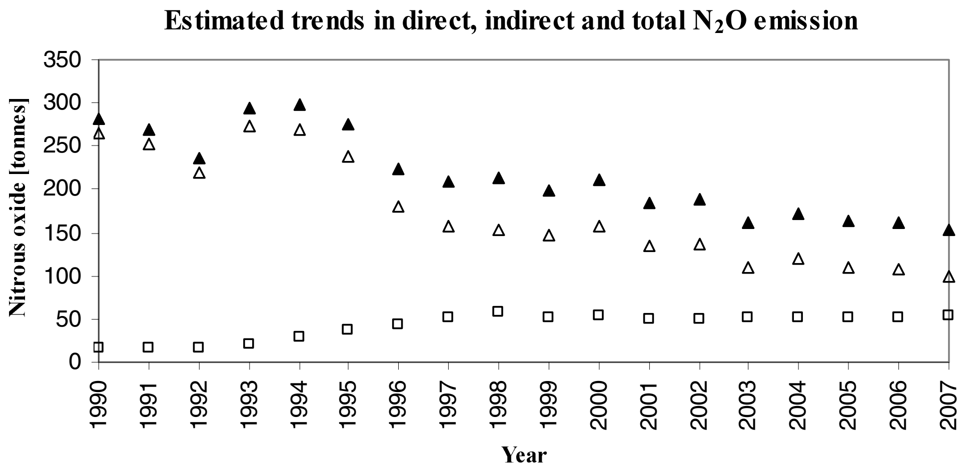


Figure 8.2 Time trends for direct emission of N_2O (open squares), indirect emission, i.e. from wastewater effluents (open triangles) and total N_2O emission (black triangles).

emission from effluent wastewater is due to the technical upgrade and centralisation of the Danish WWTPs following the adoption of the Action Plan on the Aquatic Environment in 1987. The increase in the direct N_2O emission are following the increase in influent TOW by an increased connection of industry to the municipal sewage system; reaching a constant level from 1997-1999 and onwards.

It should be mentioned that varying amounts of inflowing rainwater, as well as outflowing water, may contribute to the "noise" or fluctuation in the time trend of the calculated indirect N_2O emission.

8.3.3 Uncertainties and time-series consistency

Uncertainty

The parameters considered in the uncertainty analyses and the estimated uncertainties of the parameters are shown in Table 8.24. For all uncertainties, symmetric values based on maximum numeric value are estimated.

Table 8.24 Uncertainties for main parameters of emissions for wastewater handling.

Parameter	Uncertainty	Reference/Note	Emission type
TOW	±20 %	Default IPCC value (GPG, Table 5.3, p 5.19); maximum uncertainty in the country-specific data is 28 %	Gross CH_4 emission
Maximum methane producing Capacity (Bo)	±30 %	Default IPCC value (GPG, Table 5.3, p 5.19)	
Fraction treated anaerobically, i.e. the methane conversion factor (MCF)	±28 %	Based on the variation in registered data (Thomsen & Lyck, 2005)	
Methane potential	±50 %	Estimated based on IPCC background paper (2003)	Not emitted CH_4
Final disposal category data	±30 %	Estimated to be equal to the uncertainty in influent loads of organic matter	
EFN_2O,direct	±30 %	Calculated from average and standard deviation on data from Table 8.13, the uncertainty is around 10 %. Due to uncertainty in the industrial influent load I, (cf. Thomsen and Lyck, 2005) the uncertainty at this point is set to 30 %	Direct N_2O emission
Fconnected	±5 %	Set equal to uncertainty on population number	
N_{pop} is the Danish population number	±5 %	Default from IPCC GPG	
P is the annual protein pr capita consumption pr person pr year	±30 %	Not known/NERI estimate	Indirect N_2O emission
F_N is the fraction of nitrogen in protein	0 %	Empirical number without uncertainty	
N_{pop} is the Danish population number	±5 %	Default from IPCC GPG	
F_{nc} is the fraction of the Danish population not connected to the municipal sewer system	±5 %	Set equal to uncertainty on population	
F is the fraction of non-consumption protein in domestic wastewater	±30 %	Not known/NERI estimate	
$D_{N.WWTP}$ is the effluent discharged sewage nitrogen load	±30 %	Not known/NERI estimate	
$EF_{N2O.WWTP.effluent}$ is the IPCC default emission factor of 0.01 kg N_2O-N pr kg sewage-N produced	±30 %	Not known/NERI estimate	
M_{N2O}	0 %	Empirical number without uncertainty	

At this point, data regarding industrial on-site wastewater treatment processes is not available at a level that allows for calculation of the on-site industrial contribution to CH_4 or N_2O emissions. The degree to which industry is covered by the estimated emission is, therefore, dependent on the amount of industrial wastewater connected to the municipal sewer system. Any emissions from pre-treatment on-site are not covered at this stage of the method development.

The overall uncertainty on the emissions from uncertainty estimates in Table 8.24, and with the use of GPG Equation 6.3 and 6.4, is as follows:

Methane:

Uncertainty in estimating the gross emission of CH_4, U_{gross}:

U_{gross} = SQRT($28^2+20^2+30^2$) = 46.7 %

Uncertainty in estimating the recovered or not emitted CH_4, $U_{not\ emitted}$ is estimated to be equal for all four categories at this stage:

$U_{not\ emitted}$ = SQRT(30^2+50^2) = 58.3 %

The total uncertainty, U_{total}, associated with CH_4 emission estimates is estimated to be around 40 %, using Equation 6.3 (IPCC (2000) page. 6.12) and uncertainty quantities (x_i in eq. 6.3, IPCC (2000) set equal to the yearly average fraction treated anaerobically or by final sludge categories leading to a reduction in the gross emission.

Nitrous oxide:
Uncertainty estimates for the direct N_2O emission, U_{direct}:

U_{direct} = SQRT($30^2+5^2+5^2$) = 30.8 %

Uncertainty in the indirect N_2O emission, $U_{indirect}$, has been calculated as the uncertainty in the emission from the population connected and not connected to a WWTP, respectively, by use of Eq. 6.3 in the IPCC (2000) GPG.

The uncertainty associated with the emission of N_2O based on the proportion of the population not connected to a WWTP:

$U_{not\ connected}$ = SQRT($30^2+5^2+5^2+30^2+30^2$) = 52.4 %

The uncertainty in the emission from wastewater based on the proportion of the population connected to a WWTP:

$U_{connected}$ = SQRT(30^2+30^2) = 42.4 %

The resulting total uncertainty in the N_2O emission is estimated to be in the region of 26 % at this stage. The total uncertainty has been estimated based on uncertainty quantities equal to the fraction of the population connected and not connected to a WWTP, respectively. These fractions were multiplied by the average effluent N from households and WWTPs including industrial wastewater treatment, respectively (cf. Thomsen & Lyck, 2005). When the uncertainty quantities are set equal to the fraction connected and not connected, the total uncertainty estimate is 25 % (Eq. 6.3, IPCC GPG).

Time-series consistency and completeness
The frequency and form of registration of the different activity data, which are critical for the calculation of the emission of methane as well as nitrous oxide, is of varying quality.

Registration of the activity data needed for the calculation of nitrous oxide emission from the effluent water has been registered as a measure of the effectiveness (distance to target) of the Action Plan on the Aquatic Environment in 1987. However, especially data on final disposal categories used for calculating the amount of recovered, e.g. not emitted methane, is limited. Until now data has been extracted from different report series published by DEPA and from Statistics Denmark. DEPA consistency and completeness are expected to be improved by a harmonised databases held by the Environmental web portal secretariat located at the Agency for Spatial and Environmental Planning. Furthermore, an evaluation and quality assessment of existing sludge data are presently carried out by the soil contamination office at DEPA (personal communications). Comparability of existing data collection extracted from different reports with data at facility level as registered on the environmental web portal database, ISAG database, green accounting data is ongoing. By the end of this process increased consistency and completeness in the data set as well as the quality of the country-specific activity data and emission factors are expected.

8.3.4 QA/QC and verification

QA/QC-procedure

The methodology for estimating emissions from wastewater handling was introduced for the first time in the inventory submission in March-April 2005. Data in this methodology has been updated and revised were possible for the current submission involving activity data for 2004-2007 as presented in the preceding sections. As the activity data has been improved, there has been introduced smaller changed in the methodology in the 2006 submission and 2008 submission. These smaller changes will be documented together with the improved data quality as mentioned in the above section in the future.

In general terms, for this part of the inventory, the Data Storage (DS) Level 1 and 2 and the Data Processing (DP) Level 1 can be described as follows:

Data Storage Level 1

The external data level refers to the placement of input data used for deriving yearly activity and emission factors; references in terms of report and databases used for deriving input for the emission calculations. Reports and a list of links to external data sources are stored in a common data storage system including all sectors of the yearly NIRs.

Table 8.25 Overview of yearly stored external data sources at DS level1.

File or folder name	Description	AD or EF mf.	Reference	Contact(s)	Data agreement/ comment
Report series may be found at: www.mst.dk and www.miljoeportalen.dk or stored at NERI data-exchange folder I:\ROSPROJ\LUFT-_EMI\Inventory\waste sector\ 6 B. Wastewater Handling\NIR2007\DS1\	Yearly/ Each second year reporting frequency	Activity data	Report series from DEPA: "*Wastewater from municipal and private wastewater treatment plants*" and "*Point sources*".	Karin Dahlgren (kdl@blst.dk) and Trine Leth Kølby (trile@mst.dk)	none
http://faostat.fao.org	Annual protein consumption	Activity data	FAOSTAT	Marianne Thomsen (mth@dmu.dk)	none
http://www.statistikbanken.dk/FU5	Population	Activity data	Statistics Denmark	Marianne Thomsen (mth@dmu.dk)	none
http://danva.dk	Medium and small WWTP influent data used for calculating a correction factor accounting for the industrial contribution to wastewater characteristics	Emission factor	The Danish water and wastewater institution	Marianne Thomsen (mth@dmu.dk)	none

*The data storage level 1 consists of DEPA reports and other sources listed in the Table.

Data Processing Level 1

This level, for wastewater handling, comprises a stage where the external data are treated internally, preparing for the input to the country-specific models. Programming as to automatically calculations based on activity data and emission factors are not yet fully operational. Calculations are carried out and the output stored in a not editable format each year. The DP at level 1 has been improved to fit into a more uniform and easily accessible data reporting format. Regarding the derivation of activity data and emission factors used in the model calculations, improvements are ongoing and specifically in the next submission.

Data Storage Level 2

Data Storage Level 2 is the placement of selected output data from the country-specific models as inventory data on SNAP levels in the Access (CollectER) database.

Points of measurement

The present stage of QA/QC for the Danish emission inventories for wastewater handling is described below for DS and DP level 1 Points of Measurement (PMs). This is to be seen in connection with the general QA/QC description in Section 1.6 and, especially, 1.6.10 on specific description of PMs common to all sectors, general to QA/QC.

Data Storage level 1	1. Accuracy	DS.1.1.1	General level of uncertainty for every dataset including the reasoning for the specific values

With regard to the general level of uncertainty, the amounts in final disposal categories and i.e. the amount of not emitted methane are rather uncertain due to the missing systematic registering and definitions of the final disposal categories. In addition the activity data for calculating the direct and indirect nitrous oxide emission are scattered between different sources of varying reporting frequency and format of reporting. Improvements in terms of data agreements are in progress with the Agency for Spatial and Environmental Planning.

Data Storage level 1	1. Accuracy	DS.1.1.2	Quantification of the uncertainty level of every gle data value including the reasoning for the cific values.

Quantitative uncertainty measures of country-specific and measured data are not available. The uncertainties are either calculated or defaults numbers are taken from the IPCC GL and GPG and presented in Section 8.3.3.

Data Storage level 1	2.Comparability	DS.1.2.1	Comparability of the data values with similar data from other countries, which are comparable with Denmark, and evaluation of discrepancy.

Comparison of Danish data values with data sources from other countries has been carried out in order to evaluate discrepancies as presented in the national verification report by Fauser et al., 2006 and the methodology report by Thomsen & Lyck, 2005.

Data Storage level 1	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included by setting down the reasoning behind the selection of datasets.

Methodology, reasoning and relevance of data sources used as input at DS level 1 have to some extent been improved in cooperation with the DEPA and the Agency for Spatial and Environmental Planning. Subjects to be discussed are: the possibility and relevance of including direct nitrous emissions from separate industries; methane emission from industrial wastewater handling; aspects related to the improvement of completeness of input data.

Data Storage level 1	4.Consistency	DS.1.4.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PMs).

The origin of external activity data has been preserved as much as possible. Files are saved for each year of reporting in a non editable format. In this way changes to previously received data and calculations is reflected and explanations are given.

Data Storage level 1	6.Robustness	DS.1.6.1	Explicit agreements between the external institution holding the data and NERI about the conditions of delivery.

This point is especially critical due to the missing timing of DEPA reporting and submission date of the yearly NIR. Clarification regarding possible optimisation of data and delivery agreement has taken place.

Data Storage level 1	7.Transparency	DS.1.7.1	Summary of each dataset including the reasoning for selecting the specific dataset

A summary of the data set can be seen in section 8.3.1 and 8.3.2. For the reasoning behind the selection of the specific dataset, refer to methodology report by Thomsen & Lyck, 2005.

Data Storage level 1	7.Transparency	DS.1.7.3	References for citation for any external dataset have to be available for any single value in any dataset.

These references exist in the description given in the Section 8.3, under methodological issues. In addition, they are directly accessible from the reports given in the list of references including link to internet accessible formats and stored every year in the given data exchange folder at NERI (cf. Table 8.25). However, changes in terms of a database on sewage sludge related data held by the Agency for Spatial and Environmental Planning are expected to improve data availability and transparency in term of origin.

Data Storage level 1	7.Transparency	DS.1.7.4	Listing of external contacts for every dataset

Due to restructuring, contacts for has been moved partially to the Agency for Spatial and Environmental Planning. Furthermore, the report series *Wastewater from municipal and private wastewater treatment plants* is no longer published. For future submissions, data will be obtained from a database held by the environmental portal secretariat positioned at the Agency for Spatial and Environmental Planning (www. miljoeportalen.dk) and possible the regional environmental centre in Roskilde which is the entity in the country collecting waste water data. Contact persons related to the delivery of data related to wastewater and sewage sludge have until now been, respectively, Karin Dahlgren and Kristoffer Colding, Agency for Spatial and Environmental Planning. However, data related to sludged are to be received in cooperation with contact person Trine Leth Kølby from DEPA in the future.

Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to type of variability. (Distribution as: normal, log normal or other type of variability)

Tier 1 uncertainty calculations are made. The use of the Tier 1 methodology presumes a normal distribution of activity data and emission factor variability. Uncertainties are reported in Table 8.25.

Data Processing level 1	1. Accuracy	DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals)

The uncertainty assessment has been given in Section 8.3.2 and 8.3.3.

Data Processing level 1	1. Accuracy	DP.1.1.3	Evaluation of the methodological approach using international guidelines

An evaluation of the methodological approach, in comparison with the check and default IPCC methodology 1, has been performed and is presented in Thomsen & Lyck, 2005.

Data Processing level 1	1. Accuracy	DP.1.1.4	Verification of calculation results using guideline values

This has been performed in Thomsen & Lyck, 2005 and in the NIR 2006 submission.

Data Processing level 1	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by the UNFCCC and IPCC.

The calculations follow the IPCC GL and GPG.

Data Processing level 1	3.Completeness	DP.1.3.1	Assessment of the most important quantitative knowledge which is lacking.

There is no quantitative knowledge on the characteristics of industrial versus domestic influent organic carbon. Furthermore cf. DP 1.1.2 regarding accuracy. Uniform definitions of final disposal categories are needed.

Data Processing level 1	3.Completeness	DP.1.3.2	Assessment of the most important cases where access is lacking with regard to critical data sources that could improve quantitative knowledge.

To be assessed once a systematic reporting format replacing the former report series from the DEPA are in place (cf. DS.1.7.4). Information on methane emissions for separate industries may be of importance. In addition changes in final disposal categories and related methane potentials recovered or not emitted.

Data Processing level 1	4.Consistency	DP.1.4.1	In order to keep consistency at a high level, an explicit description of the activities needs to accompany any change in the calculation procedure.

There have been small changes in the calculation procedure during the time-series due to small changed in the data gap filling procedure with respect to TOW activity data. As far as possible, the calculation procedures are kept consistent for the calculation of the time-series.

Data Processing level 1	5.Correctness	DP.1.5.1	Show at least once, by independent calculation, the correctness of every data manipulation.

The model has been checked by comparison with the IPCC default methodologies as presented in Thomsen & Lyck, 2005.

Data Processing level 1	5.Correctness	DP.1.5.2	Verification of calculation results using time-series

The time-series of activities and emissions in the model output, in the SNAP source categories and in the CRF format have been prepared. The time-series are examined and significant changes are checked and explained.

Data Processing level 1	5.Correctness	DP.1.5.3	Verification of calculation results using other measures

The correct interpretation in the model of the methodology and the parameterisation has been checked as far as possible, refer DP.1.5.1.

Data Processing level 1	5.Correctness	DP.1.5.4	Shows one-to-one correctness between external data sources and the databases at Data Storage level 2

Data transfer control is made from the external data sources and to the SNAP source categories at level 2. This control is carried on further to the aggregated CRF source categories.

Data Processing level 1	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described

The calculation principle and equations are described in Section 8.3.2 and 8.3.3 and in Thomsen and Lyck, 2005. Further transparency becomes realised by further implementation of the NERI QA/QC plan as described in chapter 1.6.

Data Processing level 1	7.Transparency	DP.1.7.2	The theoretical reasoning for all methods must be described

The theoretical reasoning is described in Section 8.4.3 and in Thomsen & Lyck, 2005.

Data Processing level 1	7.Transparency	DP.1.7.3	Explicit listing of assumptions behind all methods

The assumption is that the emissions can be described according to the applied methodology and models as these are developed in accordance to the IPCC GL and GPG for wastewater handling.

Data Processing level 1	7.Transparency	DP.1.7.4	Clear reference to dataset at Data Storage level 1

Refer to the Table 8.26 and DS.1.1.1 above.

Data Processing level 1	7.Transparency	DP.1.7.5	A manual log to collect information about recalculations

Recalculation changes in the emission inventories are described in the NIR. The logging of the changes takes place in the yearly model file.

Data Storage level 2	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data types at level 2 to data at level 1

The full documentation for the correct connection exists through the yearly model file, its output and report files made by the CollectER database system.

Data Storage level 2	5.Correctness	DS.2.5.2	Check if a correct data import to level 2 has been made

This check is performed, comparing model output and report files made by the CollectER database system, refer to DS.2.5.1.

8.3.5 Recalculations

The emissions from wastewater handling were until the 2005 submission reported as zero. So, the methodology used for the CRF Source Category 6B for CH_4 and N_2O emissions is included for the fifth time in this submission. No revisions compared to the 2008 submission have been performed.

8.3.6 Planned improvements

Suggested QA/QC plan for wastewater handling

As described in chapter 8.3.4.

In addition, the suggestions in the review report on the 2005 submission, wherein the expert review team encouraged Denmark to estimate the domestic and the industrial wastewater contributions separately. This suggestion has been considered. National Statistics reports total TOC for industrial and household wastewater only. Separate emission estimated for domestic and industrial wastewater could be achieved for the purposes of comparison, by simply dividing the total TOW influent load according to percent contributions from industry and household, respectively. However, as the new guidelines suggests no to do this exercise in the future, this spitting of the emission estimate has not been performed.

Furthermore, the expert review team encouraged Denmark to make revisions to the reporting of N_2O emissions from human sewage and wastewater effluent. The N_2O emissions from human sewage is as suggested by the expert reviewer team reported in 6.B.3 and the remaining emission from wastewater treatment is reported in Domestic and Commercial wastewater, as suggested. This will be implemented in the future by reconsideration of other aspects as e.g. mentioned in Annex 5.

Improvements on the emission factor for N_2O are in progress, but have not been validated as required prior to implementation in the NIR submissions. At this point the environmental portal secretariat has suggested that detailed data for realisation of this improvement is obtained from Roskilde centre of environment; one of the seven regional environmental centres under the Agency for Spatial and Environmental Planning.

8.4 Waste Incineration (CRF Source Category 6C)

8.4.1 Source category description

For the CRF source category *6.C. Waste Incineration,* the emissions are included in the energy sector since all waste incinerated in Denmark is used in energy production.

The amounts of waste incinerated are given in the CRF-Table 6A,C.

As regards further information on waste incineration, see the Energy sector in this report.

8.5 Waste Other (CRF Source Category 6D)

8.5.1 Source category description

Emission from the combustion of biogas in biogas production plants is included in CRF sector 6D. The fuel consumption rate of the biogas production plants refers to the Danish energy statistics. The applied emission factors are the same as for biogas boilers (see NIR Chapter 3, Energy).

References

Agency for Spatial and Environmental Planning (ASEP), 2007: Point sources 2006. In Danish: Punktkilder 2006. Det nationale program for overvågning af vandmiljøet; Fagdatacenterrapport. Available at: http://www2.blst.dk/udgiv/Publikationer/2007/978-87-92256-36-2/pdf/978-87-92256-37-9.pdf (March 1, 2009)

Danish Environmental Protection Agency (DEPA), 2009: Personal communication February 9, 2009, Unit for Soil and Waste. Preliminary data. Final data to be published in Affaldsstatistik 2007 and 2008. (In Danish: Waste Statistics 2007 and 2008.)

Danish Environmental Protection Agency (DEPA), 2008: Affaldsstatistik 2006. (In Danish: Waste Statistics 2006.) Orientering fra Miljøstyrelsen nr 2 2008. Available at: http://www2.mst.dk/udgiv/publikationer/2008/978-87-7052-753-8/pdf/978-87-7052-754-5.pdf (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 2006b: Affaldsstatitik 2005 (In Danish: Waste Statistics 2005). Orientering fra Miljøstyrelsen nr. 6. Available at: http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publikationer/2006/87-7052-284-7/html/default.htm (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 2006a: Waste Statistics 2004. Available at:

http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publications/2006/87-7614-962-5/html/default_eng.htm (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 2005a: Waste Statistics 2003. Available at: http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publications/2005/87-7614-585-9/html/default_eng.htm (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 2005b: Point Sources 2003. Revision. In Danish: Punktkilder 2003 – revideret, Orientering fra Miljøstyrelsen, nr, 1. Avaible at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 2004a: Waste Statistics 2001. Available at: http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publications/2004/87-7614-105-5/html/default_eng.htm (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 2004b: Waste Statistics 2002. Available at: http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publications/2004/87-7614-107-1/html/default_eng.htm (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 2004c: Point Sources 2003. In Danish: Punktkilder 2003, Orientering fra Miljøstyrelsen, nr, 16. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 2004d: Wastewater from municipal and private wastewater treatment plants in 2002. In Danish: Spildevandsslam fra kommunale og private renseanlæg i 2002, Orientering fra Miljøstyrelsen, nr, 5, 2004. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 2003a: Point Sources 2002. In Danish: Punktkilder 2002, Orientering fra Miljøstyrelsen, nr, 10. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 2003b: Wastewater from municipal and private wastewater treatment plants in 2001. In Danish: Spildevandsslam fra kommunale og private renseanlæg i 2000 og 2001, Orientering fra Miljøstyrelsen, nr, 9, 2003. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 2002a: Waste Statistics 2000. Available at: http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publications/2002/87-7972-027-7/html/default_eng.htm (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 2002b: Point Sources 2001. In Danish: Punktkilder 2001, Orientering fra Miljøstyrelsen, nr, 7. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 2002c: Nonylphenol and nonylphenolethoxylater in wastewater and sludge. In Danish: Miljøprojekt Nr, 704 (2002), Nonylphenol og nonylphenolethoxylater i spildevand og slam, Bodil Mose Pedersen og Søren Bøwadt, DHI - Institut for Vand og Miljø, Miljøstyrelsen, Miljøministeriet.

Danish Environmental Protection Agency (DEPA), 2001a: Waste Statistics 1998. Available at:
http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publications/2001/87-7944-351-6/html/default_eng.htm (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 2001b: Waste Statistics 1999. Available at:
http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publications/2001/87-7944-381-8/html/default_eng.htm (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 2001c: Wastewater from municipal and private wastewater treatment plants in 1999. In Danish: Spildevandsslam fra kommunale og private renseanlæg i 1999, Orientering fra Miljøstyrelsen, nr, 3, 2001. Available at:
http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 2001d: Point Sources 2000. In Danish: Punktkilder 2000, Orientering fra Miljøstyrelsen, nr, 13. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 1999a: Waste Statistics 1997. Available at:
http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publications/2000/87-7909-433-3/html/default_eng.htm (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 1999b: Point Sources 1998. In Danish: Punktkilder 1998, Orientering fra Miljøstyrelsen, nr, 6. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 1999c: Wastewater from municipal and private wastewater treatment plants in 1997. In Danish: Spildevandsslam fra kommunale og private renseanlæg i 1997, Miljøprojekt, nr. 473. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 1998a: Waste Statistics 1996. Available at:
http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publications/1998/87-7909-106-7/html/default_eng.htm (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 1998b: Point Sources 1997. In Danish: Punktkilder 1997, Orientering fra Miljøstyrelsen, nr, 6. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 1997: Point Sources 1996. In Danish: Punktkilder 1996, Orientering fra Miljøstyrelsen, nr, 9. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 1996a: Affaldsstatistik 1995 (In Danish: Waste Statistics 1995. Orientering fra Miljøstyrelsen nr 14 1997 Available at:
http://www2.mst.dk/Udgiv/publikationer/1996/87-7810-704-0/pdf/87-7810-704-0.pdf (February 24, 2009)

Danish Environmental Protection Agency (DEPA), 1996b: Point Sources 1995. In Danish: Punktkilder 1995, Orientering fra Miljøstyrelsen, nr, 16. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 1994: Point Sources 1993. In Danish: Punktkilder 1993, Orientering fra Miljøstyrelsen, nr, 8. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA), 1989: Wastewater from municipal and private wastewater treatment plants in 1987. In Danish: Spildevandsslam fra kommunale og private renseanlæg i 1987, Orientering fra Miljøstyrelsen, nr. 10. Available at: http://www.mst.dk/

Danish Environmental Protection Agency (DEPA): Environment Database. Available at:
http://gis.mst.dk/miljoedata/findbadestation.html

FAOSTAT data, 2004: Food Supply. Available at:
http://apps.fao.org/faostat/collec-tions?version=ext&hasbulk=0 "last updated August 2004"

Illerup, J.B., Lyck, E., Nielsen, O.K., Mikkelsen, M.H., Hoffmann, L., Gyldenkærne, S., Nielsen, M., Winther, M., Fauser, P., Thomsen, M., Sørensen, P.B. & Vesterdal, L. 2007: Denmark's National Inventory Report 2007. Emission Inventories - Submitted under the United Nations Framework Convention on Climate Change, 1990-2005. National Environmental Research Institute, University of Aarhus. NERI Technical Report 632: 642 pp. Available at:
http://www2.dmu.dk/Pub/FR632_Final.pdf (last accessed 01-03-2008)

Illerup, J.B., Lyck, E., Nielsen, O.K., Mikkelsen, M.H., Hoffmann, L., Gyldenkærne, S., Nielsen, M., Sørensen, P.B., Vesterdal, L., Fauser, P., Thomsen, M. & Winther, M. 2006: Denmark 's National Inventory Report 2006. Submitted under the United Nations Framework Convention on Climate Change, 1990-2004. National Environmental Research Institute. NERI Technical Report 589: 555 pp. Available at:
http://www2.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR589.pdf (last accessed 01-03-2008).

Intergovernmental Panel on Climate Change (IPCC), 2006: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, prepared by the National Greenhouse Gas Inventories Programme, Eggleston, H.S., Buendia, L., Miwa, K., Ngara, T & Tanabe, K. (eds). Published: IGES, Japan.

IPCC background paper, 2003: CH_4 and N_2O emissions from waste water handling. Avaiable at:
http://www.ipcc-nggip.iges.or.jp/public/gp/bgp/5_2_CH4-_N2O_Waste_Water.pdf

Statistics Denmark. StatBank Denmark. Available at:
http://www.statistikbanken.dk-/statbank5a/default.asp?w=1024

Nielsen, O.-K., Lyck, E., Mikkelsen, M.H., Hoffmann, L., Gyldenkærne, S., Winther, M., Nielsen, M., Fauser, P., Thomsen, M., Plejdrup, M.S., Illerup, J.B., Sørensen, P.B. & Vesterdal, L. 2008: Denmark's National Inventory Report 2008 - Emission Inventories 1990-2006 - Submitted under the United Nations Framework Convention on Climate Change. National Environmental Research Institute, University of Aarhus. 701 pp. – NERI Technical Report no. 667. Available at:
http://www.dmu.dk/Pub/FR667.pdf (February 24, 2009)

The Danish Government, 2003. Affaldsstrategi 2005-2008. (In Danish: Waste Strategy 2005-2008. Available at:
http://www2.mst.dk/Udgiv/publikationer/2003/87-7972-971-1/pdf/87-7972-973-8.pdf (February 24, 2009).

Thomsen, M. & Lyck, E. 2005: Emission of CH_4 and N_2O from wastewater treatment plants (6B). NERI Research Note No. 208. Available at: http://www2.dmu.dk/1_viden/2_Publikationer/3_arbrapporter/rapporter/AR208.pdf (February 24, 2009).

9 Other (CRF sector 7)

In CRF Sector 7, there are no activities and emissions for the inventories of Denmark. For the inventories of the Kingdom of Denmark (Denmark, Faroe Islands and Greenland) emissions for Faroe Islands and Greenland are in Sector 7.

See Annex 6.1 and 6.2.

10 Recalculations and improvements

The CRF recalculation tables for Denmark produced with the new CRF software do not include correctly the recalculations for Denmark made since the NIR submission in April 2008. The reason for this is that selection of the CRF submission against which the recalculations are to be seen has been carried out by the UNFCCC Secretariat and cannot be changed by the parties. At present, the CRF includes as the submission to which the recalculations relate the 2008 submission for the Kingdom of Denmark (i.e. Denmark as well as Greenland and the Faroe Islands), which has been submitted in 2008 under the Climate Change Convention and submitted in parallel to the inventories for Denmark. However, only one recalculation database can be included pr party. We have communicated this problem to the CRF helpdesk, but no solution has been provided. Therefore, this chapter is based on an excel file made with links to actually in 2008 submitted values. The analysis made is for Denmark only (excluding Greenland and Faroe Island). An extraction of the file only showing source categories for which there have been recalculations is Table 10.1. The aggregation level of the analysis is the level also used in the CRF recalculation tables.

10.1 Explanations and justifications for recalculations

Explanations and justifications for the recalculations performed for this submission and since submission of data in the CRF-format for submission to UNFCCC due April 15, 2008 for Denmark are given in the following sector chapters:

Energy:

- Stationary Combustion — Chapter 3.2.5
- Transport — Chapter 3.3.5
- Fugitive emissions — Chapter 3.5.5

Industry — Chapter 4.1.5

Solvents and Other Product Use — Chapter 5.2.7

Agriculture — Chapter 6.8

LULUCF

- Forest Land — Chapter 7.2.5
- Crop Land — Chapter 7.10

Waste

- Solid Waste Disposal on Land — Chapter 8.2.5
- Wastewater — Chapter 8.3.5

The main recalculations since the 2008 submission are:

Energy

Stationary Combustion

Update of fuel rates according to the latest energy statistics. The update included the years 1980-2006. The most changes were for the years 2005 and 2006.

Data from the ETS has been utilised for the second time in the 2009 inventory submission. It was mainly coal and residual oil fuelled power plants where detailed information was available. One of the reports for 2007 was judged by NERI to be incorrect, and therefore not incorporated in the 2007 inventory. Following this the 2006 report for the same plant, which was also an outlier, was removed from the inventory.

Mobile sources

Road transport

For heavy duty vehicles new information from the Danish Car Importers Association has enabled a more precise distribution of vehicles into Euro levels. Also, a more realistic development from 2005 to 2006 in the total mileage for passenger cars has been introduced in the calculations. For 2005 and 2006, DEA have made small changes in a downward direction for the annual diesel fuel consumption statistics.

Recalculations have been made from 1985-2006 resulting in minor emission differences between -0.1 and -1.2 % for CH_4 and 0 and -0.1 % for N_2O. For CO_2, the emission change in 2005 is 0.1 %.

National sea transport

Fuel consumption and emission factors directly measured for the ferries used by Mols Linien have now been implemented in the inventory calculations, and small activity changes have been made for two smaller Danish ferry companies.

This has caused the fuel consumption and emissions to change from 1996 onwards. The emission changes for CO_2 and N_2O are between 0.4 and 2.3 %, and 0.4 % and 2.5 %, respectively. For CH_4 the emission change is -0.6 % in 2006. The fuel consumption increases are between 0.4 and 2.4 % in the period.

Fishery

Due to the change in fuel consumption for national sea transport, fuel adjustments are made for gas oil used by fishing vessels, and the emissions for this sector are also affected. Also, an error in the energy statistics for the year 2006 has been corrected by the DEA, thus reducing the gas oil fuel consumption for fisheries by 0.4 PJ.

Fishery is a part of the CRF-NFR code 1A4c consisting of agriculture, forestry and fisheries activities, and hence the fuel consumption and emission impacts are somewhat smaller for the sector as a whole.

From 1996-2005 the fuel consumption and emission changes are between -2.3 and -0.5 % for CO_2, -0.9 and -0.2 % for CH_4, and -3 and -0.6 % for N_2O.

Military

Emission factors derived from the new road transport simulations have caused minor emission changes from 1985-2006. The emission differences are between -0.9 and -0.1 % for CH_4, and between -0.1 and 1.7 % for N_2O. For CO_2 the emissions remain the same.

Fugitive emissions

Oil refining

Emissions from oil refining has in earlier years been reported under 1B2a vi "Other". In 2007 "Oil refined" has been relocated to 1B2a iv "Refining/Storage". This was a result of a suggestion made during the internal EU review.

Flaring and processing of petroleum products in refineries

Recalculation has been made for the years 2005-2006 according to availability of new data from the Danish refineries.

Flaring in natural gas storage plants

The data have been relocated from CRF 1B2b iv to 1B2b iii for the year 2000 to make the time-series consistent.

Industry

The emission of CO_2 from production of cement has been revised for the years 1998-2005 based on new information from the company. For yellow bricks and expanded clay products the CO_2 emission has been adopted from the company reports to EU-ETS as the emission factors calculated previously and used until 2005 were found not to be in line with the actual emission.

In the group 2F9 Other processes production of fibre optics has been included.

The sector *Other* (2G), consumption of lubricant oil is included in the inventory for the first time.

Solvents

The following chemicals and groups have been removed, compared to the 2008 submission, due to vapour pressures below 0.01kPa: aminooxygen groups, glycerol, toluendiisocyanate, dioctylphthalate, diethylenglycol.

Emission factors (EFs) have been adjusted for all chemicals, with most predominant effect for the following chemicals: ethanol, formaldehyde, turpentine, xylene, toluene and ethylenglycol.

A differentiation of EFs in four different categories has been implemented: 1) chemical industry (lowest EF), 2) other industry, 3) non-industrial activities, 4) domestic and other diffuse use (highest EF). In previous inventories there was only a differentiation in two categories.

More detailed and reliable information on use amounts and emission factors has been obtained from importers and producers for the following chemicals: methanol, ethanol in windscreen washing agent, naphthalene, propane and butane.

Acrylic acid has been included in the inventory.

Agriculture

The most significant inventory changes are mentioned below:

Emission factors for synthetic fertilizers the have been changed to the values given by EMEP/EEA (2009) and recalculations is done for 1990-2006. This results in an increase in N_2O of less than 1 % for the period.

Updated data from The Danish Environmental Protection Agency for the use of sewage sludge as fertilizers for the years 2004-2006 have been received and therefore recalculations. This results in an increase in N_2O of 16 % for the period.

The emission factors for crops are lowered from 5 to 2 % for crops and from 3 to 0.5 % for grass based on a literary survey. Recalculations have been done for the years 1990-2006. This results in a decrease in the ammonia emission of 62-64 %. The N_2O emission from atmospheric deposition has decreased by 1-10 % in the period.

Emission factors for fur farming have been raised from 25 to 36 % in agreement with DJF and recalculation is done for the years 1990-2006.

Data for dairy cattle and heifer's time on pasture have been lowered with 10 % in 2007. In order to remove time-series inconsistency the data are interpolated for the years 2003-2006.

Waste

For the submission in 2009, recalculations have been carried out in relation to the final submission in 2008 of inventories for the years 2004-2006. The recalculation represents updates in the energy statistics on the uptake of CH_4 by installations at SWDSs for energy production. Further, for 2004-2005 rounding of data for waste amounts was removed in the model. The recalculation implies an increase in emissions of 2.5 and 4.0 % for 2004 and 2005 respectively.

LULUCF

Since the submission to UNFCCC in April 2008 we have carried out a few small recalculations.

The increase in C stock of living biomass was corrected for the year 1999 (378 Gg C to 379 Gg C).

The decrease in C stock in living biomass for conifers in forests remaining forests was corrected for the years 2005 and 2006. The reason for this is an update of harvesting figures at Statistics Denmark. There is only a slight difference between previously and currently reported net removals, i.e from 1672 Gg CO_2 to 1640 Gg CO_2 for 2005 and from 2574 to 2601 Gg CO_2 for 2006.

For cropland converted to forest land, we reported forest floor C sequestration for the fist time in the NIR from 2008, regarding the period 1990-2006. We have moved this C sink from "Net carbon stock change in soils" to "Net carbon stock change in dead organic matter" for the years 1990-2006. This would be the correct column for reporting as we understand the term "soil" as mineral soil without the organic material accumulated in the forest floor.

As the reported emission from agricultural soils is a five-year average there has been a recalculation of the emission in 2005 and 2006. Futhermore a small error in the amount of used lime in 2006 has been corrected.

10.2 Implications for emission levels

For the National total CO_2 equivalent emissions without Land-Use, Land-Use Change and Forestry, the general impact of the improvements and recalculations performed is small and the changes for the whole time-series are between -0.18 % (1998) and +0.81 % (2006). Therefore, the implications of the recalculations on the level and on the trend, 1990-2006, of this national total are small, refer Table 10.1.

For the National total CO_2 equivalent emissions with Land-Use, Land-Use Change and Forestry, the general impact of the recalculations is also small, although the impact is somewhat larger than without LULUCF. The differences vary between –0.15 % (2004) and +2.18 % (2006), refer Table 10.1.

Table 10.1 Recalculation performed year 2009 for 1990-2006. Differences in pct of CO_2-eqv between this submission and the April 2008 submission for DK, excluding Greenland and Faroe Islands.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total CO_2 Equiv. Emissions with Land-Use Change and Forestry	0.07	0.05	0.06	0.01	0.02	0.03	0.03	0.04	-0.18	0.01
Total CO_2 Equiv. Emissions without Land-Use Change and Forestry	0.07	0.05	0.06	0.01	0.02	0.03	0.03	0.04	-0.18	0.01
Continued	2000	2001	2002	2003	2004	2005	2006			
Total CO_2 Equiv. Emissions with Land-Use Change and Forestry	0.00	-0.07	-0.02	-0.08	-0.15	1.14	2.18			
Total CO_2 Equiv. Emissions without Land-Use Change and Forestry	0.00	-0.07	-0.02	-0.07	-0.15	-0.12	0.81			

10.3 Implications for emission trends, including time-series consistency

It is a high general priority in the considerations leading to recalculations back to 1990 to have and preserve the consistency of the activity data and emissions time-series. As a consequence activity data, emission factors and methodologies are carefully chosen to represent the emissions for the time-series correctly. Often considerations regarding the consistency of the time-series have led to recalculations for single years when activity data and/or emission factors have been changed or corrected. Furthermore, when new sources are considered, activity data and emissions are as far as possible introduced to the inventories for the whole time-series based on preferably the same methodology.

The implication of the recalculations is further shown in Tables 10.2-10.4.

10.4 Recalculations. Including those in response to the review process, and planned improvements to the inventory (e.g. institutional arrangements. inventory preparations)

The review on the submissions 2007 and 2008 has not been finalized and no country specific review report is available. So the most recent finalized review was the in-country review which took place in April 2007 on the 2006 submission for the inventory years 1990-2004.

The suggestions and views of the expert review team on the 2006 submission in their final report dated 7 November 2007 has been studied and implemented as far as possible.

As regards the review on the 2007 and 2008 submissions some improvement were implemented due to the communication with the review team in the autumn 2008 and due to the review draft report available to us 14 January 2009. However, implementation of recommendation and suggestions of the reviewers in the main findings etc was not possible in the time left to this submission and the start of the implementation awaits the final review report.

The specific response to the review has been given in the sector chapters of this report.

Table 10.2 Recalculation for CO_2 performed year 2009 for 1990-2006. Differences in CO_2-eqv. between this and the April 2008 submission for DK. Excluding Greenland and Faroe Islands.

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total National Emissions and Removals		**81,02**	**78,39**	**75,90**	**73,60**	**71,22**	**50,92**	**68,99**	**62,59**	**-107,68**	**44,41**	**22,98**	**-18,97**	**3,52**	**-19,89**	**-74,85**	**717,09**	**1444,60**
1. Energy		**0,03**	**-0,01**	**-0,01**	**0,01**	**-0,02**	**0,03**	**-0,03**	**-0,04**	**-103,89**	**-0,02**	**-10,30**	**-23,76**	**-11,79**	**-26,70**	**-30,09**	**-18,32**	**489,67**
1.A.	Fuel Combustion Activities	0,03	-0,01	-0,01	0,01	-0,02	0,03	-0,03	-0,04	-103,89	-0,02	-10,30	-23,76	-11,79	-26,70	-30,09	-23,74	479,60
1.A.1.	Energy Industries	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-103,94	0,00	15,90	15,18	31,43	0,00	10,48	3,27	398,35
1.A.2.	Manufacturing Industries and Construction	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-3,51	-18,11	-12,64	-18,80	-18,19	-30,46	126,32
1.A.3.	Transport	0,03	-0,01	-0,01	0,01	-0,02	0,03	3,11	11,71	11,37	12,62	10,66	9,43	8,09	8,70	9,31	-6,26	0,65
1.A.4.	Other Sectors	0,00	0,00	0,00	0,00	0,00	0,00	-3,14	-11,76	-11,32	-12,64	-33,35	-30,26	-38,67	-16,60	-31,68	9,72	-45,72
1.B.	Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	5,42	10,07
1.B.2.	Oil and Natural Gas	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	5,420	10,072
2. Industrial Processes		**49,71**	**48,86**	**48,12**	**47,55**	**46,95**	**48,84**	**48,89**	**47,15**	**-17,80**	**32,49**	**19,31**	**-5,26**	**4,39**	**-2,96**	**-42,81**	**-55,06**	**37,84**
2.A.	Mineral Products	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	-62,650	-10,222	-20,384	-43,750	-35,471	-39,996	-80,545	-92,651	0,344
3. Solvent and Other Product Use		**31,28**	**29,53**	**27,79**	**26,04**	**24,30**	**2,05**	**20,13**	**15,49**	**14,01**	**15,61**	**13,96**	**10,06**	**10,92**	**9,77**	**-1,95**	**-3,84**	**-9,94**
5. Land-Use Change and Forestry (net)		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**-3,67**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**794,32**	**927,03**
6. Waste		0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Table 10.3 Recalculation for CH_4 performed year 2009 for 1990-2006. Differences in CO_2-eqv. between this and the April 2008 submission for DK. Excluding Greenland and Faroe Islands.

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total National Emissions and Removals		**0,00**	**0,00**	**0,00**	**0,01**	**0,01**	**17,46**	**-0,01**	**0,24**	**-1,43**	**-0,82**	**1,70**	**1,17**	**8,33**	**6,57**	**10,96**	**48,27**	**109,56**
1. Energy		**0,00**	**0,00**	**0,00**	**0,01**	**0,01**	**0,01**	**-0,01**	**-0,01**	**-0,01**	**-0,02**	**-0,02**	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**0,28**	**37,93**
1.A.	Fuel Combustion Activities	0,000	0,000	0,000	0,012	0,012	0,012	-0,011	-0,015	-0,015	-0,016	-0,019	-0,028	-0,026	-0,027	-0,026	-0,026	6,079
1.A.1.	Energy Industries	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	-0,004	0,035
1.A.2.	Manufacturing Industries and Construction	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,002	0,117	0,151
1.A.3.	Transport	0,000	0,000	0,000	0,012	0,012	0,012	-0,009	-0,009	-0,009	-0,010	-0,013	-0,024	-0,022	-0,023	-0,023	-0,063	-0,329
1.A.4.	Other Sectors	0,000	0,000	0,000	0,000	0,000	0,000	-0,001	-0,005	-0,005	-0,006	-0,005	-0,005	-0,004	-0,004	-0,005	-0,076	6,222
1.A.5.	Other	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	-0,001	-0,001
1.B.	Fugitive Emissions from Fuels	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,306	31,847
1.B.2.	Oil and Natural Gas	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,306	31,847
4. Agriculture		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**17,45**	**0,00**	**0,26**	**-1,42**	**-0,81**	**1,72**	**1,20**	**8,35**	**6,59**	**10,99**	**14,06**	**18,46**
4.A.	Enteric Fermentation	0,000	0,000	0,000	0,000	0,000	17,449	0,000	0,258	-1,417	-0,807	1,717	1,198	8,353	6,593	10,986	14,058	18,463
4.B.	Manure Management	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
6. Waste		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**33,93**	**53,17**
6.A.	Solid Waste Disposal on Land	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	33,933	53,174
6.B.	Wastewater Handling	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Table 10.4 Recalculation for N_2O performed year 2009 for 1990-2006. Differences in CO_2-eqv. between this and the April 2008 submission for DK. Excluding Greenland and Faroe Islands.

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total National Emissions and Removals		**-34,18**	**-40,98**	**-32,73**	**-67,45**	**-52,38**	**-48,99**	**-45,49**	**-32,43**	**-27,24**	**-37,84**	**-27,44**	**-31,20**	**-22,27**	**-41,13**	**-34,96**	**-37,45**	**-35,70**
1. Energy		**0,00**	**0,00**	**0,00**	**0,05**	**0,05**	**0,05**	**0,06**	**0,06**	**0,06**	**0,06**	**0,04**	**0,01**	**0,01**	**0,01**	**0,04**	**-0,27**	**1,34**
1.A.	Fuel Combustion Activities	0,000	0,000	0,000	0,045	0,046	0,048	0,057	0,058	0,058	0,057	0,041	0,009	0,012	0,011	0,039	-0,304	1,285
1.A.1.	Energy Industries	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	-0,042	-0,087
1.A.2.	Manufacturing Industries and Construction	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,007	0,286	0,431
1.A.3.	Transport	0,000	0,000	0,000	0,045	0,045	0,046	0,119	0,288	0,280	0,306	0,250	0,197	0,168	0,175	0,191	0,036	-0,048
1.A.4.	Other Sectors	0,000	0,000	0,000	0,000	0,000	0,000	-0,062	-0,231	-0,222	-0,248	-0,209	-0,186	-0,159	-0,171	-0,183	-0,617	0,968
1.A.5.	Other	0,000	0,000	0,000	0,001	0,001	0,001	0,001	0,001	0,000	-0,001	-0,001	-0,001	0,002	0,006	0,025	0,033	0,021
1.B.	Fugitive Emissions from Fuels	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,030	0,055
1.B.2.	Oil and Natural Gas	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,030	0,055
3. Solvent and Other Product Use		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,59**
4. Agriculture		**-34,18**	**-40,98**	**-32,73**	**-67,49**	**-52,42**	**-49,04**	**-45,54**	**-32,49**	**-27,30**	**-37,90**	**-27,48**	**-31,21**	**-22,28**	**-41,15**	**-35,00**	**-37,18**	**-37,63**
4.B.	Manure Management	0,492	-0,990	0,764	-6,761	-3,717	-3,411	-2,731	0,055	0,886	-1,810	0,358	0,002	2,503	6,134	10,380	14,722	18,737
4.D.	Agricultural Soils (2)	-34,671	-39,987	-33,491	-60,731	-48,705	-45,628	-42,812	-32,540	-28,183	-36,086	-27,838	-31,208	-24,781	-47,280	-45,382	-51,899	-56,364
5. Land-Use Change and Forestry (net)		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
6. Waste		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
6.B.	Wastewater Handling	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Annexes to Denmarks NIR 2009, Inventories 1990 – 2007

Annex 1 Key Category Analyses

Description of the methodology used for identifying key Categories

A Key Category Analysis (KCA) for year 1990 and 2007 has been carried out in accordance with the IPCC Good Practice Guidance. The LULUCF sector is included in the KCA. Categorisations for stationairy combustion has been changed as compared to previous KCA's, since for CH_4 and N_2O groupings of sources has been included instead of a categorisation as Non-CO_2 for CH_4 and N_2O respectively. The base year in the analysis is the year 1990 for the greenhouse gases CO_2, CH_4, N_2O and 1995 for the greenhouse F-gases HFC, PFC and SF_6. The KCA approach is a Tier 1 quantitative analysis.

The level assessment of the KCA is a ranking of the source categories in accordance to their relative contribution to the national total of greenhouse gases calculated in CO_2-equivalent units. The level key categories are found from the list of source categories ranked according to their contribution in descending order. Level key categories are those from the top of the list and of which the sum constitutes 95 % of the national total.

The trend assessment of the KCA is a ranking of the source categories according to their contribution to the trend of the national total of greenhouse gases, calculated in CO_2-equivalents, from the base year to the year under consideration. The trend of the source category is calculated relative to that of the national totals and the trend is then weighted with the contribution, according to the level assessment. The ranking is in descending order. As for the level assessment, the cut-off point for the sum of contribution to the trend is 95 % and the source categories from the top of the list to the cut-off line are trend key categories.

The level of disaggregation

The starting point for the choice of source categories is presented in the GPG as Table 7.1. This table constitutes a suggested list of source categories for the KCA. It is mentioned in the GPG that categories for the KCA should be chosen in a way so that emissions from a single category are estimated with the same method and the same emission factor. Therefore, for categories in Table 7.1, which in our Corinair database are composed of activities with different emission factors or estimated with different methods, splits were made accordingly. It is in the energy sector, with its major emission contributions, that further splits are made as compared to Table 7.1 in the Good Practice Guidance.

The source categories for energy and stationary combustion are defined according to the fuels and their emission factors, which are as follows:

Table A Source categories for energy and stationary combustion defined according to the fuels and emission factors.

CO_2 emission factors, fossil	Kg pr GJ
COAL [1)]	95
COKE OVEN COKE	108
PETROLEUM COKE	92
PLASTIC WASTE	17.6
RESIDUAL OIL [1)]	78
GAS OIL	74
KEROSENE	72
NATURAL GAS	56.78
LPG	65
REFINERY GAS	56.9

[1)] These emission factors are from previous reporting and are not exactly those used for the year 2007 since emissions connected to these fuels has been reported according to the ETS.

For Energy and stationary combustion categories in the KCA are composed according to the fuels mentioned.

For energy and mobile combustion, the basis for the source categories is unchanged since previous KCA and are the following activities:

Table B Source categories fr energy and mobile combustion.

	Category for Key Source Analysis		CRF Cat	Part of CRF Cat	CRF cat descr.
1	Mobile combustion	Civil aviation	1.A.3.a		Transport
2	Mobile combustion	Road transportation	1.A.3.b		Transport
3	Mobile combustion	Railways	1.A.3.c		Transport
4	Mobile combustion	Navigation	1.A.3.d		Transport
5	Mobile combustion	Military	1.A.5.b		Other Mobil
6	Mobile combustion	National fishing		1.A.4.c	Other Sectors Agr/Fores/Fisheries
7	Mobile combustion	Agriculture		1.A.4.c	Other Sectors Agr/Fores/Fisheries
8	Mobile combustion	Forestry		1.A.4.c	Other Sectors Agr/Fores/Fisheries
9	Mobile combustion	Other mobile and machinery/industry		1.A.2.f	Manif Industries and C Other
10	Mobile combustion	Household and gardening		1.A.4.b	Other Sectors. b. Residential

The categories above, numbered 1 - 5, are directly found in the CRF-tables, while numbers 6 – 8 are found under CRF category 1.A.4.c., number 9 under 1.A.2.f and number 10 under 1.A.4.b. These categories have been chosen as source categories for the analysis due to differences in the use of fuels and fuel types and resulting differences in emission factors.

New to KCA in this submission are splitting of Non-CO_2 emission from stationary Combustion, according to the following two tables.

Table C Energy: Non-CO_2 Emission from stationary Combustion CH_4.

CRF-category/source	Fuel
1A1+1A2+1A4	BIOMASS
Biogas fuelled engines	BIOMASS
1A1+1A2+1A4	GAS
Natural gas fuelled engines	GAS
1A1+1A2+1A4	LIQUID
1A1+1A2+1A4	WASTE
1A1+1A2+1A4	SOLID

Table D Energy: Non-CO_2 Emission from stationary Combustion: N_2O.

CRF-category	Fuel
1A1+1A2+1A4	BIOMASS
1A1+1A2+1A4	GAS
1A1+1A2+1A4	LIQUID
1A1+1A2+1A4	WASTE
1A1+1A2+1A4	SOLID

For the sectors Industry, Agriculture, LULUCF and Waste, the source categories in the KCA are as before activities found in the CRF source categorisation. For industry a new activity under Industry: "Other, lubricants" is included

The selection of key source categorisation made for the KCA is well argued in relation to the intentions of the analysis in the GPG. The decision to keep the selection and further refine it has been made in order not to lose the ability to make comparisons with the KCA performed for the years 2000-2006. The choice of categories identifies 102 categories for the analysis. The split up of Non-CO_2 added 10 categories (from 2 to 12) and the new activity under Industry added 1 category further. So the additions compared to 91 categories in the 2008 analysis is 11.

The result of the Key Category Analysis for Denmark for the year 1990 and 2007

The entries in the results of KCA in Table 1, Table 2 and Table 3 for the years 1990 and 2007 are composed from the databases producing the CRF inventory for those years in this report. Note that base-year estimates are not used in the level assessment analysis for year 2007, but are only included in Table 2 to make it more uniform with Table 3.

The result of the key category level assessment for Denmark for 1990 is shown in Table 1. 23 categories were identified as key categories and marked as shaded in the table.

The result of the key category level assessment for Denmark for 2007 is shown in Table 2. 24 categories were identified and marked as shaded in the table. In 2006 the number of key categories was 23, in 2005, 2004, 2003 and 2002, the number of key categories was 21, in 2001 and 2000 the number was 20. The inclusion of the LULUCF sector in the analysis implies that the activities in this sector are all calculated positive, i.e. the absolute value of removals are included.

The result of the key category trend assessment for Denmark for 2006 is shown in Table 3. A number of 29 key categories (29 in 2006, 20 in 2005, 21 in 2004 and 2003, 17 in 2002 and 2001, and 16 in 2000) were identified and marked as shaded in the table. Note that according to the GPG, the analysis implies that contributions to the trend are all calculated as mathematically positive to be able to perform the ranking. The LULUCF activities are in the table included with there sign, i.e. emissions: +, removals: -.

Following the reporting suggestion of the GPG, the KCA is summarised in Table 4. In the table all categories used in the analysis are listed and the summary result of the KCA is given. It is seen that of the 102 source categories chosen for this analysis, 32 are identified as key source categories either in the level or in the trend analysis or in both. In 2006 this number was 30 out of 91 categories, in 2005 and 2004 this number was 24 out of 71 source categories. In 2003, this number was 25 out of 67 categories and in 2002 25 out of 63 categories. In 2001 and 2000 out of 59 categories 23 and 22 were key categories, respectively. In the KCA for 2007 21 key categories were keys in both level and trend. This number was 22 in 2006, 16 in 2005 and 18 in 2004 and 2003. In 2002 this number was 15, and 14 in both 2001 and 2000. In 2007 three categories were key for level only. In 2006 one category was key for level only. In 2005, five categories were key categories for level only (four in 2004, three in 2004, seven in 2002 and six in 2001 and in 2000). In 2007 seven categories were key categories for trend only, as in 2006. In 2005, four categories were key in trend only as in 2004 and 2003 (three in 2002, three in 2001 and two in 2000).

In the following the results of the KCA for the sectors are summarized. For the percentages for comparisons to national totals are used national total as result in the KCA. This "national total" is a sum of all contributions in absolut values. This is done to be in consistency to the KCA. For similar comparison to national totals (with or without LULUCF) the differencies for these percentages – especielly for national total without LULUCF – is small. But deviations from percentages here and percentages in sector sections may occur.

The Energy Sector and CO2 emission from Stationary Combustion contributes in 2007 with 7 key categories with respect to level and trend, as in 2006. This number was 6 in 2005, in 2004 and 2003, 7 in 2002, 7 in 2001 and 5 in 2000). These 7 key categories are as in 2006 the major fuels, Coal, Petroleum Coke, Plastic Waste, Residual Oil, Gas Oil, Natural gas (these as in 2005, 2004 and 2003) and Refinery gas. For these key categories the trend in emission estimates, comparing 1990 and 2007, Coal, Residual Oil and Gas Oil are seen to decrease, while Plastic Waste, Petroleum Coke, Refinery Gas and especially Natural Gas increase. According to the key categories level assessment Coal is the most contributing category in 2006 with 25.5 % of the national total (Table 1). Also in 2006, 2005, 2004, 2003, 2002 and 2001, Coal was the most contributing category, in 2006 contributing 28.9 %, in 2005 22.8 % and in 2004 contributing 25.5 %. This contribution was at a maximum in 2003 where it was 30.5 %, compared with 2002 where it was 24.4 % and where it had increased from 24.0 % in

2001 and 23.0 % in 2000. Natural gas is in 2007 the third largest contributer as in 2006, 2005, 2004, 2003, 2002 and 2001, the third largest contributor with with 13.5 % (14.6 % in 2006, 16.9 % in 2005, 16.4 % in 2004, 15.1 % in 2003, 16.6 % in 2002, 16.0 % in 2001 and 15.5 % in 2000). Residual oil is the eight largest contributor with 2.3 %. Gas Oil is, in 2006 the ninth largest contributor with 2.3 %. The rest of the categories mentioned in this paragraph as level and trend key categories each contribute below 1.4 % of the national total in 2007.

The **Energy Sector and CO_2 emission from Mobile Combustion** contributes with 4 key categorie. The category Road Transportation is the largest of these with increasing emission estimates from year 1990 to 2007. This category is in year 2006, as in 2005, 2004, 2003, 2002, 2001 and in 2000, the second largest contributor to the national total among the categories in this analysis, with a level contribution of 18.4 % in 2007 as compared to 16.9 % in 2006, 19.0 % in 2005, 17.7 % in 2004, 16.0 % in 2003, 16.6 % in 2002, 16.2 % in 2001 and 16.4 % in 2000. The category CO_2 from Mobile Combustion Agriculture is in 2007 key to level only. In 2006, as in 2005, 2004 and 2003, the category was a key category with respect to both level and trend. For this category the trend in emission estimates from 1990 to 2007 is slightly falling and the contribution to the national total in 2007 is 1.6 %. The category CO_2 from Mobil Combustion Other Machinery in Industry is as in 2006 an 2005 a key category for both level and trend, contributing in 2007 with 1.5 %; the emission estimates are slightly increasing. The category CO_2 from Mobile Combustion National Fishing is in 2007 a key for level and trend; in 2006 it was a key for level only. In 2005, as in 2003, it was a key category with respect to both level and trend. In 2004 this category was a key category with respect to trend only. The emission estimates from 1990 to 2006 are falling and the contribution is down to 0.5 % in 2007. The category CO_2 from Mobile Combustion Navigation is in 2007 a key category to level and trend. with decreasing emission estimates from 1990 to 2007, contributing 0.6 % in 2007. In 2006 it was not a key category.

The source category **CO_2 from Fugitive Emissions Oil and Natural Gas** is in 2007 a key for level only. In 2006 it was key for trend only as in 2005 while in the 2004 analysis it was key for both trend and level; this category was key for trend only in 2003. The contribution in 2007 is 0.5 % and the emission estimates from 1990 to 2007 are increasing.

The source category **CH_4 as Non-CO_2 Emission from Stationary Combustion** does no longer in KCA exist as a separat category. In the 2006 analysis, it was key category for level and trend, as in 2005 and 2004.

In the **Industry Sector**, two categories are keys with respect to both level and trend in 2007, as in 2006, in 2005, in 2003 and 2002 this number was three. The two keys in 2007 are CO_2 emissions from Cement Production and emission from HFCs and PFCs used for refrigeration and A/C equipment. CO_2 from Cement Production was also a level and trend key in 2006, 2005, 2004, 2003 and 2002. The F-gas emission category was in 2006 also a key category, the first year it was splited fromother F-gas emissions. N_2O emission from Nitric Acid Production is in 2007, 2006 and 2005 not a category since production stopped in the middle of 2004. The trends from year 1990 to 2007 for the two key categories are increasing emissions from Cement Production and from the F-gases (trend from

1995). As regards the level assessment, CO_2 from Cement Production is number 11 on the list to the national total and contributes with 2.0 %,1.9 % (1.9 % in 2006, 2.3 % in 2005 and 2004, 1.9 % in 2003 and 2.1 % in 2002), and F-gases is number 19 with a contribution of 1.0 %, in 2006 0.9 % (for the former F-gas category 1.3 % in 2005, 1.1 % in 2004, 1.0 % in 2003 and in 2002). Nitric Acid Production contributed with zero in 2007, 2006 and 2005, 0.8 % in 2004 (1.0 % in 2003 and 1.1 % in 2002).

For the **Agriculture Sector** the KCA analysis includes five categories as in previous years. Four of those are in 2007 keys to level and trend; while all five in 2006 were keys for level and trend. In 2005 four categories was keys to both level and trend as in 2004, while in 2003 they were all keys to both level and trend. In 2002, 2001 and 2000, only three of those categories were keys. These four key categories mentioned in order of falling contribution are direct N_2O emissions from agriculture soils (4.1 %), CH_4 from enteric fermentation (3.5 %), CH_4 from enteric fermentation (3.9 %) indirect N_2O emissions from nitrogen used in agriculture (3.8 %) and CH_4 from manure management (1.5 %). The emission estimates for the three most contributing categories represent a reduced emission from 1990 to 2006, while the fourth represents increasing emissions. N_2O from manure management (0.8 %) was key for level only. According to the level assessment, the four largest categories are among the 15 most contributing categories. Direct N_2O emissions from agriculture soils contributes 4.1 % (in 2006 3.8 %, 2005 4.7 %, in 2004 4.3 %, in 2003 3.9 %, in 2002 4.3 % and in 2001 6.5 %), CH_4 from enteric fermentation 3.9 % (in 2006 3.5 %, 4.1 % in 2005, in 2004 4.0 %, in 2003 3.7 %, in 2002 4.1 %, indirect N_2O emissions from nitrogen used in agriculture contributes 3.8 % (3.5 in 2006, 4.2 % in 2005, in 2004 4.1 %, in 2003 3.7 %, in 2002 4.1 % and in 2001 4.3 %), and in 2001 4.0 %) and CH_4 from manure management 1.5 % (in 2006 1.4 %, in 2005 1.6 %, in 2004 1.5 % and in 2003 1.3 %). The emission estimates of N_2O from manure management contributes 0.8 % (in 2006 0.7 %, in 2005 0.9 %, in 2004 and 2003 0.8 %).

The **LULUCF sector** was included in the KCA for the first time for the analyses on inventory year 2006. In the 2007 analysis three categories with CO_2 emissions/removals became key categories for both level and trend. These are as in 2006 in decreasing order of contribution for there absolute 2007 contribution, Forest Land remaining Forest Land, Broadleaves (2.5 %, CO_2 removal increasing from 1990 to 2007, Cropland remaining Cropland, Agriculture Soils (0.2 %, CO_2 emission decreasing from 1990 to 2007) and Forest Land remaining Forest Land, Conifers (1.4 %, CO_2 removal decreasing from 1990 to 2007). CO_2 from limestone application on Cropland is a key category with respect to trend as in 2006, the emission is falling markedly from 1990 to 2007.

In the **Waste Sector**, one category – CH_4 emissions from solid disposal of waste – is a key category with respect to level and trend; as in 2006. In 2005 it was a key for level only, while in previous analysis for 2001-2004 the category was key with respect to both level and trend. The emission estimates decrease over the period from 1990 to 2007, the contribution to national total being 1.5 % in 2007, as compared to 1.4 % in 2006, 1.6 % in 2005, 2004 and 2003. CH_4 from wastewater handling has become a key category with respect to trend only, the trend is increasing emissions 1990-2007.

Tables 7.A1 – 7.A3 of the Good Practice Guidance

Table 1 Key Category Analysis base year 1990, level assessment.

Table 7.A1 of Good Practice Guidance
Tier 1 Analysis - Level Assessment – DK inventory

A			B	C	E	F
IPCC Source Categories (LULUCF included)			Direct GHG	Base Yr Estimate (1) Mt CO_2-eq	Base Yr Level Assess ment	Base Yr Cumul total of Col. E
Energy	Stationary Combustion	COAL	CO_2	24.0771	0.3187	0.3187
Energy	Mobile combustion	Road Transportation	CO_2	9.2753	0.1228	0.4414
Energy	Stationary Combustion	GAS OIL	CO_2	4.5472	0.0602	0.5016
Energy	Stationary Combustion	NATURAL GAS	CO_2	4.3195	0.0572	0.5588
Agriculture	Agriculture soils, direct emissions		N_2O	4.2314	0.0560	0.6148
Agriculture	Nitrogen use, indirect emissions		N_2O	4.0829	0.0540	0.6688
Agriculture	Enteric Fermentation		CH_4	3.2590	0.0431	0.7119
LULUCF	Cropl. remain. Cropl. Agriculture soils		CO_2	2.5946	0.0343	0.7463
Energy	Stationary Combustion	RESIDUAL OIL	CO_2	2.5052	0.0332	0.7794
LULUCF	Forest L. remain. Forest L. Conifers		CO_2	-2.2917	0.0303	0.8098
Waste	Solid Waste Disposal Sites		CH_4	1.3352	0.0177	0.8274
Energy	Mobile combustion	Agriculture	CO_2	1.2725	0.0168	0.8443
Industrial Proc.	Nitric Acid Production		N_2O	1.0429	0.0138	0.8581
Industrial Proc.	Cement Production		CO_2	0.8824	0.0117	0.8698
Energy	Mobile combustion	Other Mobile and Machinery/Industry	CO_2	0.8415	0.0111	0.8809
Energy	Stationary Combustion	REFINERY GAS	CO_2	0.8062	0.0107	0.8916
Agriculture	Manure Management		CH_4	0.7512	0.0099	0.9015
Energy	Mobile combustion	Navigation	CO_2	0.7134	0.0094	0.9110
Agriculture	Manure management		N_2O	0.6849	0.0091	0.9200
Energy	Mobile combustion	National Fishing	CO_2	0.5907	0.0078	0.9278
LULUCF	Agricultural limestone CACO3 appl. Cropl.		CO_2	0.5655	0.0075	0.9353
LULUCF	Forest L. remain. Forest L. Broadleaves		CO_2	-0.5390	0.0071	0.9425
Energy	Stationary Combustion	PETROLEUM COKE	CO_2	0.4103	0.0054	0.9479
Energy	Stationary Combustion	KEROSENE	CO_2	0.3662	0.0048	0.9527
Energy	Stationary Combustion	PLASTIC WASTE	CO_2	0.3487	0.0046	0.9573
Energy	Mobile combustion	Railways	CO_2	0.2967	0.0039	0.9613
Energy	Fugitive emissions		CO_2	0.2634	0.0035	0.9648
Energy	Mobile combustion	Civil Aviation	CO_2	0.2427	0.0032	0.9680
Industrial Proc.	Foam Blowing		HFC	0.1826	0.0024	0.9704
Solvent and Other Prod. Use			CO_2	0.1794	0.0024	0.9728
Energy	Stationary Combustion	LPG	CO_2	0.1687	0.0022	0.9750
Energy	Stationary Combustion	COKE OVEN COKE	CO_2	0.1378	0.0018	0.9768
Waste	Waste Water Handling		CH_4	0.1256	0.0017	0.9785
Energy	Mobile combustion	Military	CO_2	0.1190	0.0016	0.9801
Industrial Proc.	Lime Production		CO_2	0.1155	0.0015	0.9816
Energy	Mobile combustion	Household - Gardening	CO_2	0.1128	0.0015	0.9831
LULUCF	Cropl. remain. Cropl. Peat for horticul-tural use		CO_2	0.1046	0.0014	0.9845
Energy	Mobile combustion	Road Transportation	N_2O	0.0966	0.0013	0.9857
LULUCF	Grassl. remain. Grassl. Agriculture soils		CO_2	0.0929	0.0012	0.9870
Waste	Waste Water Handling		N_2O	0.0876	0.0012	0.9881
Energy	Stationary Combustion	BIOMASS	CH_4	0.0829	0.0011	0.9892
Energy	Stationary Combustion	SOLID	N_2O	0.0798	0.0011	0.9903
Energy	Stationary Combustion	LIQUID	N_2O	0.0757	0.0010	0.9913
Industrial Proc.	Other sources of SF6		SF_6	0.0676	0.0009	0.9922

Continued						
Energy	Mobile combustion	Road Transportation	CH_4	0.0550	0.0007	0.9929
Industrial Proc.	Other, lubricants		CO_2	0.0497	0.0007	0.9936
Energy	Fugitive emissions		CH_4	0.0396	0.0005	0.9941
Energy	Stationary Combustion	BIOMASS	N_2O	0.0385	0.0005	0.9946
Industrial Proc.	Magnesium Production		SF_6	0.0359	0.0005	0.9951
Energy	Mobile combustion	Forestry	CO_2	0.0357	0.0005	0.9955
Industrial Proc.	Refrigeration and AC Equipment		HFC & PFC	0.0357	0.0005	0.9960
Industrial Proc.	Iron and Steel Production		CO_2	0.0284	0.0004	0.9964
Energy	Stationary Combustion	GAS	N_2O	0.0280	0.0004	0.9968
LULUCF	Cropl. remain. Cropl. Hedgerows		CO_2	0.0243	0.0003	0.9971
Industrial Proc.	Yellow Bricks Production		CO_2	0.0230	0.0003	0.9974
Energy	Stationary Combustion	WASTE	N_2O	0.0184	0.0002	0.9976
Industrial Proc.	Limestone and Dolomite use		CO_2	0.0181	0.0002	0.9979
Industrial Proc.	Glass/GlassWoll Production		CO_2	0.0174	0.0002	0.9981
Energy	Mobile combustion	Agriculture	N_2O	0.0153	0.0002	0.9983
Energy	Stationary Combustion	SOLID	CH_4	0.0149	0.0002	0.9985
Industrial Proc.	Expanded Clay		CO_2	0.0149	0.0002	0.9987
Energy	Mobile combustion	Navigation	N_2O	0.0134	0.0002	0.9989
Energy	Mobile combustion	National Fishing	N_2O	0.0115	0.0002	0.9990
Energy	Stationary Combustion	BROWN COAL BRI.	CO_2	0.0110	0.0001	0.9992
Energy	Mobile combustion	Other Mobil and Machinery/Industry	N_2O	0.0106	0.0001	0.9993
Energy	Stationary Combustion	GAS	CH_4	0.0084	0.0001	0.9994
Energy	Stationary Combustion	LIQUID	CH_4	0.0068	0.0001	0.9995
Energy	Stationary Combustion, Natural gas fuelled engines	GAS	CH_4	0.0046	0.0001	0.9996
Industrial Proc.	Electrical equipment		SF6	0.0039	0.0001	0.9996
Energy	Mobile combustion	Civil Aviation	N_2O	0.0032	<0.0001	0.9997
Energy	Mobile combustion	Household - Gardening	CH_4	0.0031	<0.0001	0.9997
Energy	Mobile combustion	Railways	N_2O	0.0025	<0.0001	0.9997
Energy	Mobile combustion	Agriculture	CH_4	0.0022	<0.0001	0.9998
LULUCF	Wetlands remain. Wetlands. Peat extraction		CO_2	0.0020	<0.0001	0.9998
Energy	Stationary Combustion Biogas fuelled engines	BIOMASS	CH_4	0.0019	<0.0001	0.9998
Energy	Stationary Combustion	WASTE	CH_4	0.0018	<0.0001	0.9999
Industrial Proc.	Road paving with Asphalt		CO_2	0.0018	<0.0001	0.9999
LULUCF	Cropl. remain. Cropl. Hoticulture		CO_2	-0.0015	<0.0001	0.9999
Energy	Fugitive emissions		N_2O	0.0014	<0.0001	0.9999
Energy	Mobile combustion	Other Mobil and Machinery/Industry	CH_4	0.0013	<0.0001	0.9999
Energy	Mobile combustion	Military	N_2O	0.0012	<0.0001	0.9999
Industrial Proc.	Catalysts/Fertilizers and Pesticides		CO_2	0.0008	<0.0001	1.0000
Energy	Mobile combustion	Navigation	CH_4	0.0006	<0.0001	1.0000
LULUCF	Land conv. to Wetlands		CH_4	-0.0006	<0.0001	1.0000
Energy	Mobile combustion	Household - Gardening	N_2O	0.0005	<0.0001	1.0000
Energy	Mobile combustion	Forestry	CH_4	0.0004	<0.0001	1.0000
Energy	Mobile combustion	National Fishing	CH_4	0.0003	<0.0001	1.0000
Energy	Mobile combustion	Railways	CH_4	0.0003	<0.0001	1.0000
Energy	Mobile combustion	Forestry	N_2O	0.0002	<0.0001	1.0000
Energy	Mobile combustion	Civil Aviation	CH_4	0.0002	<0.0001	1.0000
Energy	Mobile combustion	Military	CH_4	0.0001	<0.0001	1.0000
LULUCF	Land conv. to Wetlands		N_2O	0.0001	<0.0001	1.0000
Industrial Proc.	Asphalt Roofing		CO_2	0.0000	<0.0001	1.0000
Solvent and Other Prod. Use			N_2O	0.0000	<0.0001	1.0000
Total (incl. LULUCF)				**69,89**		

(1) The Estimates include signs, where + : emission - : removal, allthough in the level analyses only the absolute values are used

Tables 7.A1 – 7.A3 of the Good Practice Guidance

Table 2 Key Category Analysis 1990-2007, level assessment.

Table 7.A1 of Good Practice Guidance

Tier 1 Analysis - Level Assessment - DK inventory

A			B	C	D	E	F
IPCC Source Categories (LULUCF included)			Direct GHG	Base Year Estimate (1) Mt CO_2-eq	Year 2007 Estimate (1) Mt CO_2-eq	Year 2007 Level Assessment	Year 2007 Cumul total of Col. E
Energy	Stationary Combustion	Coal	CO_2	24.0771	21.5580	0.2892	0.2892
Energy	Mobile combustion	Road Transportation	CO_2	9.2752	12.5945	0.1689	0.4581
Energy	Stationary Combustion	Natural Gas	CO_2	4.3297	10.8458	0.1455	0.6036
Agriculture	Agriculture soils, direct emissions		N_2O	4.2220	2.8603	0.0384	0.6419
Agriculture	Enteric Fermentation		CH_4	3.2590	2.6025	0.0349	0.6768
Agriculture	Nitrogen use, indirect emissions		N_2O	4.1271	2.5813	0.0346	0.7115
Energy	Stationary Combustion	Residual Oil	CO_2	2.5052	2.0344	0.0273	0.7388
Energy	Stationary Combustion	Gas Oil	CO_2	4.5472	1.9828	0.0266	0.7654
LULUCF	Forest L. remain. Forest L.	Conifers	CO_2	-2.2917	-1.5877	0.0213	0.7866
Industrial Proc.	Cement Production		CO_2	0.8824	1.3955	0.0187	0.8054
Energy	Mobile combustion	Agriculture	CO_2	1.2725	1.1092	0.0149	0.8202
Agriculture	Manure Management		CH_4	0.7512	1.0423	0.0140	0.8342
Waste	Solid Waste Disposal Sites		CH_4	1.3352	1.0280	0.0138	0.8480
Energy	Mobile combustion, Other	Machinery/Industry	CO_2	0.8415	1.0210	0.0137	0.8617
LULUCF	Forest L. remain. Forest L.	Broadleaves	CO_2	-0.5390	-0.9863	0.0132	0.8749
Energy	Stationary Combustion	Refinery Gas	CO_2	0.8062	0.9325	0.0125	0.8874
Energy	Stationary Combustion	Petroleum Coke	CO_2	0.4103	0.8942	0.0120	0.8994
Industrial Proc.	Refrigeration and AC Equipment		HfcPfc	0.0357	0.7034	0.0094	0.9089
Energy	Stationary Combustion	Plastic Waste	CO_2	0.3487	0.7021	0.0094	0.9183
LULUCF	Cropl. remain. Cropl.	Agriculture soils	CO_2	2.5946	0.6527	0.0088	0.9270
Agriculture	Manure management		N2O	0.6844	0.5187	0.0070	0.9340
Energy	Mobile combustion	National Fishing	CO_2	0.5907	0.4728	0.0063	0.9403
Energy	Non-CO_2 Stationary Combustion		CH_4	0.1214	0.4609	0.0062	0.9465
Energy	Mobile combustion	Navigation	CO_2	0.7134	0.4548	0.0061	0.9526
Energy	Fugitive emissions	Oil and Natural Gas	CO_2	0.2634	0.4147	0.0056	0.9582
Energy	Non-CO_2 Stationary Combustion		N_2O	0.2404	0.2913	0.0039	0.9621
Waste	Waste Water Handling		CH_4	0.1256	0.2460	0.0033	0.9654
Energy	Mobile combustion	Househ., Gardening	CO_2	0.1128	0.2326	0.0031	0.9685
Energy	Mobile combustion	Railways	CO_2	0.2967	0.2268	0.0030	0.9716
LULUCF	Agricultural limestone CACO3	Appl. Cropl.	CO_2	0.5655	0.1792	0.0024	0.9740
Energy	Mobile combustion	Civil Aviation	CO_2	0.2427	0.1412	0.0019	0.9759
LULUCF	Cropl. remain. Cropl.	Peat for horticulture	CO_2	0.1046	0.1391	0.0019	0.9777
Industrial Proc.	Foam Blowing		HFC	0.1826	0.1267	0.0017	0.9794
Energy	Mobile combustion	Military	CO_2	0.1190	0.1265	0.0017	0.9811
Energy	Mobile combustion	Road Transportation	N_2O	0.0966	0.1247	0.0017	0.9828
LULUCF	Cropl. converted to Forest L.	Broadleaves	CO_2	NA NE NO	-0.1214	0.0016	0.9844
Energy	Stationary Combustion	LPG	CO_2	0.1687	0.1118	0.0015	0.9859
Energy	Stationary Combustion	Coke Oven Coke	CO_2	0.1378	0.1091	0.0015	0.9874
Solvent Oth Pro.			CO_2	0.1481	0.1020	0.0014	0.9888
Energy	Fugitive emissions	Oil and Natural Gas	CH_4	0.0396	0.0976	0.0013	0.9901
LULUCF	Cropl. remain. Cropl.	Hedgerows	CO_2	0.0243	-0.0901	0.0012	0.9913
LULUCF	Grassl. remain. Grassl.	Agriculture soils	CO_2	0.0929	0.0810	0.0011	0.9924
Industrial Proc.	Limestone and Dolomite use		CO_2	0.0181	0.0738	0.0010	0.9933
Industrial Proc.	Lime Production		CO_2	0.1155	0.0692	0.0009	0.9943
LULUCF	Cropl. converted to Forest L.	Conifers	CO_2	NA NE NO	-0.0622	0.0008	0.9951
Waste	Waste Water Handling		N_2O	0.0876	0.0500	0.0007	0.9958

Continued							
Solvent, Oth Pro.			N_2O	0.0000	0.0373	0.0005	0.9963
Industrial Proc.	Yellow Bricks Production		CO_2	0.0230	0.0368	0.0005	0.9968
Energy	Mobile combustion	Road Transportation	CH_4	0.0550	0.0271	0.0004	0.9971
Industrial Proc.	Other sources of SF6		SF_6	0.0676	0.0230	0.0003	0.9974
Industrial Proc.	Expanded Clay		CO_2	0.0149	0.0185	0.0002	0.9977
Energy	Mobile combustion	Forestry	CO_2	0.0357	0.0173	0.0002	0.9979
Industrial Proc.	Aerosols		HFC	NA	0.0161	0.0002	0.9981
Energy	Stationary Combustion	Kerosene	CO_2	0.3662	0.0159	0.0002	0.9984
Energy	Mobile combustion	Agriculture	N_2O	0.0153	0.0144	0.0002	0.9986
Industrial Proc.	Glass/GlassWoll Production		CO_2	0.0174	0.0135	0.0002	0.9987
Energy	Mobile combustion, Other	Machinery/Industry	N_2O	0.0106	0.0134	0.0002	0.9989
Industrial Proc.	Electrical equipment		SF_6	0.0039	0.0129	0.0002	0.9991
Energy	Mobile combustion	National Fishing	N_2O	0.0115	0.0093	0.0001	0.9992
Energy	Mobile combustion	Navigation	N_2O	0.0134	0.0080	0.0001	0.9993
LULUCF	Cropl. remain. Cropl.	Horticulture	CO_2	-0.0015	0.0073	0.0001	0.9994
LULUCF	Cropland conv. to Wetlands.	Mineral soils	CO_2	NA	-0.0057	0.0001	0.9995
Energy	Mobile combustion	Househ., Gardening	CH_4	0.0031	0.0049	0.0001	0.9996
LULUCF	Cropland conv. to Wetlands.	Organic soils	CO_2	NA	-0.0046	0.0001	0.9996
Industrial Proc.	Other i.e Fibre Optics		HfcPfc	NO	0.0043	0.0001	0.9997
LULUCF	Grassland conv. to Wetlands.	Mineral soils	CO_2	NA	-0.0030	<0.0001	0.9997
Energy	Mobile combustion	Civil Aviation	N_2O	0.0032	0.0025	<0.0001	0.9997
Energy	Fugitive emissions	Oil and Natural Gas	N_2O	0.0014	0.0023	<0.0001	0.9998
Industrial Proc.	Catalysts/Fertilizers/Pesticides		CO_2	0.0008	0.0022	<0.0001	0.9998
Energy	Mobile combustion	Railways	N_2O	0.0025	0.0019	<0.0001	0.9998
Industrial Proc.	Road paving with Asphalt		CO_2	0.0018	0.0018	<0.0001	0.9999
LULUCF	Grassland conv. to Wetlands.	Organic soils	CO_2	NA	-0.0018	<0.0001	0.9999
Energy	Mobile combustion	Agriculture	CH_4	0.0022	0.0016	<0.0001	0.9999
LULUCF	Wetlands remain. Wetlands.	Peat extraction	CO_2	0.0020	0.0016	<0.0001	0.9999
Energy	Mobile combustion	Military	N_2O	0.0012	0.0012	<0.0001	0.9999
Energy	Mobile combustion	Househ., Gardening	N_2O	0.0005	0.0011	<0.0001	1.0000
Energy	Mobile combustion, Other	Machinery/Industry	CH_4	0.0013	0.0009	<0.0001	1.0000
Energy	Mobile combustion	Navigation	CH_4	0.0006	0.0007	<0.0001	1.0000
LULUCF	Land conv. to Wetlands		CH_4	-0.0006	-0.0005	<0.0001	1.0000
Energy	Mobile combustion	National Fishing	CH_4	0.0003	0.0002	<0.0001	1.0000
Energy	Mobile combustion	Railways	CH_4	0.0003	0.0002	<0.0001	1.0000
Energy	Mobile combustion	Forestry	N_2O	0.0002	0.0002	<0.0001	1.0000
Energy	Mobile combustion	Civil Aviation	CH_4	0.0002	0.0001	<0.0001	1.0000
Energy	Mobile combustion	Military	CH_4	0.0001	0.0001	<0.0001	1.0000
Energy	Mobile combustion	Forestry	CH_4	0.0004	0.0001	<0.0001	1.0000
LULUCF	Land conv. to Wetlands		N_2O	0.0001	0.0001	<0.0001	1.0000
Industrial Proc.	Asphalt Roofing		CO_2	0.0000	0.0000	<0.0001	1.0000
Energy	Stationary Combustion	Brown Coal Bri	CO_2	0.0110	0.0000	<0.0001	1.0000
Industrial Proc.	Iron and Steel Production		CO_2	0.0284	0.0000	<0.0001	1.0000
Industrial Proc.	Nitric Acid Production		N_2O	1.0429	0.0000	<0.0001	1.0000
Industrial Proc.	Magnesium Production		SF_6	0.0359	0.0000	<0.0001	1.0000
Total (incl. LULUCF)				**69.9**	**68.8**	1.00	

(1) The Estimates include signs, where + : emission - : removal, allthough in the level analyses only the absolute values are used

Table 3 Key Category Analysis 1990-2007, trend assessment.

Table 7.A2 of Good Practice Guidance
Tier 1 Analysis - Trend Assessment - DK inventory

A			B	C	D	E	F	G
IPCC Source Categories (LULUCF included)			Direct GHG	Base Yr Estimate (1) Mt CO_2-eq	Yr 2006 Estimate (1) Mt CO_2-eq	Trend Assess-ment	Contribution to Trend %	Cumul. total of col. F %
Energy	Stationary Combustion	COAL	CO_2	24.0771	18.3046	0.0564	13.65	13.65
Energy	Stationary Combustion	NATURAL GAS	CO_2	4.3195	9.7023	0.0748	18.10	31.75
Energy	Mobile combustion	Road Transportation	CO_2	9.2753	13.1978	0.0596	14.42	46.17
Energy	Stationary Combustion	GAS OIL	CO_2	4.5472	1.6140	0.0351	8.48	54.64
LULUCF	Forest L. remain. Forest L. Conifers		CO_2	-2.2917	-1.0057	0.0189	4.58	59.22
Agriculture	Nitrogen use, indirect emis-sions		N_2O	4.0829	2.6956	0.0150	3.62	62.84
LULUCF	Forest L. remain. Forest L. Broadleaves		CO_2	-0.5390	-1.7629	0.0158	3.81	66.65
Agriculture	Agriculture soils, direct emissions		N_2O	4.2314	2.9560	0.0134	3.23	69.89
Industrial Proc.	Nitric Acid Production		N_2O	1.0429	0.0000	0.0129	3.13	73.02
LULUCF	Cropl. remain. Cropl. Agriculture soils		CO_2	2.5946	1.5646	0.0115	2.78	75.79
Industrial Proc.	Refrigeration and AC Equipment		HFC & PFC	0.0357	0.7338	0.0093	2.24	78.04
Energy	Stationary Combustion	RESIDUAL OIL	CO_2	2.5052	1.6542	0.0092	2.22	80.26
Energy	Stationary Combustion	PETROLEUM COKE	CO_2	0.4103	0.9700	0.0077	1.87	82.13
Industrial Proc.	Cement Production		CO_2	0.8824	1.4071	0.0077	1.86	83.99
Energy	Stationary Combustion	PLASTIC WASTE	CO_2	0.3487	0.7115	0.0051	1.23	85.22
Agriculture	Manure Management		CH_4	0.7512	1.0480	0.0046	1.10	86.32
LULUCF	Agricultural limestone CACO3 appl. Cropl.		CO_2	0.5655	0.1920	0.0045	1.08	87.40
Energy	Stationary Combustion	KEROSENE	CO_2	0.3662	0.0086	0.0044	1.07	88.48
Energy	Mobile combustion	Other Mobil and Machinery/Industry	CO_2	0.8415	1.0875	0.0040	0.96	89.43
Agriculture	Enteric Fermentation		CH_4	3.2590	2.7866	0.0036	0.86	90.29
Energy	Mobile combustion	Navigation	CO_2	0.7134	0.4536	0.0028	0.69	90.98
Energy	Stationary Combustion	Natural gas fuelled engines	CH_4	0.0046	0.1983	0.0026	0.62	91.60
Waste	Solid Waste Disposal Sites		CH_4	1.3352	1.0630	0.0025	0.60	92.20
Energy	Mobile combustion	National Fishing	CO_2	0.5907	0.3818	0.0023	0.55	92.75
Energy	Stationary Combustion	REFINERY GAS	CO_2	0.8062	0.9056	0.0020	0.48	93.23
LULUCF	Cropl. converted to Forest L. Broadleaves		CO_2	NA.NE.NO	-0.1396	0.0018	0.45	93.68
Waste	Waste Water Handling		CH_4	0.1256	0.2558	0.0018	0.44	94.12
Energy	Mobile combustion	Household - Garde-ning	CO_2	0.1128	0.2320	0.0017	0.40	94.53
Energy	Mobile combustion	Civil Aviation	CO_2	0.2427	0.1067	0.0016	0.39	94.91
Energy	Fugitive emissions		CO_2	0.2634	0.3666	0.0016	0.38	95.30
LULUCF	Cropl. remain. Cropl. Hedgerows		CO_2	0.0243	-0.0951	0.0016	0.38	95.67
Energy	Stationary Combustion	BIOMASS	CH_4	0.0829	0.1871	0.0014	0.35	96.02
Energy	Fugitive emissions		CH_4	0.0396	0.1283	0.0012	0.29	96.32
Solvent and Other Prod. Use			CO_2	0.1794	0.0871	0.0011	0.26	96.57
LULUCF	Cropl. converted to Forest L. Conifers		CO_2	NA.NE.NO	-0.0689	0.0009	0.22	96.80
Industrial Proc.	Foam Blowing		HFC	0.1826	0.1030	0.0009	0.22	97.01
Energy	Stationary Combustion	LPG	CO_2	0.1687	0.0902	0.0009	0.22	97.23
Energy	Mobile combustion	Military	CO_2	0.1190	0.1749	0.0008	0.20	97.43
Agriculture	Manure management		N_2O	0.6849	0.5862	0.0007	0.18	97.61
Energy	Mobile combustion	Railways	CO_2	0.2967	0.2276	0.0007	0.16	97.77
Energy	Stationary Combustion	GAS	N_2O	0.0280	0.0764	0.0007	0.16	97.93
Industrial Proc.	Other sources of SF_6		SF_6	0.0676	0.0153	0.0006	0.15	98.09
Energy	Stationary Combustion	BIOMASS	N_2O	0.0385	0.0793	0.0006	0.14	98.23

Continued								
Industrial Proc.	Lime Production		CO_2	0.1155	0.0669	0.0005	0.13	98.36
Solvent and Other Prod. Use			N_2O	0.0000	0.0369	0.0005	0.12	98.48
Energy	Mobile combustion	Road Transportation	N_2O	0.0966	0.1266	0.0005	0.12	98.59
Waste	Waste Water Handling		N_2O	0.0876	0.0474	0.0005	0.11	98.70
Industrial Proc.	Limestone and Dolomite use		CO_2	0.0181	0.0510	0.0005	0.11	98.81
Industrial Proc.	Magnesium Production		SF_6	0.0359	0.0000	0.0004	0.11	98.92
LULUCF	Cropl. remain. Cropl. Peat for horticultural use		CO_2	0.1046	0.1295	0.0004	0.10	99.02
Energy	Mobile combustion	Agriculture	CO_2	1.2725	1.1659	0.0004	0.09	99.11
Energy	Mobile combustion	Road Transportation	CH_4	0.0550	0.0249	0.0004	0.09	99.19
Industrial Proc.	Iron and Steel Production		CO_2	0.0284	0.0000	0.0004	0.09	99.28
Energy	Stationary Combustion	LIQUID	N_2O	0.0757	0.0474	0.0003	0.08	99.35
Energy	Stationary Combustion	SOLID	N_2O	0.0798	0.0561	0.0002	0.06	99.41
Industrial Proc.	Yellow Bricks Production		CO_2	0.0230	0.0380	0.0002	0.05	99.47
Energy	Mobile combustion	Forestry	CO_2	0.0357	0.0172	0.0002	0.05	99.52
Energy	Stationary Combustion	Biogas fuelled engi-nes	CH_4	0.0019	0.0170	0.0002	0.05	99.57
Industrial Proc.	Expanded Clay		CO_2	0.0149	0.0269	0.0002	0.04	99.61
Industrial Proc.	Electrical equipment		SF_6	0.0039	0.0151	0.0002	0.04	99.64
Industrial Proc.	Aerosols		HFC	NA	0.0109	0.0001	0.03	99.68
Energy	Stationary Combustion	BROWN COAL BRI.	CO_2	0.0110	0.0000	0.0001	0.03	99.71
LULUCF	Cropl. remain. Cropl. Hoticulture		CO_2	-0.0015	-0.0118	0.0001	0.03	99.75
Industrial Proc.	Other, lubricants		CO_2	0.0497	0.0379	0.0001	0.03	99.77
Energy	Stationary Combustion	COKE OVEN COKE	CO_2	0.1378	0.1212	0.0001	0.03	99.80
Industrial Proc.	Other i.e Fibre Optics		HFC & PFC	NO	0.0076	0.0001	0.02	99.82
Energy	Stationary Combustion	GAS	CH_4	0.0084	0.0145	0.0001	0.02	99.84
LULUCF	Cropland conv. to Wetlands. Mineral soils		CO_2	NA	-0.0057	0.0001	0.02	99.86
Energy	Stationary Combustion	SOLID	CH_4	0.0149	0.0094	0.0001	0.01	99.88
LULUCF	Cropland conv. to Wetlands. Organic soils		CO_2	NA	-0.0046	0.0001	0.01	99.89
Energy	Mobile combustion	Navigation	N_2O	0.0134	0.0080	0.0001	0.01	99.91
Energy	Mobile combustion	Other Mobil and Machinery/Industry	N_2O	0.0106	0.0143	0.0001	0.01	99.92
Energy	Mobile combustion	National Fishing	N_2O	0.0115	0.0075	<0.0001	0.01	99.93
LULUCF	Grassl. remain. Grassl. Agriculture soils		CO_2	0.0929	0.0841	<0.0001	0.01	99.94
LULUCF	Grassland conv. to Wet-lands. Mineral soils		CO_2	NA	-0.0030	<0.0001	0.01	99.95
Energy	Mobile combustion	Household - Garde-ning	CH_4	0.0031	0.0049	<0.0001	0.01	99.96
LULUCF	Grassland conv. to Wet-lands. Organic soils		CO_2	NA	-0.0018	<0.0001	0.01	99.96
Energy	Stationary Combustion	WASTE	N_2O	0.0184	0.0186	<0.0001	0.00	99.97
Industrial Proc.	Catalysts/Fertilizers and Pesticides		CO_2	0.0008	0.0022	<0.0001	0.00	99.97
Industrial Proc.	Glass/GlassWoll Production		CO_2	0.0174	0.0150	<0.0001	0.00	99.98
Energy	Stationary Combustion	LIQUID	CH_4	0.0068	0.0054	<0.0001	0.00	99.98
Energy	Mobile combustion	Agriculture	N_2O	0.0153	0.0152	<0.0001	0.00	99.98
Energy	Mobile combustion	Civil Aviation	N_2O	0.0032	0.0021	<0.0001	0.00	99.98
Energy	Stationary Combustion	WASTE	CH_4	0.0018	0.0010	<0.0001	0.00	99.99
Energy	Mobile combustion	Military	N_2O	0.0012	0.0018	<0.0001	0.00	99.99
Energy	Mobile combustion	Household - Garde-ning	N_2O	0.0005	0.0011	<0.0001	0.00	99.99
Energy	Mobile combustion	Agriculture	CH_4	0,0022	0,0016	<0,0001	0,00	99,99
Energy	Mobile combustion	Railways	N_2O	0,0025	0,0019	<0,0001	0,00	99,99
Industrial Proc.	Road paving with Asphalt		CO_2	0,0018	0,0020	<0,0001	0,00	99,99
Energy	Mobile combustion	Forestry	CH_4	0,0004	0,0001	<0,0001	0,00	100,00
Energy	Fugitive emissions		N_2O	0,0014	0,0010	<0,0001	0,00	100,00

Continued								
Energy	Mobile combustion	Other Mobil and Machinery/Industry	CH_4	0,0013	0,0009	<0,0001	0,00	100,00
LULUCF	Wetlands remain. Wetlands. Peat extraction		CO_2	0,0020	0,0016	<0,0001	0,00	100,00
LULUCF	Land conv. to Wetlands		CH_4	-0,0006	-0,0005	<0,0001	0,00	100,00
Energy	Mobile combustion	Navigation	CH_4	0,0006	0,0007	<0,0001	0,00	100,00
Energy	Mobile combustion	National Fishing	CH_4	0,0003	0,0002	<0,0001	0,00	100,00
Energy	Mobile combustion	Railways	CH_4	0,0003	0,0002	<0,0001	0,00	100,00
Energy	Mobile combustion	Military	CH_4	0,0001	0,0002	<0,0001	0,00	100,00
Energy	Mobile combustion	Civil Aviation	CH_4	0,0002	0,0001	<0,0001	0,00	100,00
Industrial Proc.	Asphalt Roofing		CO_2	0,0000	0,0000	<0,0001	0,00	100,00
LULUCF	Land conv. to Wetlands		N_2O	0,0001	0,0001	<0,0001	0,00	100,00
Energy	Mobile combustion	Forestry	N_2O	0,0002	0,0002	<0,0001	0,00	100,00
Total (incl LULUCF)				**69,9**	**65,5**	0,4134	100,00	

(1) The Estimates include signs, where + : emission - : removal, allthough in the level analyses only the absolute values are used

Table 4 Key category Analysis 1990-2007. Summary.

Table 7.A3 of Good Practice Guidance Quantitative method used: Tier 1 - Source Category Analysis - Summary (DK-inventory)						
A			B	C	D	E
IPCC Source Categories (LULUCF included)			Direct GHG	Key Source 2006	If C is yes criteria for identifikation	Comments
Energy	Stationary Combustion	COAL	CO_2	Yes	Level, Trend	*See text*
Energy	Stationary Combustion	BROWN COAL BRI.	CO_2	No		
Energy	Stationary Combustion	COKE OVEN COKE	CO_2	No		
Energy	Stationary Combustion	PETROLEUM COKE	CO_2	Yes	Level, Trend	*See text*
Energy	Stationary Combustion	PLASTIC WASTE	CO_2	Yes	Level, Trend	*See text*
Energy	Stationary Combustion	RESIDUAL OIL	CO_2	Yes	Level, Trend	*See text*
Energy	Stationary Combustion	GAS OIL	CO_2	Yes	Level, Trend	*See text*
Energy	Stationary Combustion	KEROSENE	CO_2	Yes	Trend	*See text*
Energy	Stationary Combustion	NATURAL GAS	CO_2	Yes	Level, Trend	*See text*
Energy	Stationary Combustion	LPG	CO_2	No		
Energy	Stationary Combustion	REFINERY GAS	CO_2	Yes	Level, Trend	*See text*
Energy	Mobile combustion	Civil Aviation	CO_2	No	Trend	
Energy	Mobile combustion	Road Transportation	CO_2	Yes	Level, Trend	*See text*
Energy	Mobile combustion	Railways	CO_2	No		
Energy	Mobile combustion	Navigation	CO_2	Yes	Level, Trend	*See text*
Energy	Mobile combustion	Military	CO_2	No		
Energy	Mobile combustion	National Fishing	CO_2	Yes	Level, Trend	*See text*
Energy	Mobile combustion	Agriculture	CO_2	Yes	Level	*See text*
Energy	Mobile combustion	Forestry	CO_2	No		
Energy	Mobile combustion	Other Mobil and Machinery/Industry	CO_2	Yes	Level, Trend	*See text*
Energy	Mobile combustion	Household - Gardening	CO_2	Yes	Trend	*See text*
Energy	Fugitive emissions		CO_2	Yes	Level	*See text*
Energy	Stationary Combustion	BIOMASS	CH_4	No		
Energy	Stationary Combustion	Biogas fuelled engines	CH_4	No		
Energy	Stationary Combustion	GAS	CH_4	No		
Energy	Stationary Combustion	Natural gas fuelled engines	CH_4	No	Trend	*See text*
Energy	Stationary Combustion	LIQUID	CH_4	No		
Energy	Stationary Combustion	WASTE	CH_4	No		
Energy	Stationary Combustion	SOLID	CH_4	No		
Energy	Mobile combustion	Civil Aviation	CH_4	No		
Energy	Mobile combustion	Road Transportation	CH_4	No		
Energy	Mobile combustion	Railways	CH_4	No		
Energy	Mobile combustion	Navigation	CH_4	No		
Energy	Mobile combustion	Military	CH_4	No		
Energy	Mobile combustion	National Fishing	CH_4	No		
Energy	Mobile combustion	Agriculture	CH_4	No		
Energy	Mobile combustion	Forestry	CH_4	No		
Energy	Mobile combustion	Other Mobil and Machinery/Industry	CH_4	No		
Energy	Mobile combustion	Household - Gardening	CH_4	No		
Energy	Fugitive emissions		CH_4	No		
Energy	Stationary Combustion	BIOMASS	N_2O	No		
Energy	Stationary Combustion	GAS	N_2O	No		
Energy	Stationary Combustion	LIQUID	N_2O	No		
Energy	Stationary Combustion	WASTE	N_2O	No		
Energy	Stationary Combustion	SOLID	N_2O	No		
Energy	Mobile combustion	Civil Aviation	N_2O	No		
Energy	Mobile combustion	Road Transportation	N_2O	No		
Energy	Mobile combustion	Railways	N_2O	No		
Energy	Mobile combustion	Navigation	N_2O	No		

Continued						
Energy	Mobile combustion	Military	N_2O	No		
Energy	Mobile combustion	National Fishing	N_2O	No		
Energy	Mobile combustion	Agriculture	N_2O	No		
Energy	Mobile combustion	Forestry	N_2O	No		
Energy	Mobile combustion	Other Mobil and Machinery/Industry	N_2O	No		
Energy	Mobile combustion	Household - Gardening	N_2O	No		
Energy	Fugitive emissions		N_2O	No		
Industrial Proc.	Cement Production		CO_2	Yes	Level, Trend	*See text*
Industrial Proc.	Lime Production		CO_2	No		
Industrial Proc.	Limestone and Dolomite use		CO_2	No		
Industrial Proc.	Asphalt Roofing		CO_2	No		
Industrial Proc.	Road paving with Asphalt		CO_2	No		
Industrial Proc.	Glass/GlassWoll Production		CO_2	No		
Industrial Proc.	Yellow Bricks Production		CO_2	No		
Industrial Proc.	Expanded Clay		CO_2	No		
Industrial Proc.	Catalysts/Fertilizers and Pesticides		CO_2	No		
Industrial Proc.	Iron and Steel Production		CO_2	No		
Industrial Proc.	Other, lubricants		CO_2	No		
Industrial Proc.	Nitric Acid Production		N_2O	Yes	Trend	*See text*
Industrial Proc.	Magnesium Production		SF_6	No		
Industrial Proc.	Electrical equipment		SF_6	No		
Industrial Proc.	Other sources of SF6		SF_6	No		
Industrial Proc.	Refrigeration and AC Equipment		HFC % PFC	Yes	Level, Trend	*See text*
Industrial Proc.	Foam Blowing		HFC	No		
Industrial Proc.	Aerosols		HFC	No		
Industrial Proc.	Other i.e Fibre Optics		HFC & PFC	No		
Solvent and Other Prod. Use			CO_2	No		
Solvent and Other Prod. Use			N_2O	No		
Agriculture	Enteric Fermentation		CH_4	Yes	Level, Trend	*See text*
Agriculture	Manure Management		CH_4	Yes	Level, Trend	*See text*
Agriculture	Manure management		N_2O	Yes	Level	*See text*
Agriculture	Agriculture soils, direct emissions		N_2O	Yes	Level, Trend	*See text*
Agriculture	Nitrogen use, indirect emissions		N_2O	Yes	Level, Trend	*See text*
Waste	Solid Waste Disposal Sites		CH_4	Yes	Level, Trend	*See text*
Waste	Waste Water Handling		CH_4	Yes	Trend	*See text*
Waste	Waste Water Handling		N_2O	No		
LULUCF	Forest L. remain. Forest L. Broadleaves		CO_2	Yes	Level, Trend	*See text*
LULUCF	Forest L. remain. Forest L. Conifers		CO_2	Yes	Level, Trend	*See text*
LULUCF	Cropl. converted to Forest L. Broadleaves		CO_2	Yes	Trend	*See text*
LULUCF	Cropl. converted to Forest L. Conifers		CO_2	No		
LULUCF	Cropl. remain. Cropl. Hedgerows		CO_2	No		
LULUCF	Cropl. remain. Cropl. Hoticulture		CO_2	No		
LULUCF	Cropl. remain. Cropl. Agriculture soils		CO_2	Yes	Level, Trend	*See text*
LULUCF	Cropl. remain. Cropl. Peat for horticultural use		CO_2	No		
LULUCF	Agricultural limestone CACO3 appl. Cropl.		CO_2	Yes	Trend	*See text*
LULUCF	Grassl. remain. Grassl. Agriculture soils		CO_2	No		
LULUCF	Wetlands remain. Wetlands. Peat extraction		CO_2	No		

Continued					
LULUCF	Land conv. to Wetlands		CH_4	No	
LULUCF	Land conv. to Wetlands		N_2O	No	
LULUCF	Cropland conv. to Wetlands. Mineral soils		CO_2	No	
LULUCF	Cropland conv. to Wetlands. Organic soils		CO_2	No	
LULUCF	Grassland conv. to Wetlands. Mineral soils		CO_2	No	
LULUCF	Grassland conv. to Wetlands. Organic soils		CO_2	No	

Annex 2 Detailed discussion of methodology and data for estimation of CO_2 emission from fossil fuel combustion

Please refer to Annex 3A and 3B.

Annex 3 Other detailed methodological descriptions for individual source or sink categories (where relevant)

Annex 3A Danish Emission Inventories for Stationary Combustion Plants

Inventories until year 2007

Malene Nielsen
Ole-Kenneth Nielsen
Marlene Plejdrup
Jytte Boll Illerup

Contents

Preface

The Danish National Environmental Research Institute (NERI) prepares the Danish atmospheric emission inventories and reports the results on an annual basis to the Climate Convention. This report forms part of the documentation for the inventories and covers emissions from stationary combustion plants. The results of inventories up to 2007 are included. The annex extracts relevant data from an update version of the sector report for stationary combustion plants that will be published later this year.

Sammendrag

Opgørelser over de samlede danske luftemissioner rapporteres årligt til Klimakonventionen (*UN Framework Convention on Climate Change, UNFCCC*). Endvidere rapporteres drivhusgasemissionen til EU, fordi EU – såvel som de enkelte medlemslande – har ratificeret klimakonventionen. De danske emissioner opgøres og rapporteres af Danmarks Miljøundersøgelser (DMU). Emissionsopgørelserne omfatter følgende stoffer af relevans for stationær forbrænding: CO_2, CH_4, N_2O, SO_2, NO_x, NMVOC og CO. Foruden de årlige opgørelser over samlede nationale emissioner rapporteres også sektoropdelt emission.

Emissionsopgørelserne for stationære forbrændingsanlæg (ikke mobile kilder) er baseret på den danske energistatistik og på et sæt af emissionsfaktorer for forskellige sektorer, teknologier og brændsler. Anlægsspecifikke emissionsdata for store anlæg, som fx kraftværker, indarbejdes i opgørelserne. Denne rapport giver detaljeret baggrundsinformation om den anvendte metode samt referencer for de data der ligger til grund for opgørelsen – energistatistikken og emissionsfaktorerne.

Emissionsfaktorerne stammer enten fra danske referencer eller fra internationale guidebøger (EEA 2007 og IPCC 1997) udarbejdet til brug for denne type emissionsopgørelser. De danske referencer omfatter miljølovgivning, danske rapporter samt middelværdier baseret på anlægsspecifikke emissionsdata fra et betydeligt antal større værker. Anlægsspecifikke emissionsfaktorer oplyses af anlægsejere, bl.a. i grønne regnskaber.

I emissionsopgørelsen for 2007 er 71 stationære forbrændingsanlæg defineret som punktkilder. Punktkilderne omfatter: kraftværker, decentrale kraftvarmeværker, affaldsforbrændingsanlæg, industrielle forbrændings-anlæg samt raffinaderier. Brændselsforbruget for disse anlæg svarer til 60 % af det samlede brændselsforbrug for alle stationære forbrændingsanlæg.

Variationen i årlig import/eksport af el medfører at brændselsforbruget til stationære forbrændingsanlæg varierer. Siden 1990 er brændselsforbruget steget med 12 %, men forbruget af fossile brændsler er faldet 2 %. Forbruget af kul er faldet, mens forbruget af naturgas og af biobrændsler er steget.

Emissionen fra stationær forbrænding udgør over 50 % af den nationale emission af CO_2 og SO_2. Endvidere udgør emissionen over 10 % af den nationale emission af NO_x, CO og NMVOC. Stationær forbrænding bidrager med mindre end 10 % af den nationale emission af CH_4 og N_2O.

Indenfor de stationære forbrændingsanlæg er kraftværker og decentrale kraftvarmeværker den betydeligste emissionskilde for CO_2, N_2O, SO_2 og NO_x.

Gasmotorer installeret på decentrale kraftvarmeværker er sammen med forbrænding af biomasse i forbindelse med beboelse de største CH_4 emissionskilder.

Emissioner fra kedler, brændeovne mv. i forbindelse med beboelse er den betydeligste emissionskilde for CO og NMVOC. Det er især forbrænding af træ, som bidrager til disse emissioner.

I rapporten vises tidsserier for emissioner fra stationær forbrænding.

Udviklingen i emissionen af drivhusgasser følger udviklingen i CO_2-emissionen ganske tæt. Både CO_2-emissionen og den samlede drivhusgas-emission fra stationær forbrænding er lavere i 2007 end i basisåret 1990 – CO_2 er 10 % lavere og drivhusgasemissionen er 9 % lavere. Emissionerne fluktuerer dog betydeligt pga. variationerne i import/eksport af el samt varierende udetemperatur.

CH_4-emissionen fra stationær forbrænding er steget med en faktor 3,6 siden 1990. Denne stigning skyldes primært at der i 1990-erne blev installeret et betydeligt antal gasmotorer på decentrale kraftvarmeværker. De senere år er emissionen dog faldet lidt. Dette skyldes de ændrede afregningsregler iht. det frie elmarked. Emissionen fra beboelse er steget væsentligt de senere år pga. den øgede forbrænding af træ i brændeovne mv.

Emissionen af N_2O var 16 % højere i 2007 end i 1990. Emissionen af N_2O fluktuerer som følge af variationerne i import/eksport af el.

SO_2-emissionen fra stationær forbrænding er faldet med 87 % siden 1990. Den store reduktion skyldes primært, at emissionen fra el- og fjernvarmeproducerende anlæg er faldet, som følge af installering af afsvovlningsanlæg samt brug af brændsler med lavere svovlindhold.

NO_x-emissionen fra stationær forbrænding er faldet med 46 % siden 1990. Reduktionen skyldes primært at emissionen fra el og fjernvarmeproducerende anlæg er faldet som følge af at der benyttes lav-NO_x-brændere på flere anlæg og at der er idriftsat NO_x-røggasrensning på flere store kraftværker. Variationen i NO_x-emissionen følger variationen i import/eksport af el.

Forbrænding af træ i villakedler og brændeovne var i 2007 4,1 gange så højt som i 1990. Denne stigning har medført en væsentlig stigning i emissionen af CO og NMVOC. Emissionen af CO og NMVOC stiger dog knap så meget idet emissionsfaktorerne for forbrænding af træ i forbindelse med husholdninger er dog faldende. Dette skyldes at emissionen fra nyere brændeovne mv er lavere end for de ældre.

CO emissionen er steget 22 % siden 1990. Emissionen fra brændeovne er steget, men samtidig er emissionen fra halmfyrede gårdanlæg faldet.

Emissionen af NMVOC fra stationær forbrænding er øget med 109 % siden 1990. Stigningen skyldes primært det øgede forbrug af træ i forbindelse med beboelse (brændeovne mv.) og idriftsættelsen af gasmotorer på decentrale kraftvarmeværker.

Emissionen af drivhusgasser er bestemt med en usikkerhed på ±8,5 %. Drivhusgas emissionen er faldet 8,5 % ± 2,1 %-point.

Summary

Danish emission inventories are prepared on an annual basis and are reported to the *UNECE Framework Convention on Climate Change* (UNFCCC or Climate Convention). Furthermore, a greenhouse gas emission inventory is reported to the EU, due to the EU – as well as the individual member states – being party to the Climate Convention. The annual Danish emission inventories are prepared by the Danish National Environmental Research Institute (NERI). The inventories include the following pollutants relevant to stationary combustion: CO_2, CH_4, N_2O, SO_2, NO_x, NMVOC and CO. In addition to annual national emissions, the report includes emission data for subsectors.

The inventories for stationary combustion are based on the Danish energy statistics and on a set of emission factors for various sectors, technologies and fuels. Plant specific emissions for large combustion sources are incorporated into the inventories. This report provides detailed background information on the methodology and references for the input data in the inventory - energy statistics and emission factors.

The emission factors are based either on national references or on international guidebooks (EEA 2007 and IPCC 1997). The majority of the country-specific emission factors refer to: Danish legislation, Danish research reports or calculations based on plant-specific emission data from a considerable number of large point sources. The plant-specific emission factors are provided by plant operators, e.g. in annual environmental reports or in the EU ETS[1].

In the inventory for the year 2007, 71 stationary combustion plants are specified as large point sources. The point sources include large power plants, municipal waste incineration plants, industrial combustion plants and petroleum refining plants. The fuel consumption of these large point sources corresponds to 60 % of the overall fuel consumption of stationary combustion.

Since 1990 fuel consumption has increased by 12 % - fossil fuel consumption, however, decreased by 2 %. The use of coal has decreased whereas the use of natural gas and renewable fuels has increased. The fuel consumption for stationary combustion plants fluctuates due to variation in the import/export of electricity from year to year.

Stationary combustion plants account for more than 50 % of the national emission of CO_2 and SO_2. Furthermore, the emission from stationary combustion plants accounts for more than 10 % of the national emission of NO_x, CO and NMVOC. Stationary combustion plants account for less than 10 % of the national CH_4 and N_2O emission.

Public electricity and heat production are the most important stationary combustion emission source for CO_2, N_2O, SO_2 and NO_x.

[1] EU Emission Trading Scheme

Lean-burn gas engines installed in decentralised CHP plants and combustion of biomass in residential plants are the two largest emission sources for CH_4.

Residential plants represent the most important stationary combustion source for CO and NMVOC. Wood combustion in residential plants is the predominant emission source.

The greenhouse gas emission (GHG) development follows the CO_2 emission development closely. Both the CO_2 and the total GHG emission were lower in 2007 than in 1990: CO_2 by 10 % and GHG by 9 %. However fluctuations in the GHG emission level are great. The fluctuations in the time-series are a result of electricity import/export and of outdoor temperature variations from year to year.

The CH_4 emission from stationary combustion increased by a factor of 3.6 since 1990. This is mainly a result of the considerable number of lean-burn gas engines installed in CHP plants in Denmark during the 1990-ties. In resent years the emission has declined. This is due to structural changes in the Danish electricity market, which means that the fuel consumption in gas engines has been decreasing. The CH_4 emission from residential plants has increased since 1990 due to increased combustion of wood in residential plants.

The emission of N_2O was 16 % higher in 2007 than in 1990. The fluctuations follows the fluctuations of the fuel consumption that is a result of import/eksport of electricity.

SO_2 emission from stationary combustion plants has decreased by 87 % since 1990. The considerable emission decrease is mainly a result of the reduced emission from electricity and heat production due to installation of desulphurisation technology and the use of fuels with lower sulphur content.

The NO_x emission from stationary combustion plants has decreased by 46 % since 1990. The reduced emission is mainly a result of the reduced emission from electricity and heat production that is a result of installation of low NO_x burners and selective catalytic reduction (SCR) units. The fluctuations in the emission time-series follow fluctuations in electricity import/export.

Wood consumption in residential plants 2007 is 4.1 times the 1990 level. This has caused a considerable increase in the emission of CO and NMVOC. A change of technology (installation of modern stoves) has however caused decreasing emission factors for both pollutants.

The CO emission has increased by 22 % from 1990 to 2007. The increase in CO emission from residential plants is less than the increase in wood consumption, because the CO emission factor for wood combustion in residential plants decreased since 1990. Furthermore the emission from straw-fired farmhouse boilers has decreased considerably.

The NMVOC emission from stationary combustion plants has increased 109 % from 1990. The increased NMVOC emission is mainly a result of the increasing wood combustion in residential plants and the increased use of lean-burn gas engines. The emission from straw-fired farmhouse boilers has decreased.

The uncertainty level of the Danish greenhouse gas emission from stationary combustion is estimated to be within a range of ±8.5 % and the trend in GHG emission is -8.5 % ± 2.1 %-age points.

1 Fuel consumption data

In 2007 total fuel consumption for stationary combustion plants was 559 PJ of which 446 PJ was fossil fuels and 114 PJ was biomass. The fuel consumption rates are shown in Appendix 3A-3.

Fuel consumption distributed according to the stationary combustion subsectors is shown in Figure 3A-1. The majority - 59 % - of all fuels is combusted in the sector, *Public electricity and heat production.* Other sectors with high fuel consumption are *Residential* and *Industry*. The energy consumption in *Other energy industries* is mainly natural gas used in gas turbines in the off-shore industry.

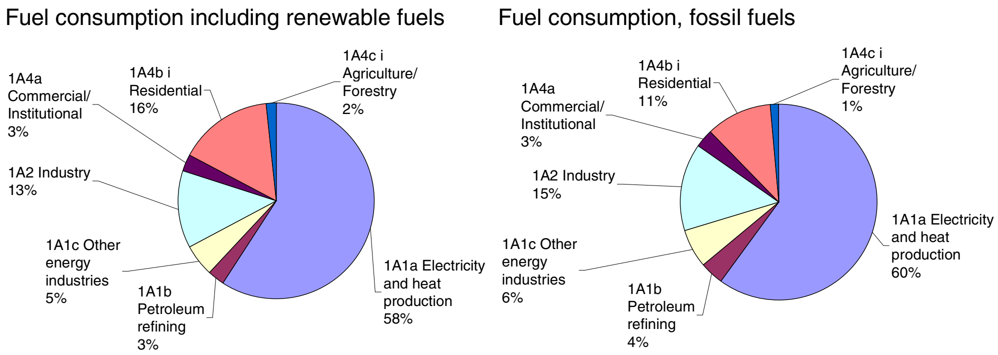


Figure 3A-1 Fuel consumption rate of stationary combustion, 2007 (based on DEA (2008a)).

Coal and natural gas are the most utilised fuels for stationary combustion plants. Coal is mainly used in power plants and natural gas is used in power plants and decentralised CHP plants, as well as in industry, district heating, residential plants and off-shore gas turbines (see Figure 3A-2).

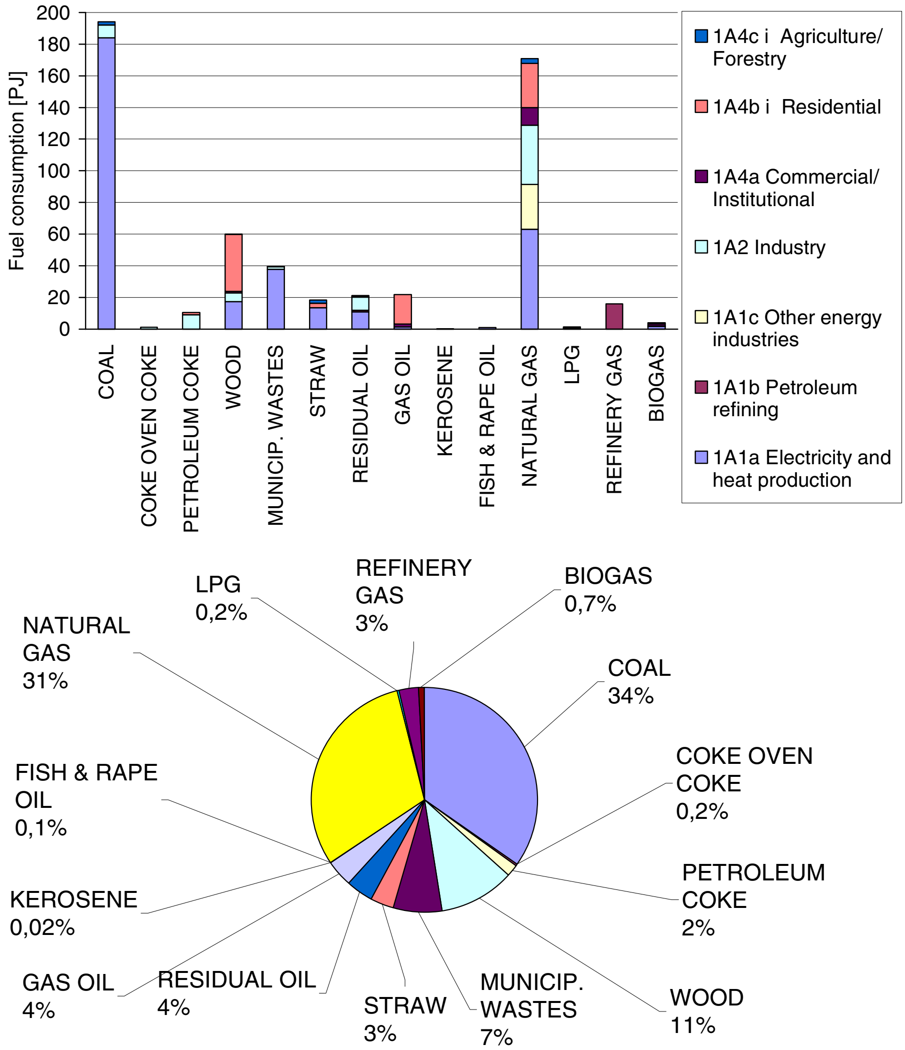


Figure 3A-2 Fuel consumption of stationary combustion plants 2007 (based on DEA (2008a)).

Fuel consumption time-series for stationary combustion plants are presented in Figure 3A-3. The total fuel consumption has increased by 12 % from 1990 to 2007, while the fossil fuel consumption has decreased by 2 % and the biomass fuel consumption increased by 163 %.

The consumption of natural gas and renewable fuels has increased since 1990 whereas coal consumption has decreased.

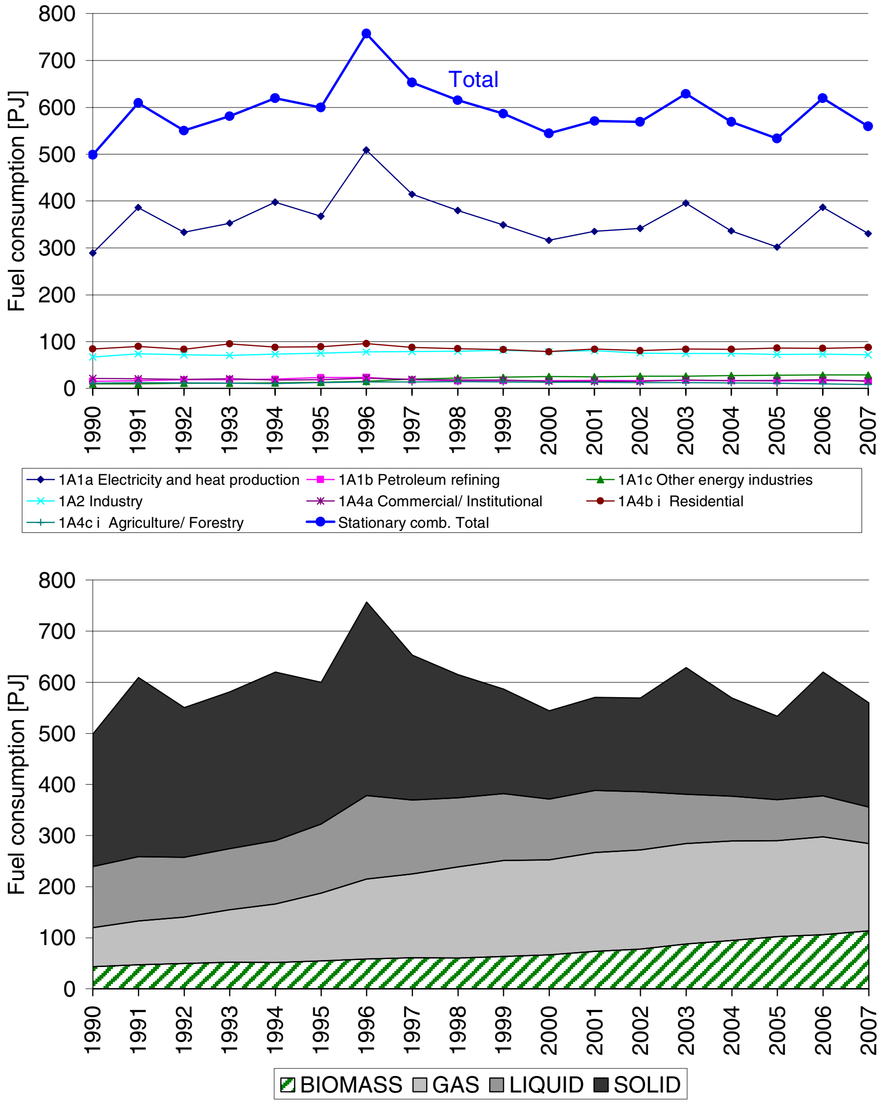


Figure 3A-3 Fuel consumption time-series, stationary combustion (based on DEA (2008a)).

The fluctuations in the time-series for fuel consumption are mainly a result of electricity import/export, but also of outdoor temperature variations from year to year. This, in turn, leads to fluctuations in emission levels. The fluctuations in electricity trade, fuel consumption, CO_2 and NO_x emission are illustrated and compared in Figure 3A-4. In 1990 the Danish electricity import was large causing relatively low fuel consumption, whereas the fuel consumption was high in 1996 due to a large electricity export. In 2007 the net electricity export was 3420 TJ which is a lower export rate than in 2006. The large electricity export that occurs some years is a result of low rainfall in Norway and Sweden causing insufficient hydropower production in both countries.

To be able to follow the national energy consumption as well as for statistical and reporting purposes, the Danish Energy Authority produces a correction of the actual fuel consumption and CO_2 emission without random variations in electricity imports/exports and in ambient temperature. This fuel consumption trend is also illustrated in Figure 3A-4. The corrections are included here to explain the fluctuations in the emission time-series.

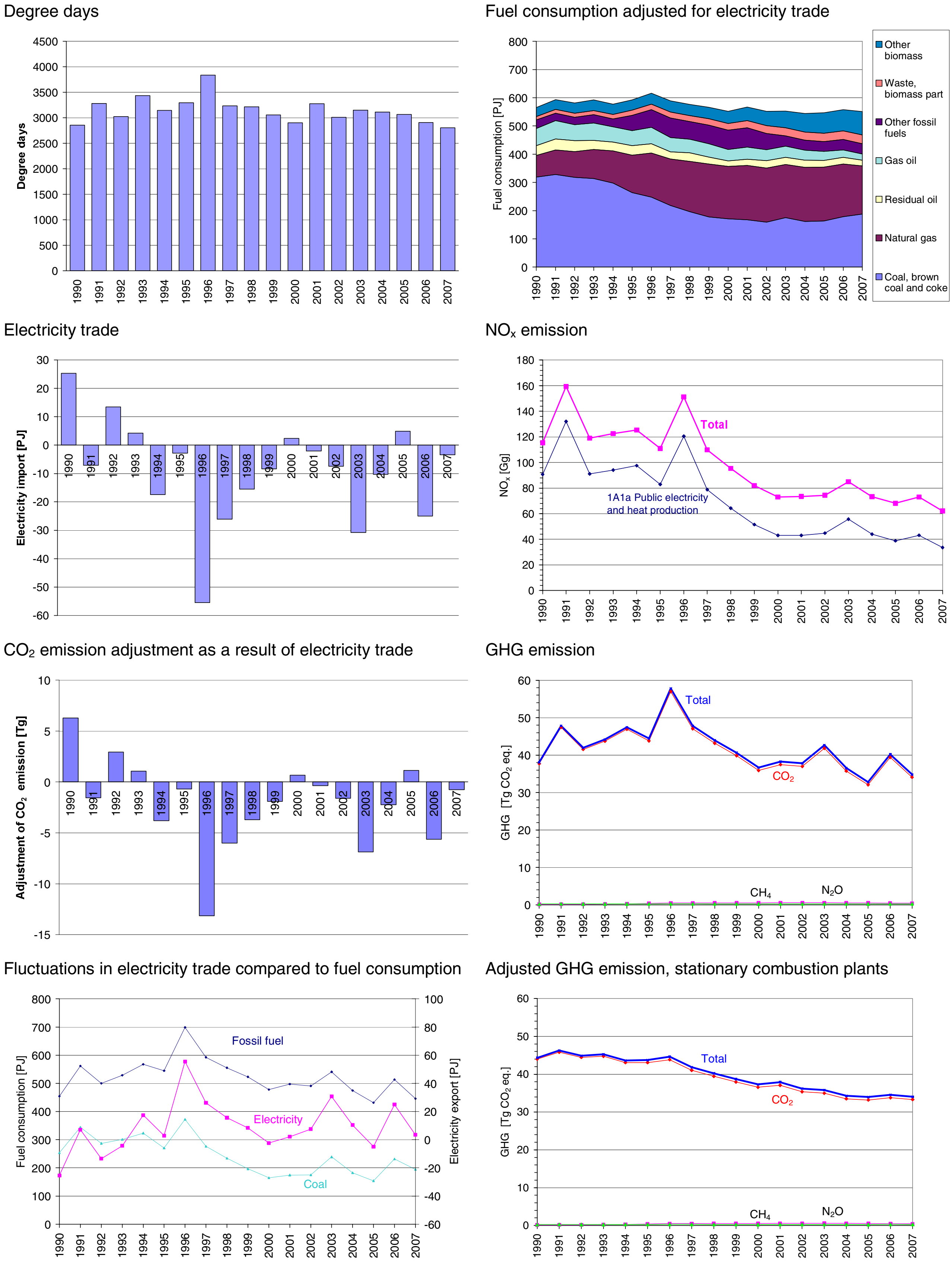


Figure 3A-4 Comparison of time-series fluctuations for electricity trade, fuel consumption and NO_x emission (DEA, 2008b).

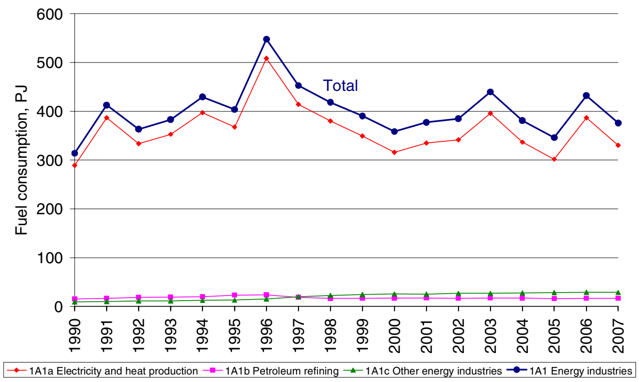
Fuel consumption time-series for the subsectors to stationary combustion is shown in Figure 3A-5.

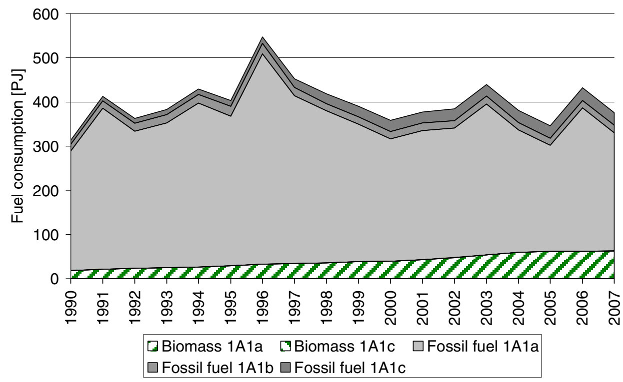
Fuel consumption for the <u>*1A1 Energy Sector*</u> is fluctuating due to electricity trade as discussed above. The fluctuation in electricity production is based on fossil fuel consumption in sector *1A1a Electricity and Heat Production*. Time-series for fossil fuel consumption in other sectors are more stable. The biomass fuel consumption in *1A1 Energy Sector* 2007 added up to 63 PJ which is 3.4 times the level in 1990.

The fuel consumption in <u>*1A2 Industry*</u> increased 7 % since 1990 (Figure 3A-5). However in resent years the fuel consumption seems to be slowly decreasing. The biomass fuel consumption in *1A2 Industry* 2007 added up to 7 PJ which is a 19 % increase since 1990.

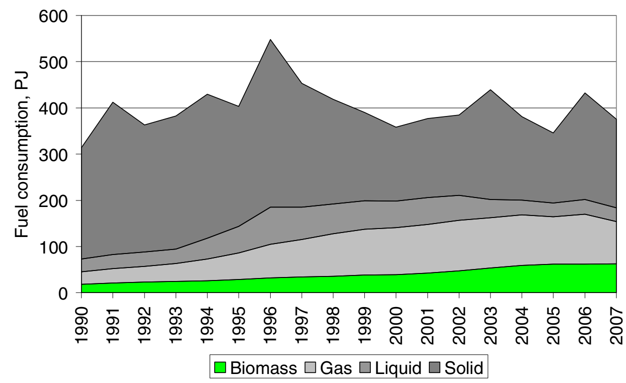
The fuel consumption in <u>*1A4 Other Sectors*</u> decreased 5 % since 1990 (Figure 3A-5). The biomass part of the fuel consumption has increased; the biomass part of the fuel consumption increased from 16 % in 1990 to 39 % in 2007.

1A1 Energy Sector

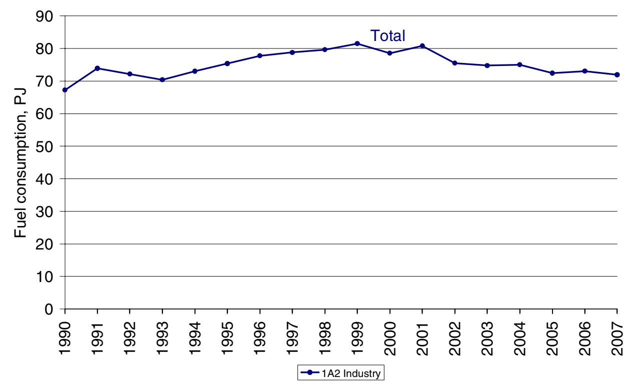




Fuel category



1A2 Industry



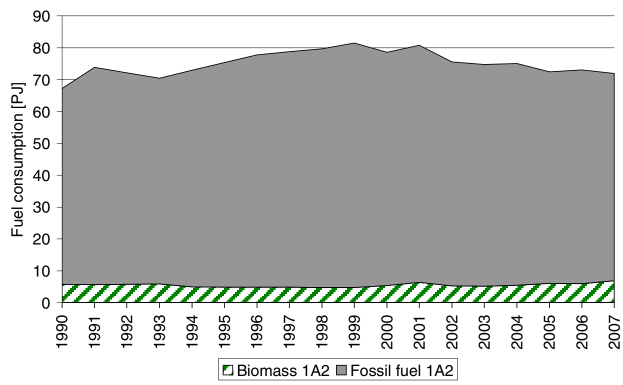
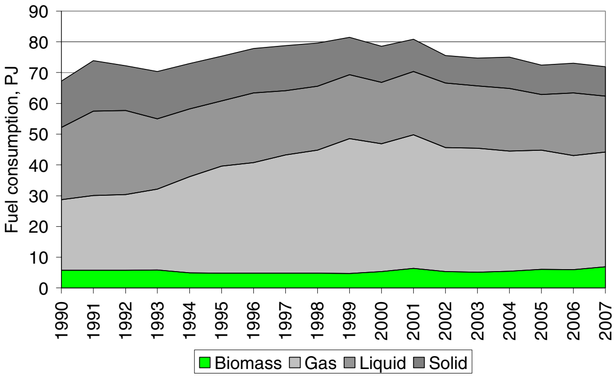
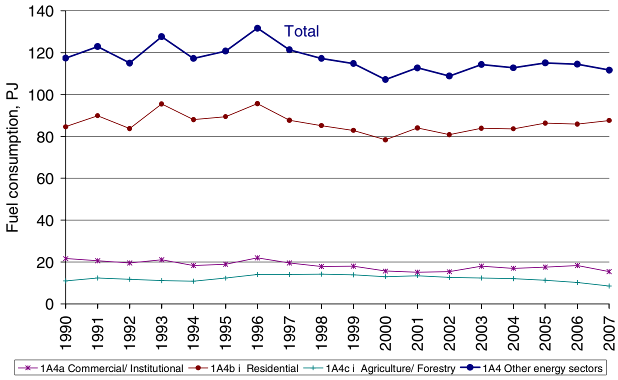


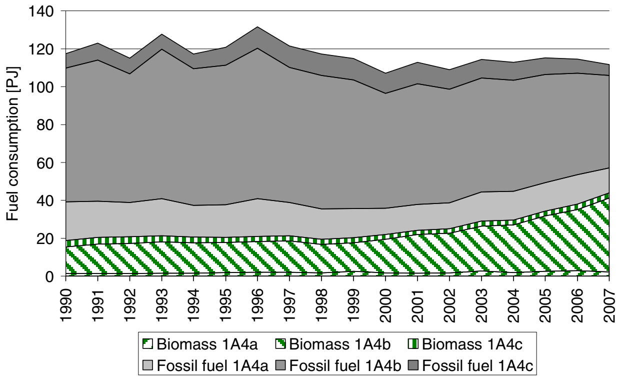
Figure 3A-5 Fuel consumption time-series for subsectors.

Fuel category

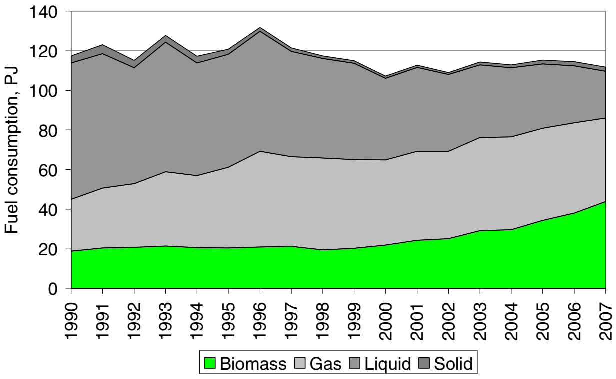


1A4 Other Sectors





Fuel category



Continued Figure 3A-5 Fuel consumption time-series for subsectors.

2 Greenhouse gas emission

The national greenhouse gas (GHG) emission in the year 2007 was 64.498 Gg CO_2 equivalent including land-use change and forestry or 66.641 Gg CO_2 equivalent excluding land-use change and forestry. The greenhouse gas pollutants HFCs, PFCs and SF_6 are not emitted from combustion plants and, as such, only the pollutants CO_2, CH_4 and N_2O are considered below.

The global warming potentials of CH_4 and N_2O applied in greenhouse gas inventories refer to the second IPCC assessment report (IPCC 1995):

- 1 g CH_4 equals 21 g CO_2
- 1 g N_2O equals 310 g CO_2

The GHG emissions from stationary combustion are listed in Table 3A-1. The emission from stationary combustion accounts for 52 % of the national GHG emission.

The CO_2 emission from stationary combustion plants accounts for 64 % of the national CO_2 emission (not including land-use change and forestry). The CH_4 emission accounts for 8 % of the national CH_4 emission and the N_2O emission for 4 % of the national N_2O emission.

Table 3A-1 Greenhouse gas emission for the year 2007 [1].

	CO_2	CH_4	N_2O
	Gg CO_2 equivalent		
1A1 Fuel consumption, Energy industries	25132	193	150
1A2 Fuel consumption, Manufacturing Industries and Construction[1]	4609	19	45
1A4 Fuel consumption, Other sectors [1]	4351	220	83
Emission from stationary combustion plants	34092	433	278
National emission (excluding net emission from LULUCF)	53228	5748	6780
		%	
Emission share for stationary combustion	64 %	8 %	4 %

1) Only stationary combustion sources of the sector is included

CO_2 is the most important GHG pollutant and accounts for 98.0 % of the GHG emission (CO_2 eq.). CH_4 accounts for 1.2 % and N_2O for 0.8 % of the GHG emission from stationary combustion.

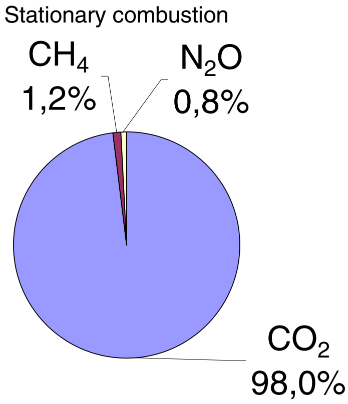


Figure 3A-6 GHG emission (CO_2 equivalent), contribution from each pollutant.

Figure 3A-7 depicts the time-series of GHG emission (CO_2 eq.) from stationary combustion and it can be seen that the GHG emission development follows the CO_2 emission development very closely. Both the CO_2 and the total GHG emission are lower in 2007 than in 1990, CO_2 by 10 % and GHG by 9 %. However, fluctuations in the GHG emission level are large.

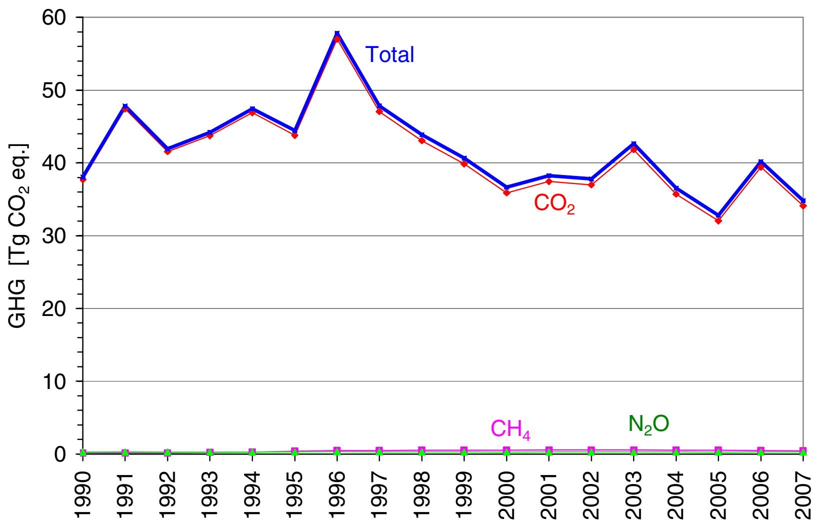


Figure 3A-7 GHG emission time-series for stationary combustion.

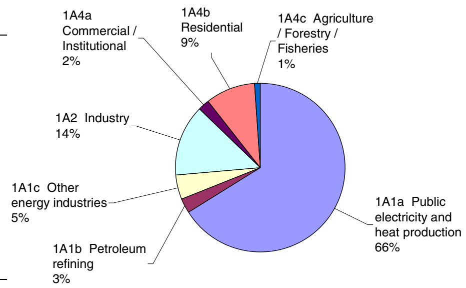
The fluctuations in the time-series are largely a result of electricity import/export activity, but also of outdoor temperature variations from year to year. The fluctuations follow the fluctuations in fuel consumption discussed in Chapter 1. As mentioned in Chapter 1, the Danish Energy Authority estimates a correction of the actual CO_2 emissions without random variations in electricity imports/exports and in ambient temperature. The GHG emission corrected for electricity import/export and ambient temperature has decreased by 22 % since 1990, and the CO_2 emission by 23 %. These data are included here to explain the fluctuations in the emission time-series.

2.1 CO_2

The carbon dioxide (CO_2) emission from stationary combustion plants is one of the most important GHG emission sources. Thus the CO_2 emission from stationary combustion plants accounts for 64 % of the national CO_2 emission. Table 3A-2 lists the CO_2 emission inventory for stationary combustion plants for 2007. *1A1a Electricity and heat production* accounts for 66 % of the CO_2 emission from stationary combustion. This share is somewhat higher than the fossil fuel consumption share for this sector, which is 59 % (Figure 3A-1). This is due to a large share of coal in this sector. Other large CO_2 emission sources are *1A2 Industry* and *1A4b Residential* plants. These are the sectors, which also account for a considerable share of fuel consumption.

Table 3A-2 CO_2 emission from stationary combustion plants 2007 [1)].

CO_2	2007	
1A1a Public electricity and heat production	22545	Gg
1A1b Petroleum refining	970	Gg
1A1c Other energy industries	1617	Gg
1A2 Industry	4599	Gg
1A4a Commercial/Institutional	790	Gg
1A4b Residential	3136	Gg
1A4c Agriculture/Forestry/Fisheries	425	Gg
Total	34082	Gg

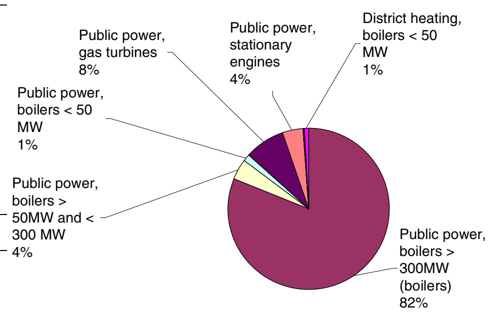


1) Only emission from stationary combustion plants in the sectors is included.

In the Danish inventory the sector *1A1a Electricity and heat production* is further disaggregated. The CO_2 emission from each of the subsectors is shown in Table 3A-3. The largest subsector is power plant boilers >300MW.

Table 3A-3 CO_2 emission from subsectors to *1A1a Electricity and heat production*.

Sub-sector ID (SNAP)	Subsector name	2007	
0101	Public power		
010100	Public power	2	
010101	Combustion plants ≥ 300MW (boilers)	18313	Gg
010102	Combustion plants ≥ 50MW and < 300 MW (boilers)	909	Gg
010103	Combustion plants <50 MW (boilers)	331	Gg
010104	Gas turbines	1803	Gg
010105	Stationary engines	928	Gg
0102	District heating plants		
010200	District heating plants		Gg
010201	Combustion plants ≥ 300MW (boilers)	2	Gg
010202	Combustion plants ≥ 50MW and < 300 MW (boilers)	43	Gg
010203	Combustion plants <50 MW (boilers)	197	Gg
010204	Gas turbines	1	Gg
010205	Stationary engines	17	Gg



CO_2 emission from combustion of biomass fuels is not included in the total CO_2 emission data, because biomass fuels are considered CO_2 neutral. The CO_2 emission from biomass combustion is reported as a memo item in Climate Convention reporting. In 2007 the CO_2 emission from biomass combustion was 12078 Gg.

In Figure 3A-8 the fuel consumption share (fossil fuels) is compared to the CO_2 emission share disaggregated to fuel origin. Due to the higher CO_2 emission factor for coal than oil and gas, the CO_2 emission share from coal combustion is higher than the fuel consumption share. Coal accounts for 44 % of the fossil fuel consumption and for 54 % of the CO_2 emission. Natural gas accounts for 38 % of the fossil fuel consumption but only 28 % of the CO_2 emission.

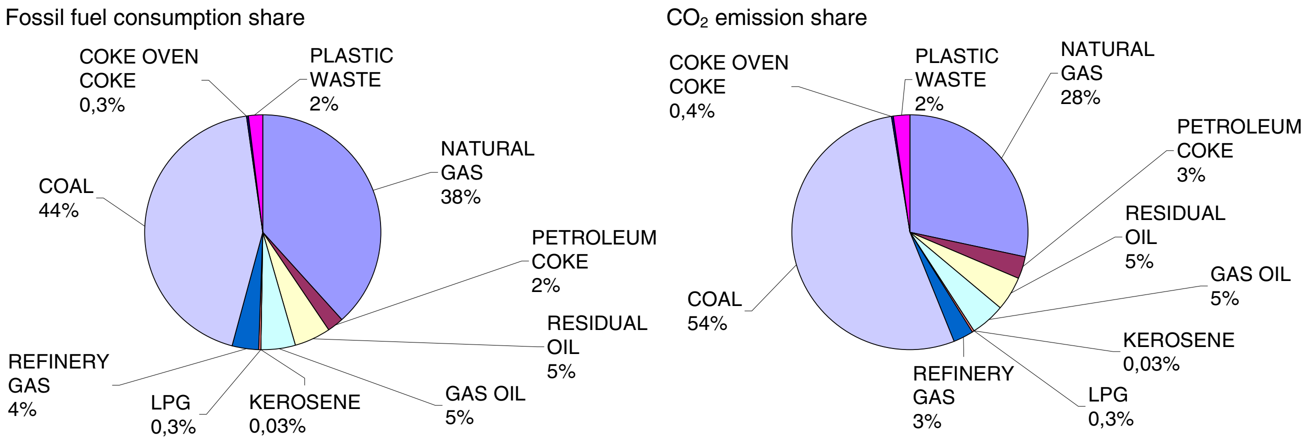


Figure 3A-8 CO_2 emission, fuel origin.

Time-series for CO_2 emission are provided in Figure 3A-9. Despite an increase in fuel consumption of 12 % since 1990 CO_2 emission from stationary combustion has decreased by 10 % because of the change of fuel type used.

The fluctuations in total CO_2 emission follow the fluctuations in CO_2 emission from *Electricity and heat production* (Figure 3A-9) and in coal consumption (Figure 3A-3). The fluctuations are a result of electricity import/export activity as discussed in Chapter 1.

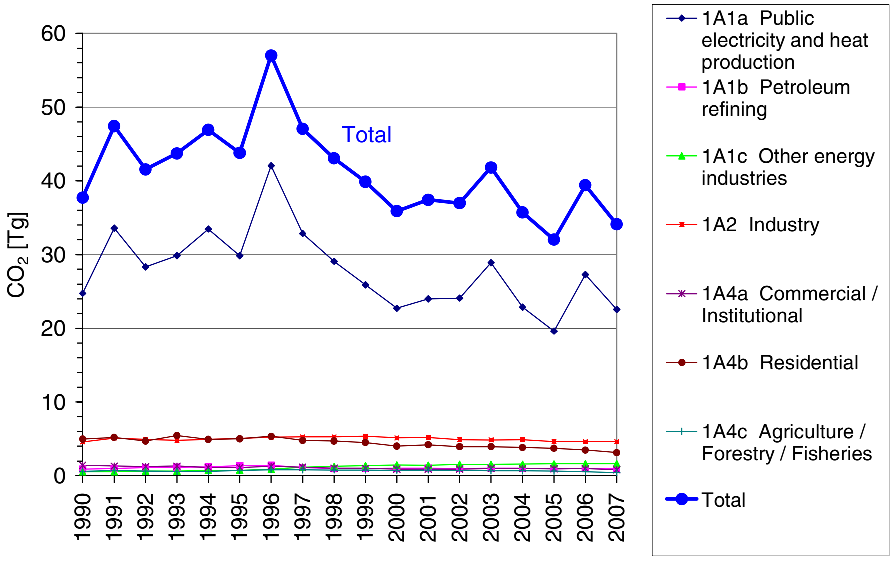


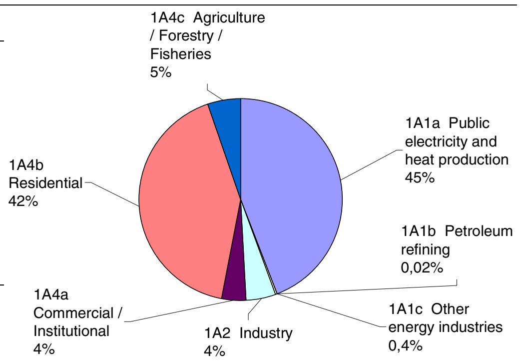
Figure 3A-9 CO_2 emission time-series for stationary combustion plants.

2.2 CH_4

The methane (CH_4) emission from stationary combustion plants accounts for 8 % of the national CH_4 emission. Table 3A-4 lists the CH_4 emission inventory for stationary combustion plants in 2007. Sector *1A1a Electricity and heat production* accounts for 44 % of the CH_4 emission from stationary combustion, which is somewhat less than the fuel consumption share. The emission from residential plants adds up to 42 % of the emission.

Table 3A-4 CH_4 emission from stationary combustion plants 2007 [1)].

CH_4	2007	
1A1a Public electricity and heat production	9101	Mg
1A1b Petroleum refining	3	Mg
1A1c Other energy industries	78	Mg
1A2 Industry	927	Mg
1A4a Commercial/Institutional	794	Mg
1A4b Residential	8594	Mg
1A4c Agriculture/Forestry/Fisheries	1105	Mg
Total	20603	Mg



1) Only emission from stationary combustion plants in the sectors is included.

The CH_4 emission factor for reciprocating gas engines is much higher than for other combustion plants due to the continuous ignition/burn-out of the gas. Lean-burn gas engines have an especially high emission factor as discussed in Chapter 5.6.3. A considerable number of lean-burn gas engines are in operation in Denmark and these plants account for 50 % of the CH_4 emission from stationary combustion plants (Figure 3A-10). Most engines are installed in CHP plants and the fuel used is either natural gas or biogas.

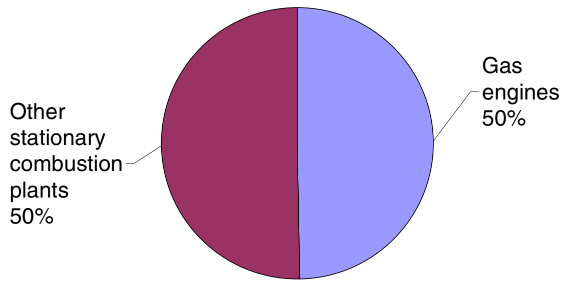


Figure 3A-10 Gas engine CH_4 emission share, 2007.

Figure 3A-11 shows time-series for CH_4 emission. The CH_4 emission from stationary combustion increased by a factor of 3.6 since 1990 (Figure 3A-11). This results from the considerable number of lean-burn gas engines installed in CHP plants in Denmark during the 1990-ties. Figure 3A-12 provides time-series for the fuel consumption rate in gas engines and the corresponding increase of CH_4 emission. The decline in later years is due to structural changes in the Danish electricity market, which means that the fuel consumption in gas engines has been decreasing.

The emission from residential plants has increased since 1990 due to increased combustion of biomass in residential plants. Combustion of wood accounts for more than 80 % of the emission from residential plants.

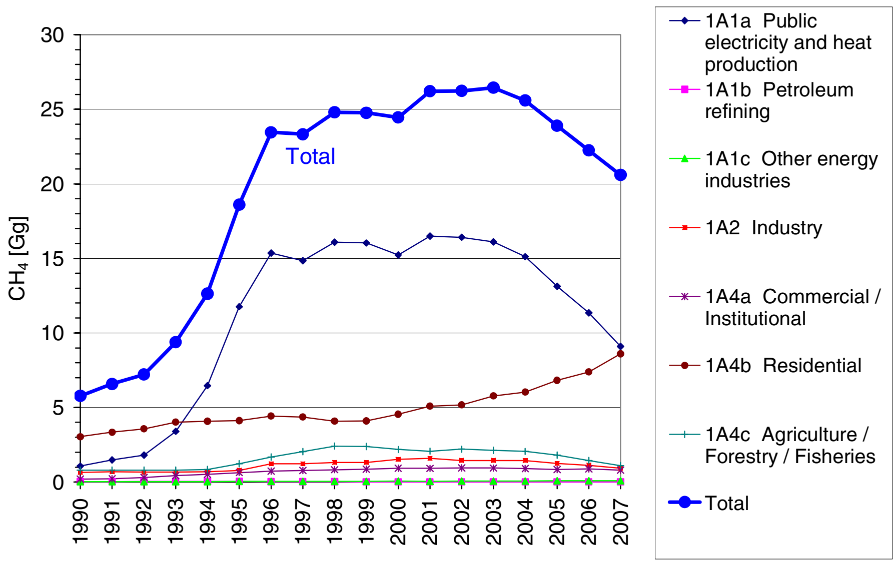


Figure 3A-11 CH_4 emission time-series for stationary combustion plants.

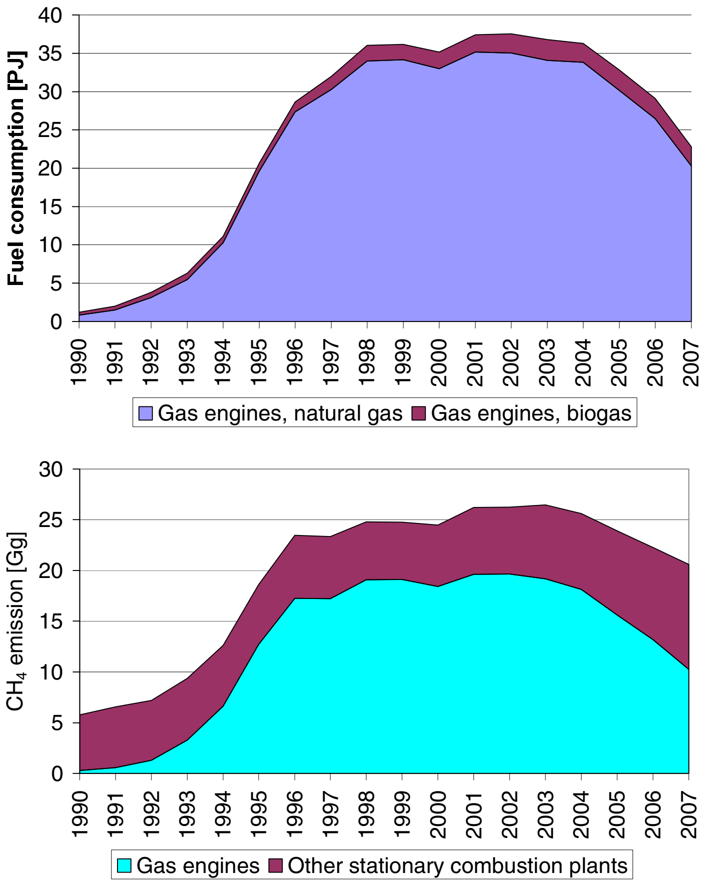


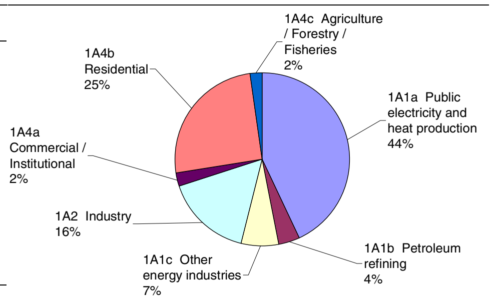
Figure 3A-12 Fuel consumption and CH_4 emission from gas engines, time-series.

2.3 N_2O

The nitrous oxide (N_2O) emission from stationary combustion plants accounts for 4 % of the national N_2O emission. Table 3A-5 lists the N_2O emission inventory for stationary combustion plants in the year 2007. *Electricity and heat production* accounts for 43 % of the N_2O emission from stationary combustion.

Table 3A-5 N_2O emission from stationary combustion plants 2007 [1].

N_2O	2007	
1A1a Public electricity and heat production	387	Mg
1A1b Petroleum refining	34	Mg
1A1c Other energy industries	62	Mg
1A2 Industry	144	Mg
1A4a Commercial/Institutional	22	Mg
1A4b Residential	227	Mg
1A4c Agriculture/Forestry/Fisheries	20	Mg
Total	897	Mg



1) Only emission from stationary combustion plants in the sectors is included.

Figure 3A-13 shows time-series for N_2O emission. The N_2O emission from stationary combustion increased by 16 % from 1990 to 2007, but again fluctuations in emission level due to electricity import/export are considerable.

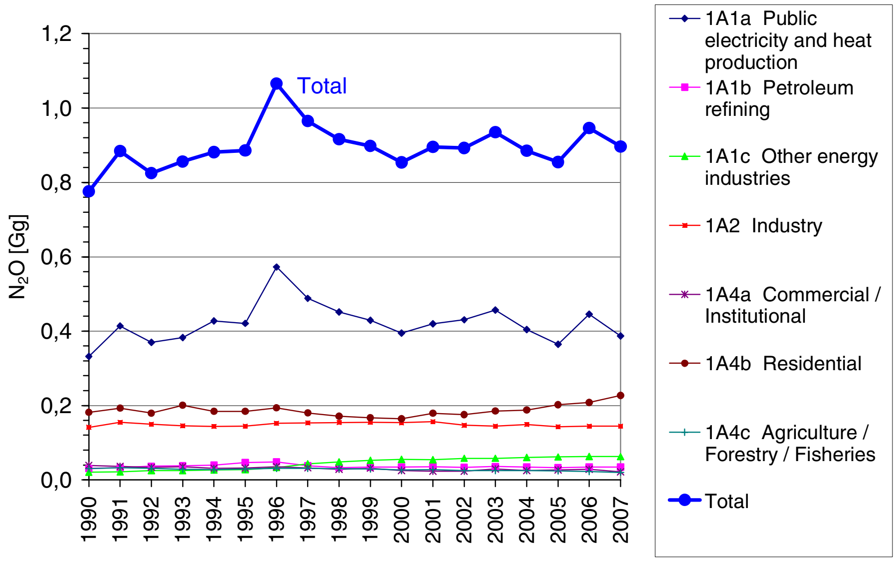


Figure 3A-13 N_2O emission time-series for stationary combustion plants.

3 SO_2, NO_x, NMVOC and CO

The emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x), non volatile organic compounds (NMVOC) and carbon monoxide (CO) from Danish stationary combustion plants 2007 are presented in Table 3A-6. The emission of these pollutants is also included in the report to the Climate Convention.

SO_2 from stationary combustion plants accounts for 88 % of the national emission. NO_x, CO and NMVOC account for 37 %, 38 % and 25 % of national emissions, respectively.

Table 3A-6 SO_2, NO_x, NMVOC and CO emission from stationary combustion 2007 [1)].

Pollutant	NO_x	CO	NMVOC	SO_2
	Gg	Gg	Gg	Gg
1A1 Fuel consumption, Energy industries	42,5	9,3	2,7	9,1
1A2 Fuel consumption, Manufacturing Industries and Construction (Stationary combustion)	11,1	13,6	0,6	7,2
1A4 Fuel consumption, Other sectors (Stationary combustion)	8,5	147,6	23,1	4,4
Emission from stationary combustion plants	62,1	170,5	26,4	20,6
National emission	166,7	448,1	104,4	23,3
		%		
Emission share for stationary combustion	37	38	25	88

1) Only emissions from stationary combustion plants in the sectors are included.

3.1 SO_2

Stationary combustion is the most important emission source for SO_2 accounting for 88 % of the national emission. Table 3A-7 present the SO_2 emission inventory for the stationary combustion subsectors.

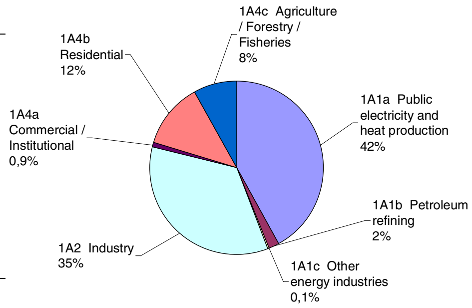
Electricity and heat production is the largest emission source accounting for 42 % of the emission. However, the SO_2 emission share is lower than the fuel consumption share for this sector, which is 59 %. This is a result of effective flue gas desulphurisation equipment installed in power plants combusting coal. In the Danish inventory the sector *1A1a Electricity and heat production* is further disaggregated. Figure 3A-14 shows the SO_2 emission from *Electricity and heat production* on a disaggregated level. Power plants >300MW_{th} are the main emission source, accounting for 79 % of the emission.

The SO_2 emission from industrial plants is 35 %, a remarkably high emission share compared with fuel consumption. The main emission sources in the industrial sector are combustion of coal and residual oil, but emissions from the cement industry is also a considerable emission source. Some years ago, SO_2 emission from the industrial sector only accounted for a small portion of the emission from stationary combustion, but as a result of reduced emissions from power plants the share has now increased.

Time-series for SO_2 emission from stationary combustion are shown in Figure 3A-15. The SO_2 emission from stationary combustion plants has decreased by 87 % from 1990. The large emission decrease is mainly a result of the reduced emission from *Electricity and heat production*, made possible due to installation of desulphurisation plants and due to the use of fuels with lower sulphur content. Despite the considerable reduction in emission from electricity and heat production plants, these still account for 42 % of the emission from stationary combustion, as mentioned above. The emission from other sectors also decreased considerably since 1990 (se chapter 4).

Table 3A-7 SO_2 emission from stationary combustion plants 2007 [1)].

SO_2	2007	
1A1a Public electricity and heat production	8641	Mg
1A1b Petroleum refining	423	Mg
1A1c Other energy industries	10	Mg
1A2 Industry	7157	Mg
1A4a Commercial/Institutional	183	Mg
1A4b Residential	2509	Mg
1A4c Agriculture/Forestry/Fisheries	1680	Mg
Total	20604	Mg



1) Only emission from stationary combustion plants in the sectors is included.

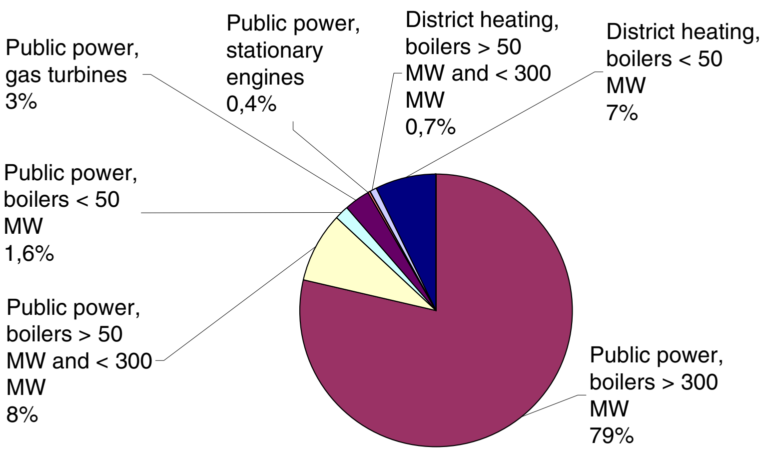


Figure 3A-14 Disaggregated SO_2 emissions from *1A1a Energy and heat production.*

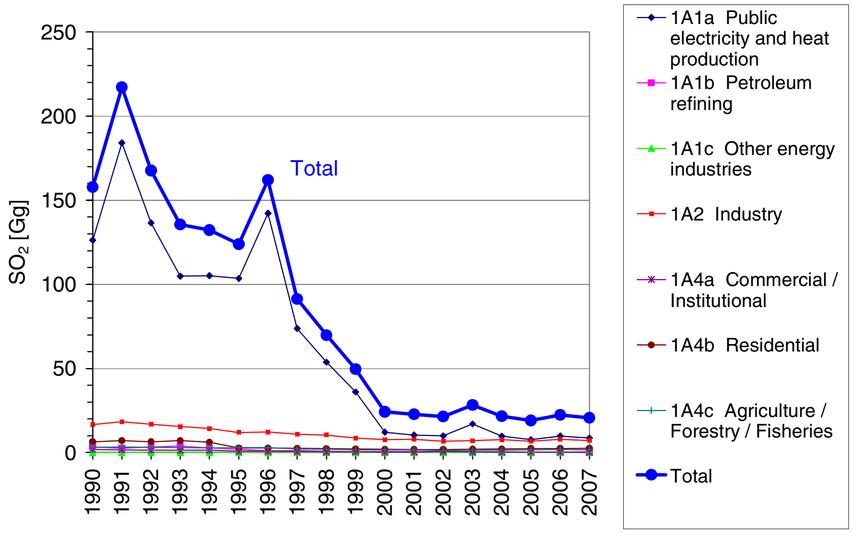


Figure 3A-15 SO_2 emission time-series for stationary combustion.

3.2 NO_x

Stationary combustion accounts for 37 % of the national NO_x emission. Table 3A-8 shows the NO_x emission inventory for stationary combustion subsectors.

Electricity and heat production is the largest emission source accounting for 54 % of the emission from stationary combustion plants.

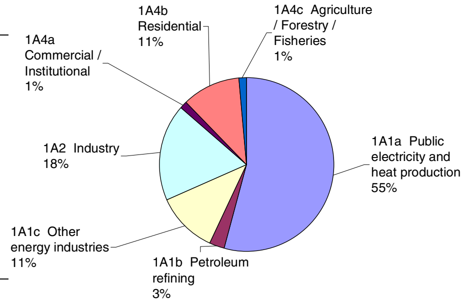
Industrial combustion plants are also an important emission source accounting for 18 % of the emission. The main industrial emission source is cement production, accounting for 64 % of the emission.

Residential plants accounts for 11 % of the NO_x emission. The fuel origin of this emission is mainly wood, gas oil and natural gas accounting for 65 %, 15 % and 15 % of the residential plant emission, respectively.

Time-series for NO_x emission from stationary combustion are shown in Figure 3A-16. NO_x emission from stationary combustion plants has decreased 46 % since 1990. The reduced emission is largely a result of the reduced emission from electricity and heat production due to installation of low NO_x burners and selective catalytic reduction (SCR) units. The fluctuations in the time-series follow the fluctuations in electricity and heat production, which, in turn, result from electricity trade fluctuations.

Table 3A-8 NO$_x$ emission from stationary combustion plants 2007 [1].

	2007	
1A1a Public electricity and heat production	33608	Mg
1A1b Petroleum refining	1754	Mg
1A1c Other energy industries	7120	Mg
1A2 Industry	11136	Mg
1A4a Commercial/Institutional	919	Mg
1A4b Residential	6653	Mg
1A4c Agriculture/Forestry/Fisheries	909	Mg
Total	62100	Mg



1) Only emission from stationary combustion plants in the sectors is included.

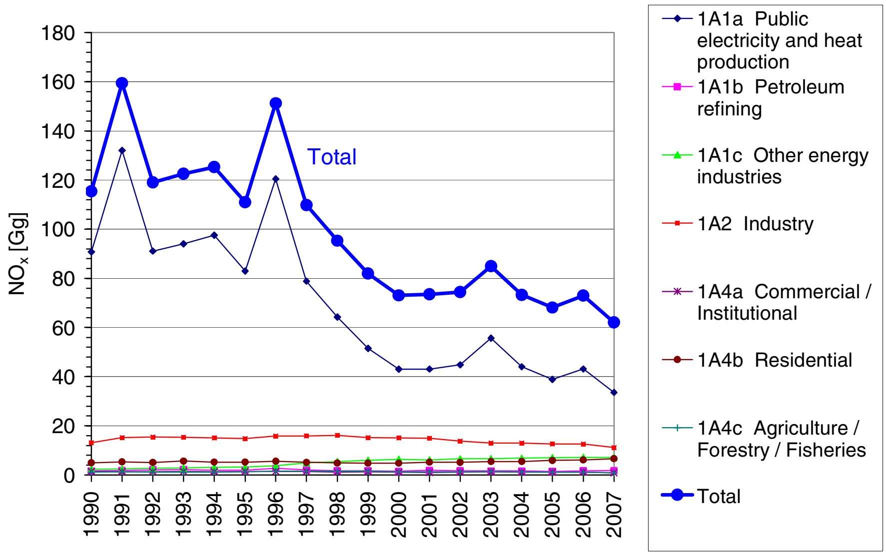


Figure 3A-16 NO$_x$ emission time-series for stationary combustion.

3.3 NMVOC

Stationary combustion plants account for 25 % of the national NMVOC emission. Table 3A-9 present the NMVOC emission inventory for the stationary combustion subsectors.

Residential plants are the largest emission source accounting for 79 % of the emission from stationary combustion plants. For residential plants NMVOC is mainly emitted from wood and straw combustion, see Figure 3A-17.

Electricity and heat production is also a considerable emission source, accounting for 10 % of the emission. Lean-burn gas engines have a relatively high NMVOC emission factor and are the most important emission source in this subsector (see Figure 3A-17). The gas engines are either natural gas or biogas fuelled.

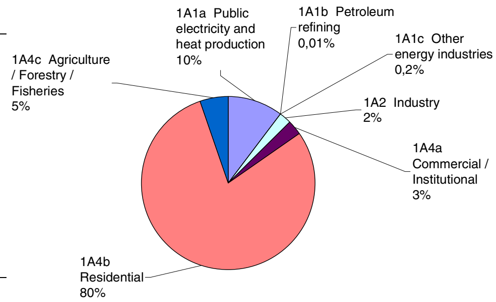
Time-series for NMVOC emission from stationary combustion are shown in Figure 3A-18. The emission has increased by 109 % from 1990. The increased emission is mainly a result of the increasing wood consumption in residential plants and of the increased use of lean-burn gas engines in CHP plants as discussed in Chapter 2.2.

The emission from residential plants in 2007 is 2.1 times the 1990 level. The NMVOC emission from wood combustion in 2007 is 3.1 times the 1990 level due to increased wood consumption. However the emission factor has decreased since 1990. Further the emission from straw combustion in farmhouse boilers has decreased (43 %) over this period.

The use of wood in residential boilers and stoves is relatively low in 1998-99 resulting in a lower emission level these years.

Table 3A-9 NMVOC emission from stationary combustion plants 2007 [1)].

	2007	
1A1a Public electricity and heat production	2698	Mg
1A1b Petroleum refining	3	Mg
1A1c Other energy industries	42	Mg
1A2 Industry	571	Mg
1A4a Commercial/Institutional	732	Mg
1A4b Residential	20957	Mg
1A4c Agriculture/Forestry/Fisheries	1379	Mg
Total	26382	Mg



1) Only emission from stationary combustion plants in the sectors is included.

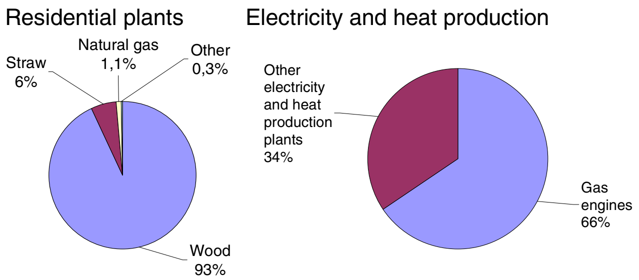


Figure 3A-17 NMVOC emission from residential plants and from electricity and heat production, 2007.

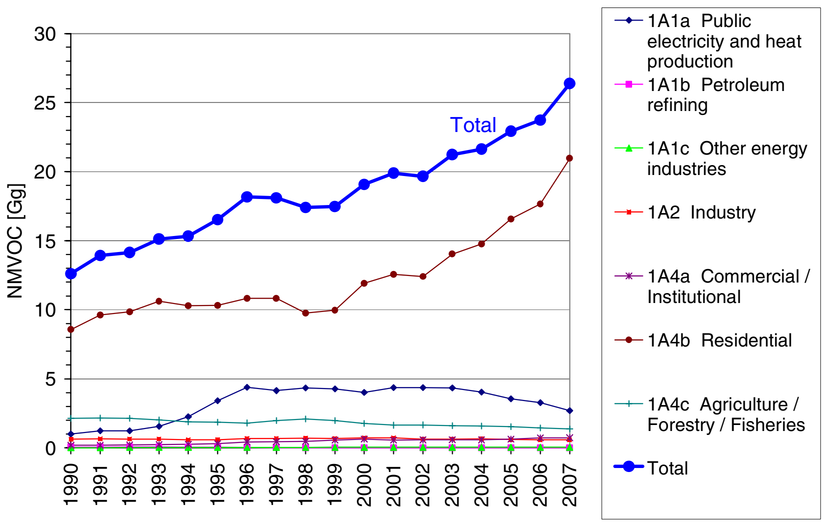


Figure 3A-18 NMVOC emission time-series for stationary combustion.

3.4 CO

Stationary combustion accounts for 38 % of the national CO emission. Table 3A-10 present the CO emission inventory for stationary combustion subsectors.

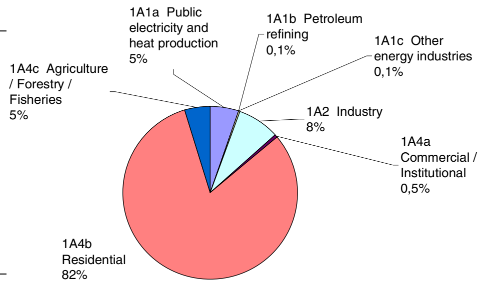
Residential plants are the largest emission source, accounting for 81 % of the emission. Wood combustion accounts for 90 % of the emission from residential plants, see Figure 3A-19. This is in spite of the fact that the fuel consumption share is only 41 %. Combustion of straw is also a considerable emission source whereas the emission from other fuels used in residential plants is almost negligible.

Time-series for CO emission from stationary combustion are shown in Figure 3A-20. The emission has increased by 22 % from 1990. The time-series for CO from stationary combustion plants follows the time-series for CO emission from residential plants.

The consumption of wood in residential plants 2007 is 4.1 times the 1990 level. However the CO emission factor for wood decreased since 1990 causing the CO emission from wood combustion in residential plants 2007 to be only 3.2 times the 1990 level. Both straw consumption and CO emission factor for residential plants have decreased since 1990.

Table 3A-10 CO emission from stationary combustion plants 2007 [1)].

	2007	
1A1a Public electricity and heat production	8854	Mg
1A1b Petroleum refining	225	Mg
1A1c Other energy industries	211	Mg
1A2 Industry	13574	Mg
1A4a Commercial/Institutional	846	Mg
1A4b Residential	138661	Mg
1A4c Agriculture/Forestry/Fisheries	8096	Mg
Total	170467	Mg



1) Only emission from stationary combustion plants in the sectors is included.

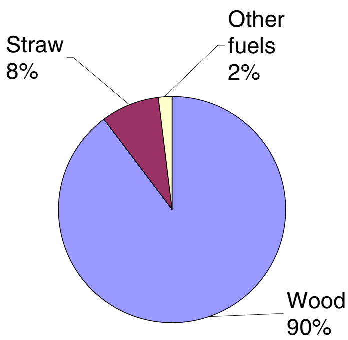
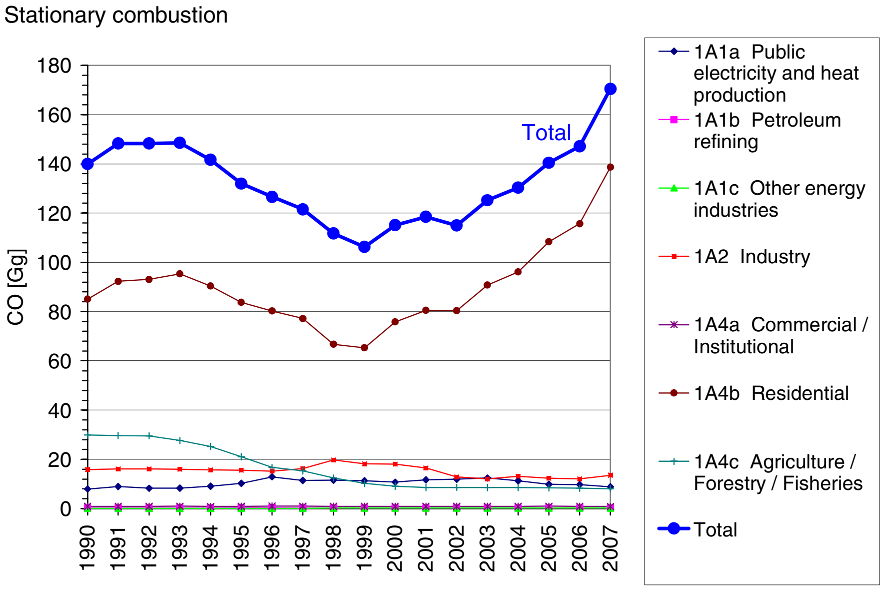


Figure 3A-19 CO emission sources, residential plants, 2007.



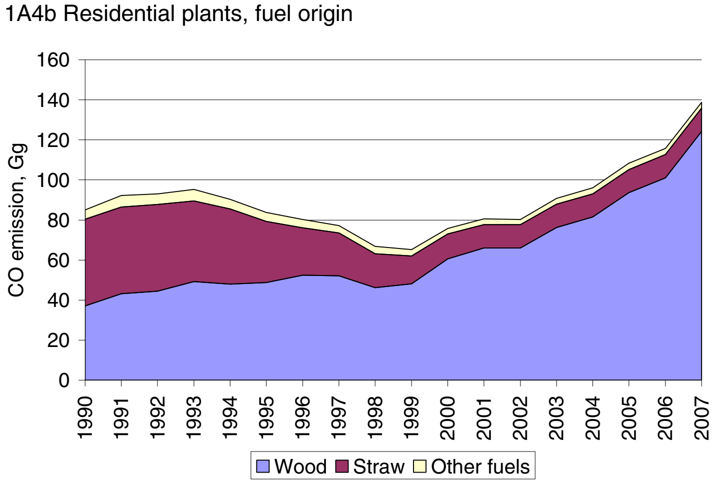


Figure 3A-20 CO emission time-series for stationary combustion.

4 Sectoral trend

In addition to the data for stationary combustion this chapter present and discuss data for each of the subsectors in which stationary combustion is included. Time-series is presented for fuel consumption and emission.

4.1 1A1 Energy industries

1A1 Energy industries consists of the subsectors:

- 1A1a Electricity and heat production
- 1A1b Petroleum refining
- 1A1c Other energy industries

Table 3A-21 – Table 3A-23 present time-series for the sector. Electricity and heat production is the largest sector accounting for the main part of all emissions. Time-series is discussed below for each subsector.

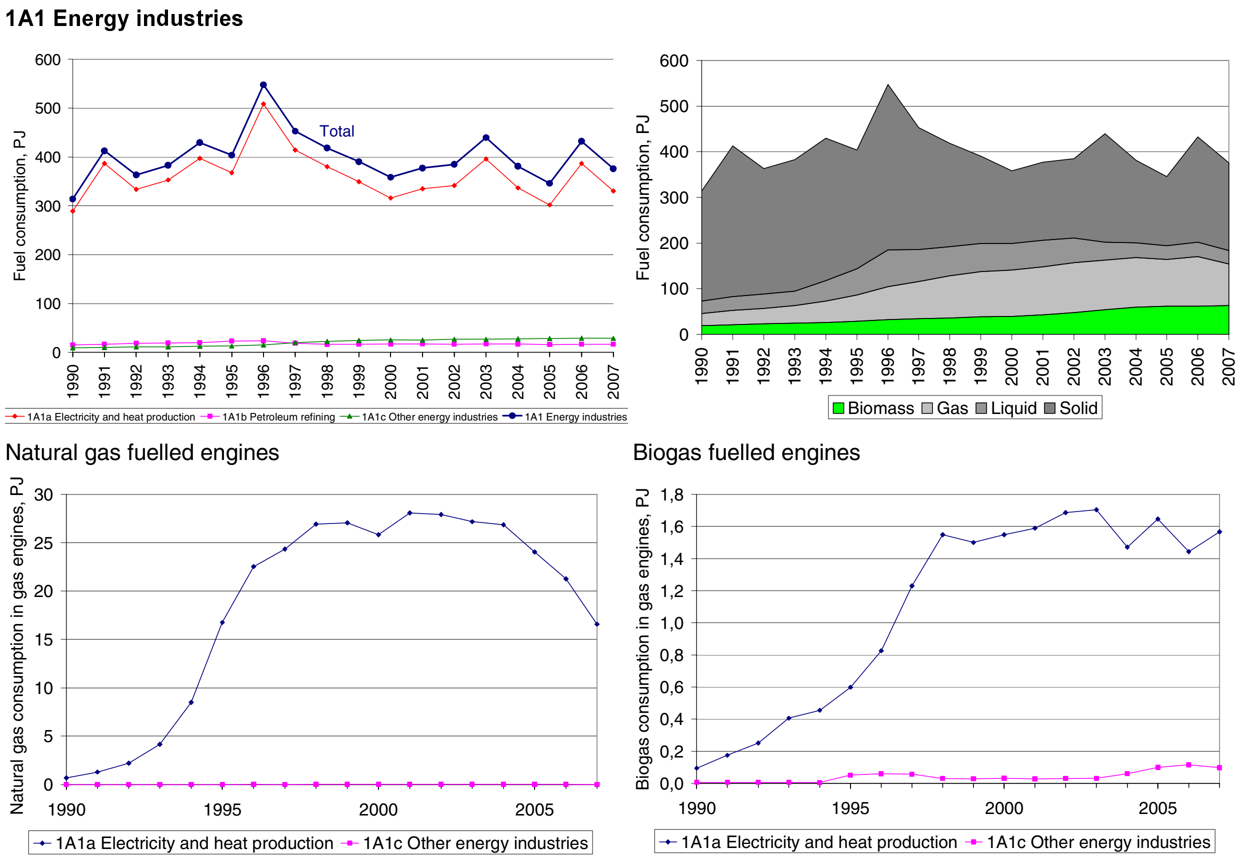


Figure 3A-21 Trend of Fuel consumption, 1A1 Energy industries.

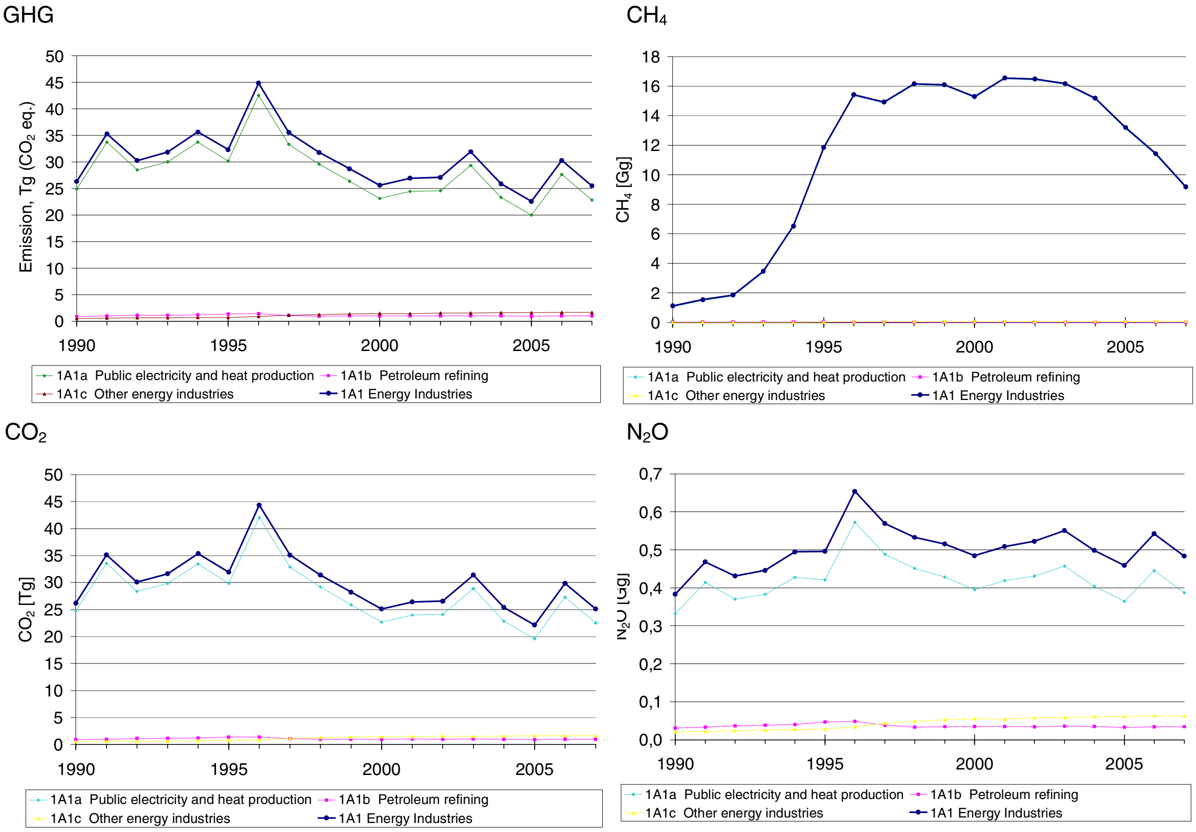


Figure 3A-22 Trend of greenhouse gas emission, 1A1 Energy industries.

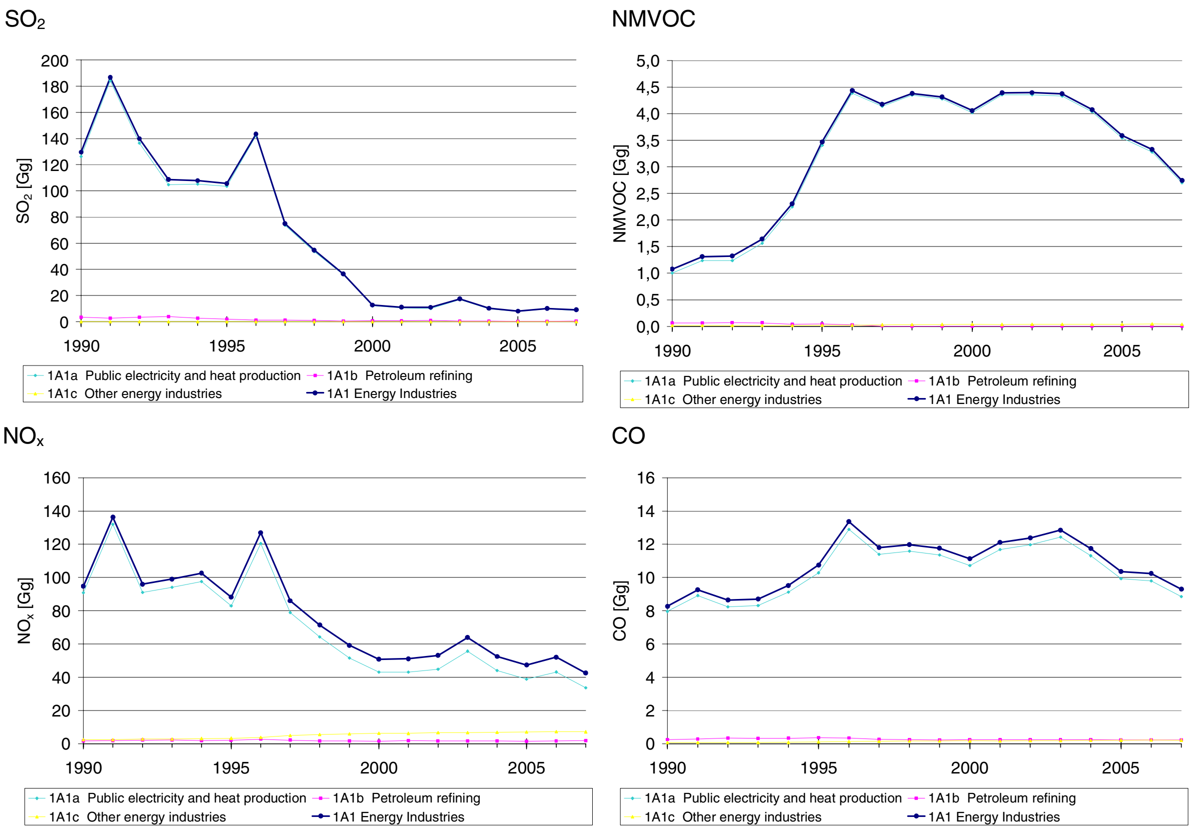


Figure 3A-23 Trend of SO_2, NO_x, NMVOC and CO emission, 1A1 Energy industries.

4.1.1 1A1a Electricity and heat production

Public electricity and heat production is the largest sector regarding both fuel consumption and greenhouse gas emissions for stationary combustion. Figure 3A-24 shows the time-series for fuel consumption and emissions.

As discussed in chapter 1 the fuel consumption fluctuates greatly as a consequence of electricity trade. Coal is the fuel that is affected most by the fluctuating electricity trade. Coal is the main fuel in the sector even in years with electricity import. The consumption in 2007 was 22 % lower than in 1990. Natural gas is also an important fuel and the consumption of natural gas has increased since 1990, but decreased since 2003. A considerable part of the natural gas is combusted in gas engines (Figure 3A-22). The consumption of municipal waste and biomass has increased. The fuel consumption in electricity and heat production was 14 % higher in 2007 than in 1990.

The CO_2 emission was 9 % lower in 2007 than in 1990. This decrease – in spite of a higher fuel consumption - is a result of the change of fuel discussed above.

For CH_4 the emission increase until mid-nineties is a result of the considerable number of lean-burn gas engines installed in CHP plants in Denmark in this period. The decline in later years is due to structural changes in the Danish electricity market, which means that the fuel consumption in gas engines has been decreasing (Figure 3A-22). The emission in 2007 was 8.5 times the 1990 emission level.

The N_2O emission was 17 % higher in 2007 than in 1990. The emission fluctuates similar to the fuel consumption.

The SO_2 emission has decreased 93 % since 1990. This decrease is a result of both lower sulphur content in fuels and installation and improved performance of desulphurisation plants.

The NO_x emission has decreased 63 % due to installation of low NO_x burners and selective catalytic reduction (SCR) units. The fluctuations in time-series follow the fluctuations in fuel consumption and electricity trade.

The emission of NMVOC in 2007 was 2.7 times the 1990 emission level. This is a result of the large number of gas engines that has been installed in Danish CHP plants as mentioned above.

The CO emission has increased 11 % since 1990. The fluctuations follow the fluctuations of the fuel consumption. In addition the emission from gas engines is considerable.

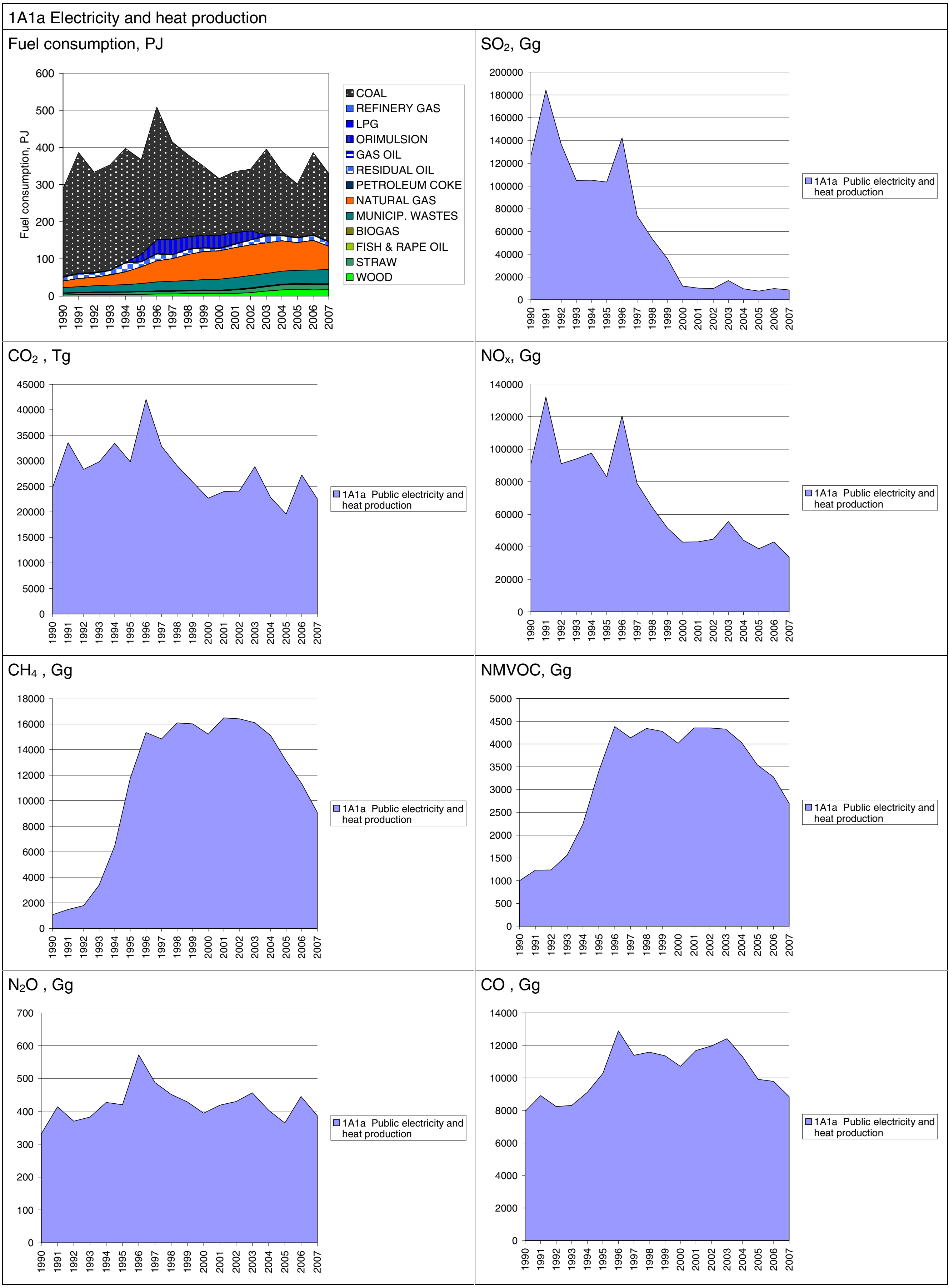


Figure 3A-24 Time-series for 1A1a Electricity and heat production.

4.1.2 1A1b Petroleum refining

Petroleum refining is small sector regarding both fuel consumption and greenhouse gas emissions for stationary combustion. There are presently only two refineries operating in Denmark. Figure 3A-25 shows the time-series for fuel consumption and emissions.

The significant decrease in both fuel consumption and emissions in 1996 is due to the closure of a refinery.

The fuel consumption has increased 10 % since 1990 and the CO_2 emission has increased 8 %.

The reduction in CH_4 emission from 1995 to 1999 is due to a combination of the closure of one refinery and a change in emission factors.

The N_2O emission has increased 12 %.

The SO_2 emission has decreased 88 % and the NO_x emission increased 9 %. In resent years data for both SO_2 and NO_x are plant specific data stated by the refineries.

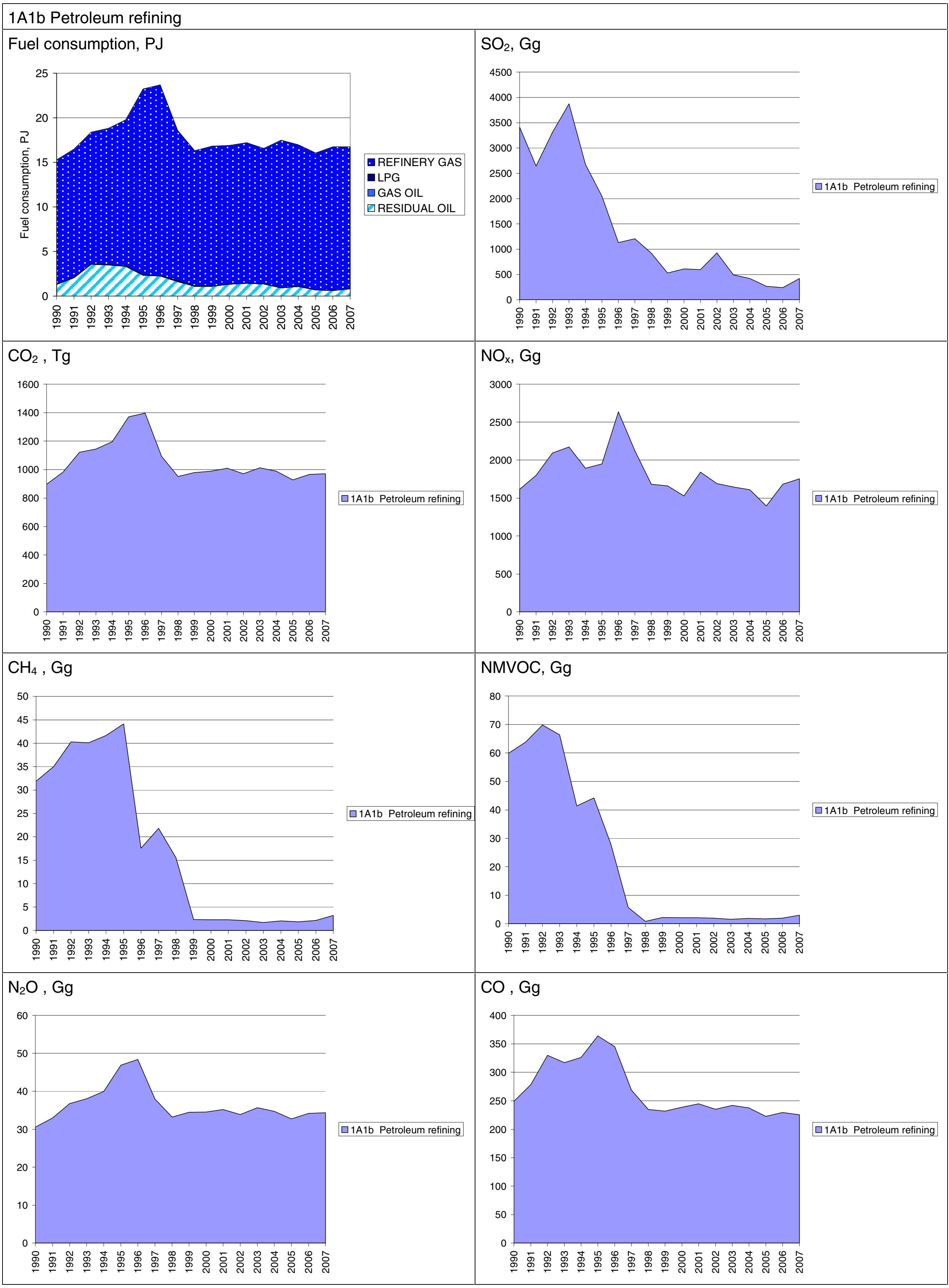


Figure 3A-25   Time-series for 1A1b Petroleum refining.

4.1.3 1A1c Other energy industries

The sector Other energy industries comprise natural gas consumption in the off-shore industry. Gas turbines are the main plant type. Figure 3A-26 shows the time-series for fuel consumption and emissions.

The fuel consumption in 2007 was 3 times the consumption in 1990. The CO_2 emission follows the fuel consumption and the emission in 2007 was also 3 times the emission in 1990.

For CH_4 the increase in emission from 2003 to 2006 is due to an increase in biogas consumption in gas engines. The high CH_4 emission factor for biogas fuelled gas engines causes the relatively large increase in CH_4 emission.

The emissions from other pollutants follow the increase of fuel consumption.

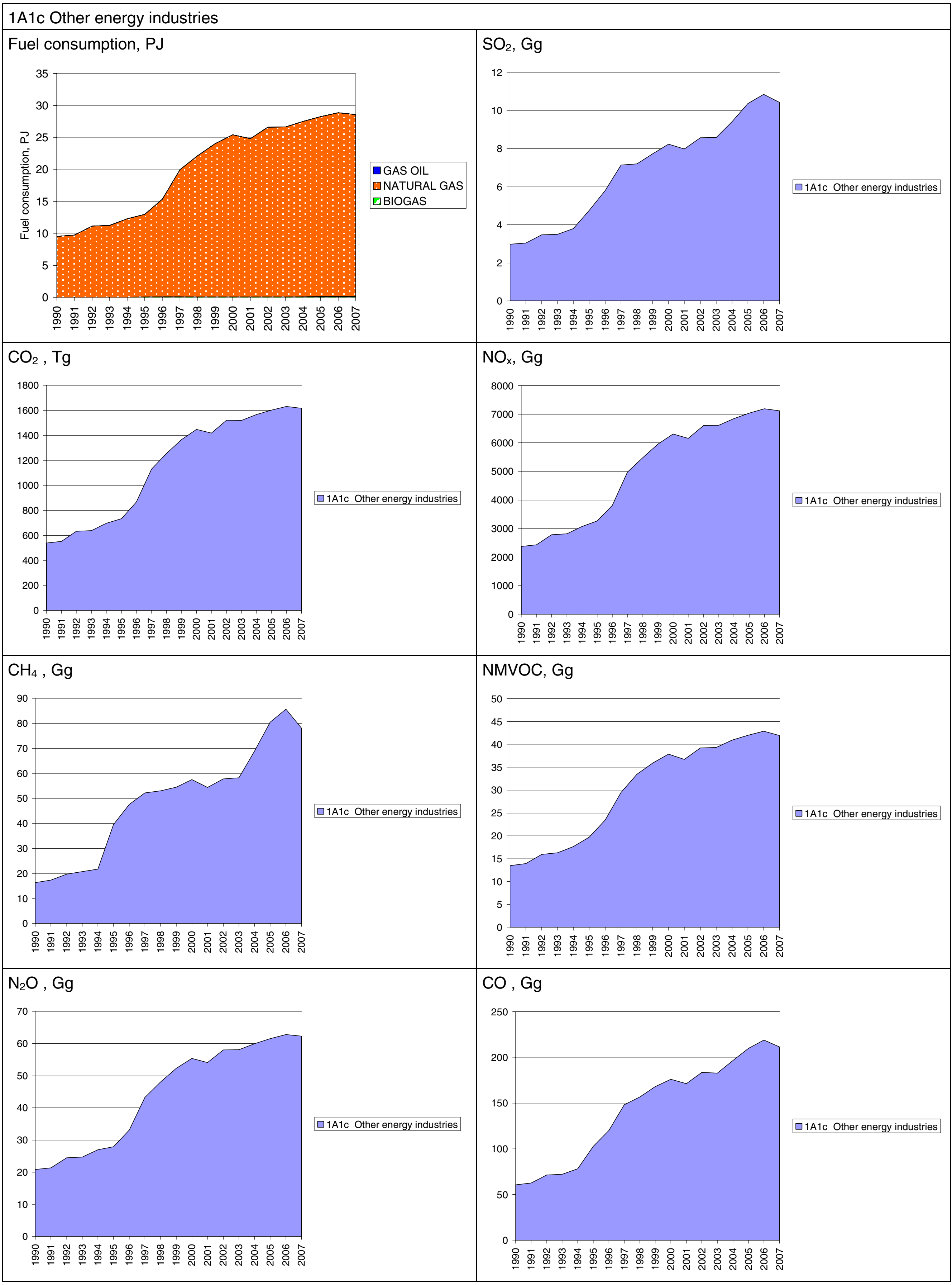


Figure 3A-26 Time-series for 1A1c Other energy industries.

4.2 1A2 Industry

Manufacturing industries and construction, IPCC sector 1A2, consists of both stationary and mobile sources. In this chapter only stationary sources are included. Figure 3A-27 to Figure 3A-29 show the time-series for fuel consumption and emissions.

Time-series for fuel consumption and emissions are shown below. The data have not been disaggregated to industrial subsectors due to the fact that the Danish inventory is based data for the industrial sector as a whole. Disaggregation to subsectors for the CRF is discussed in Chapter 5.7.

The total fuel consumption in the industrial combustion sector have been rather stable since 1990. However, the consumption of gas has increased whereas the consumption of coal has decreased. The consumption of residual oil has decreased, but the consumption of petroleum coke increased. The biomass part of fuel have not changed considerably since 1990.

The GHG emission and the CO_2 emission are both rather stable following the small fluctuations in fuel consumption. The CO_2 emission in 2007 was almost the same as in 1990.

The CH_4 emission increased in 1995-2000 and decreased again from 2004 onwards. In 2007 the emission was 43 % higher than in 1990. The CH_4 emission follows the consumption of natural gas in gas engines. Most industrial CHP plants based on gas engines came in operation in 1995-1999. The decrease in later years is a result of the liberalisation of the electricity market.

The N_2O emission follows the small fluctuations of the fuel consumption in industrial plants. In 2007 the emission was 2 % higher than in 1990.

The SO_2 emission has decreased 57 % since 1990. This is mainly a result of lower consumption of residual oil in the industrial sector. Further the sulphur content of residual oil and several other fuels have decreased since 1990 due to legislation and tax laws.

The NO_x emission fluctuations follow the fuel consumption in cement production. However, the NO_x emission has decreased 15 % since 1990 due to the reduced emission from industrial boilers.

The NMVOC emission from boilers has decreased 9 % since 1990, but the emission from engines adds considerable emissions in 2000-2005.

The CO emission in 2007 was 15 % lower than in 1990. The CO emission from boilers decreased 15 % since 1990 whereas the CO emission from engines increased in 1995-2000 and decreased in resent years.

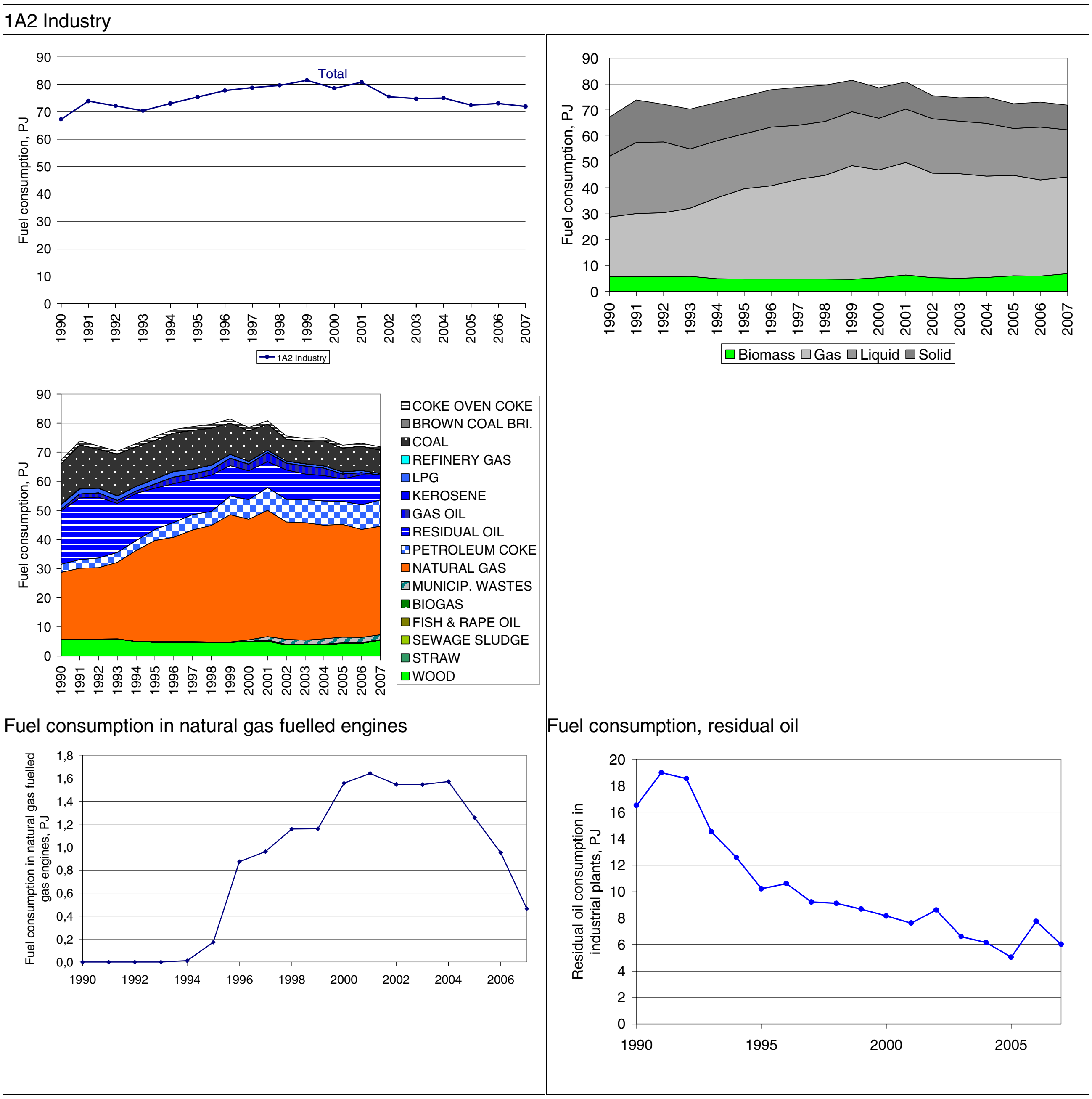


Figure 3A-27 Trend of Fuel consumption, 1A2 Industry.

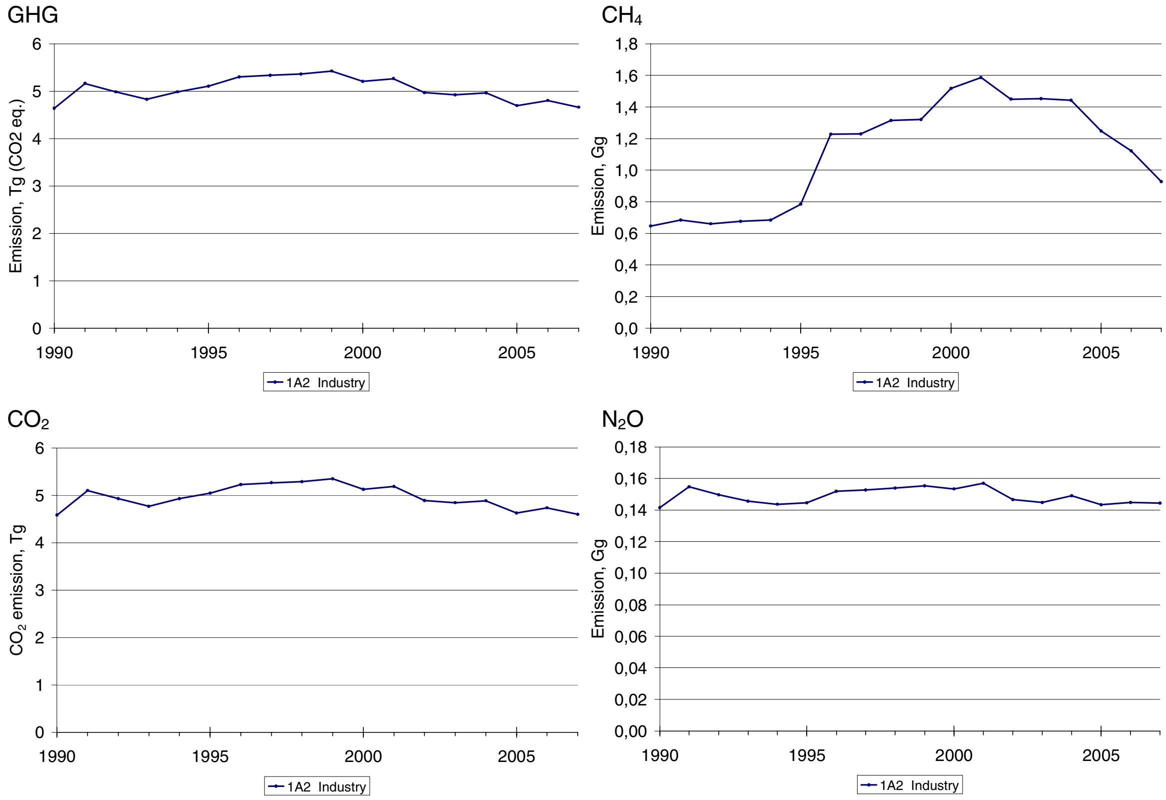


Figure 3A-28 Trend of greenhouse gas emission, 1A2 Industry.

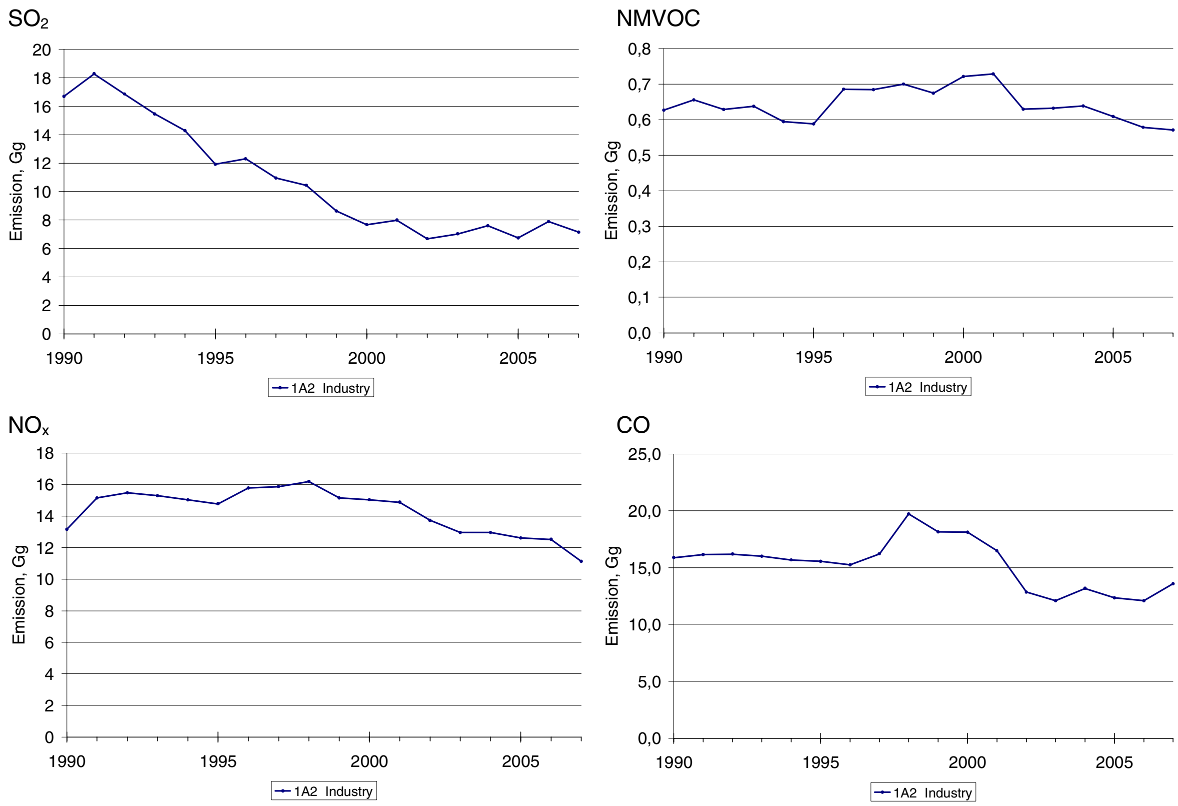


Figure 3A-29 Trend of SO_2, NO_x, NMVOC and CO emission, 1A2 Industry.

4.3 1A4 Other energy sectors

1A4 Other energy sectors consists of the subsectors:

- 1A4a Commercial/Institutional plants
- 1A4b Residential plants
- 1A1c Agriculture/Forestry

Table 3A-30 – Table 3A-32 present time-series for the sector. Residential plants are the largest sector accounting for the largest part of all emissions. Time-series is discussed below for each subsector.

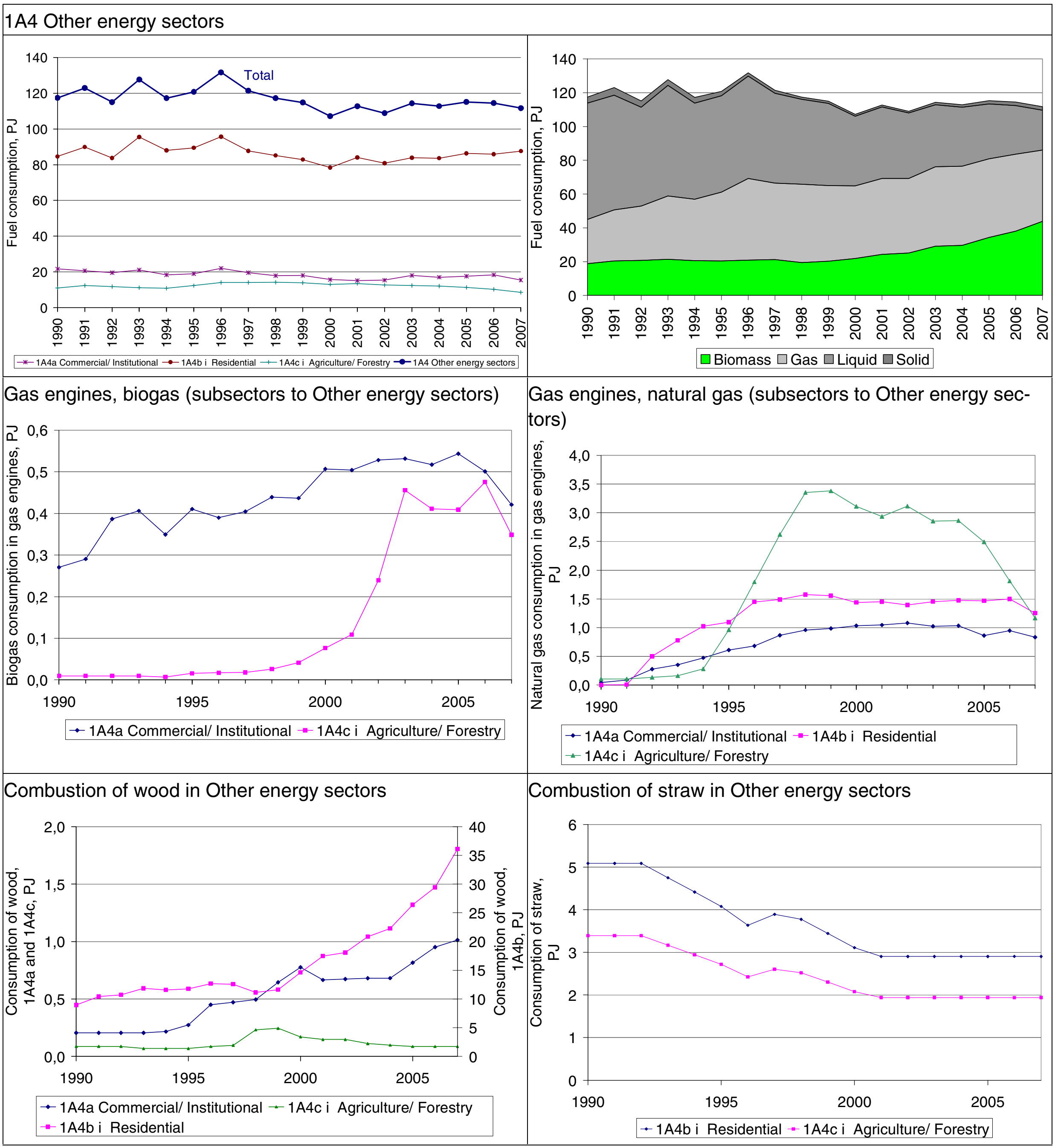


Figure 3A-30 Trend of Fuel consumption, 1A4 Other energy sectors.

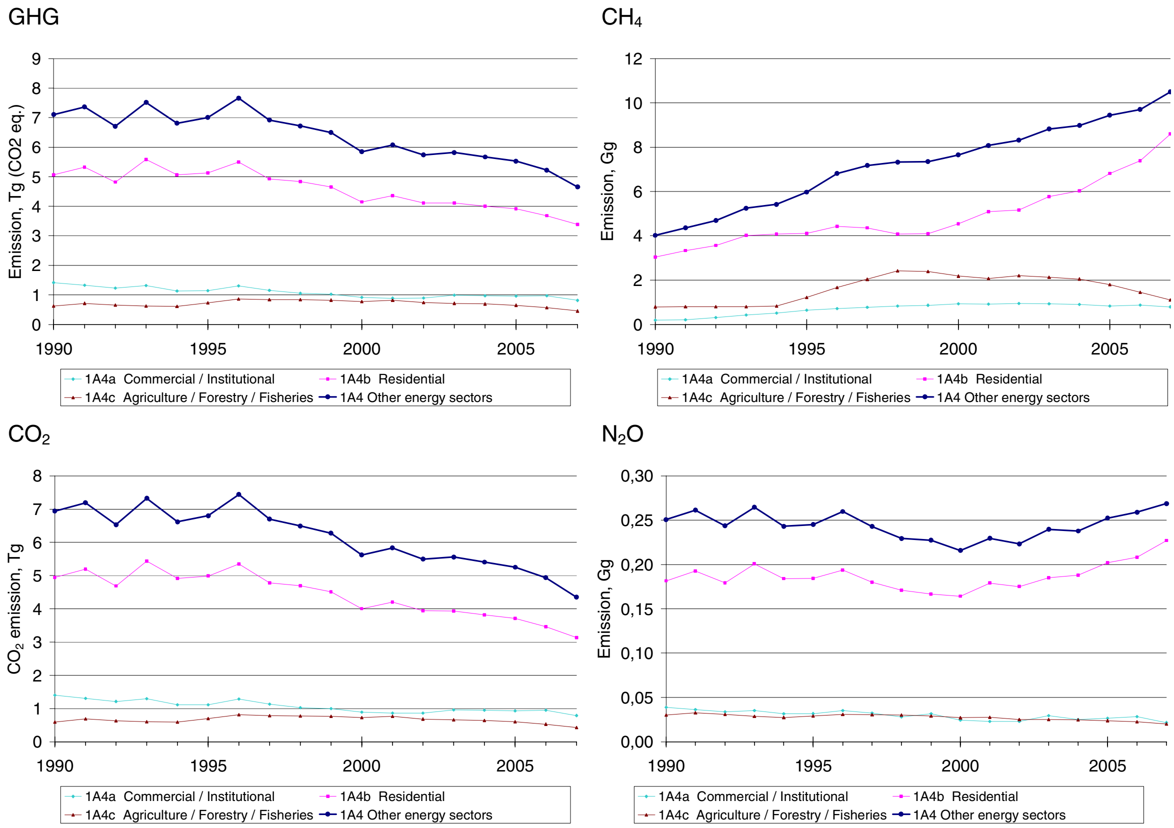


Figure 3A-31 Trend of greenhouse gas emission, 1A4 Other energy sectors.

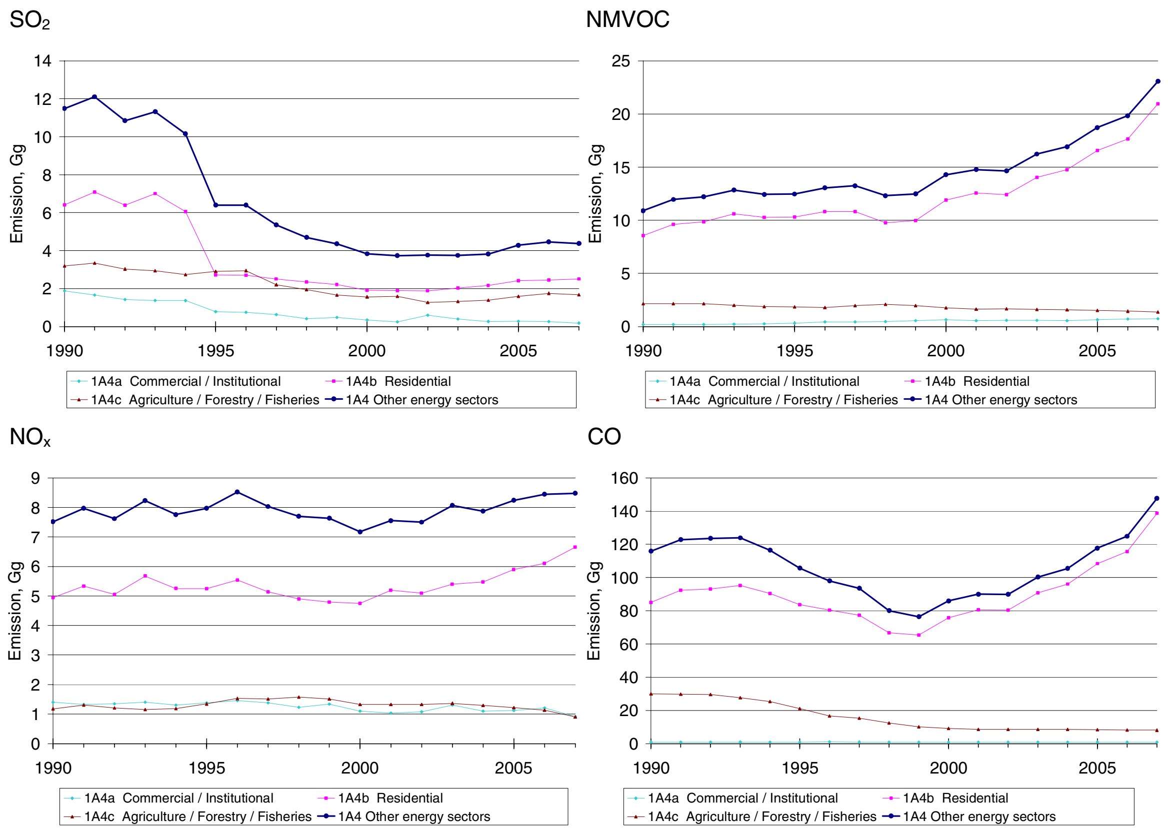


Figure 3A-32 Trend of SO_2, NO_x, NMVOC and CO emission, 1A4 Other energy sectors.

4.3.1 1A4a Commercial and institutional plants

The IPCC sector 1A4a Commercial and institutional plants has a low fuel consumption and emissions compared to the other stationary combustion sectors. Figure 3A-33 shows the time-series for fuel consumption and emissions.

The fuel consumption in commercial/institutional plants have decreased 27 % since 1990 and there have been a change of fuel type. The fuel consumption consists mainly of gas oil and natural gas. The consumption of gas oil has decreased and the consumption of natural gas has increased since 1990. The consumption of wood and biogas also increased. Wood consumption in 2007 was five times the consumption in 1990.

The CO_2 emission has decreased 44 % since 1990. Both the decrease of fuel consumption and the change of fuels – from gas oil to natural gas - contribute to the decreased CO_2 emission.

The CH_4 emission in 2007 was 4 times the 1990 level. The increase is mainly a result of the increased emission from natural gas fuelled engines. The emission from biogas fuelled engines and from combustion of wood also contributed to the increase. The time-series for consumption of natural gas and biogas is shown in Figure 3A-30.

The N_2O emission in 2007 was 45 % lower than in 1990. This decrease is a result of lower fuel consumption and of change of fuel from gas oil to natural gas. The emission from wood combustion have however been increasing. The fluctuations of the N_2O emission follow the fuel consumption.

The SO_2 emission has decreased 90 % since 1990. The decrease is mainly a result of lower sulphur content in gas oil and in residual oil. The lower sulphur content (0.05 % for gas oil since 1995 and 0.7 % for residual oil since 1997) is a result of Danish tax laws (Bek. 688, 1998).

The NO_x emission was 34 % lower in 2007 than in 1990. The decrease is a result of the lower fuel consumption but also the change from gas oil to natural gas contributes to the decrease. The emissions from gas engines and wood combustion have increased.

The NMVOC emission in 2007 was almost four times the 1990 emission level. The large increase is a result of the increased combustion of wood that is the main source of emission. The increased consumption of natural gas in gas engines also contribute to the increased NMVOC emission.

The CO emission has decreased 5 % since 1990. The emission from wood and from natural gas fuelled engines and boilers has increased whereas the emission from gas oil has decreased. This is a result of the change of fuels applied in the sector.

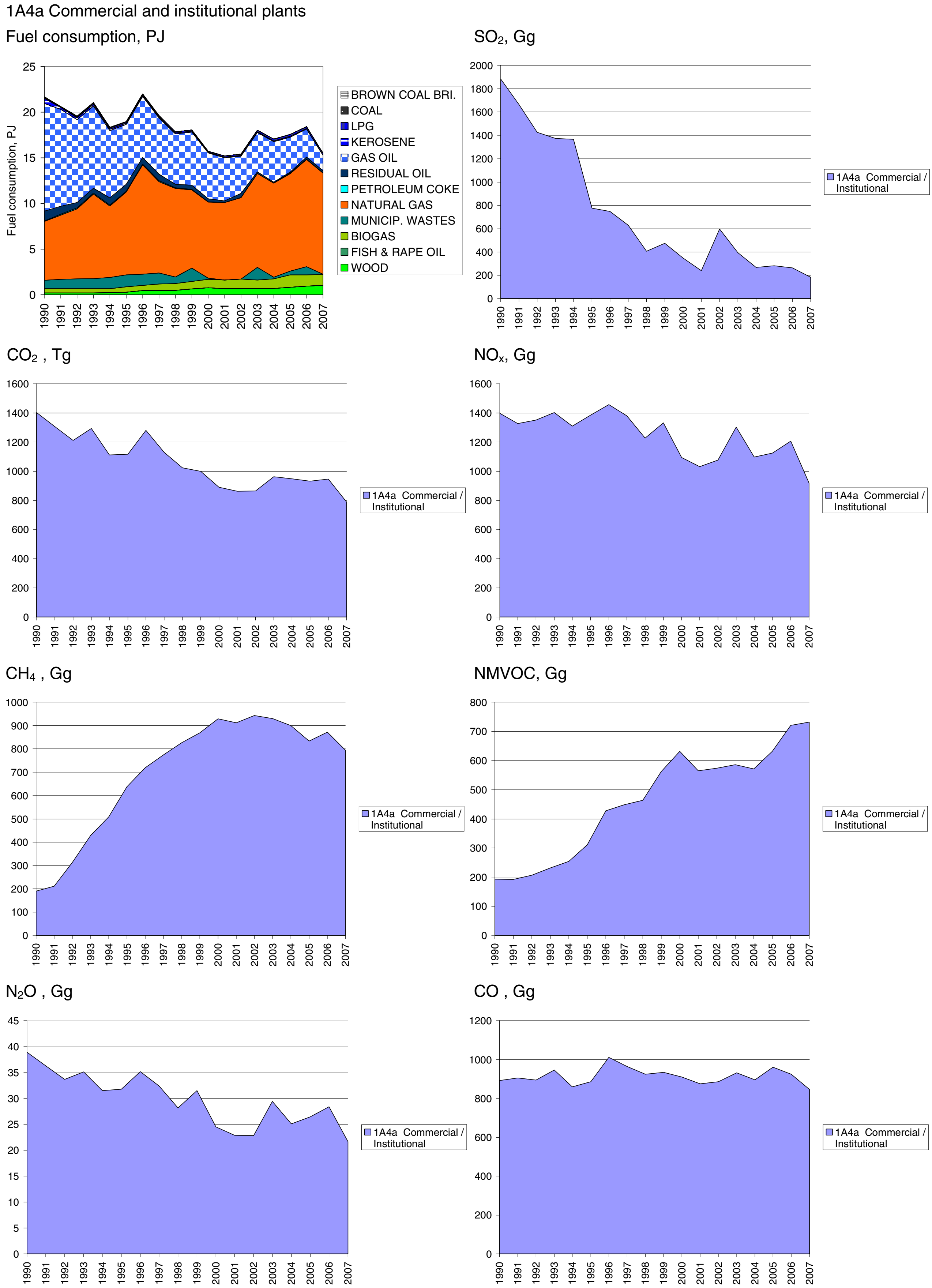


Figure 3A-33 Time-series for 1A4a Commercial /institutional.

4.3.2 1A4b Residential plants

The IPCC sector 1A4b Residential plants consist of both stationary and mobile sources. In this chapter only stationary sources are included. Figure 3A-34 shows the time-series for fuel consumption and emission.

For residential plants the total fuel consumption has been rather stable, and in 2007 the consumption was 4 % higher than in 1990. However, the consumption of gas oil has decreased since 1990 wheras the consumption of wood has increased considerably (4 times the 1990 level). The consumption of natural gas has also increased since 1990.

The CO_2 emission has decreased 37 % since 1990. This decrease is mainly a result of the considerable change of applied fuel from gas oil to wood and natural gas.

The CH_4 emission from residential plants has increased to almost three times the 1990 level due to the increased combustion of wood in residential plants that is the main source of emission. The increased emission from gas engines also contribute to the increased emission.

The N_2O emission follows the fluctuations of the total fuel consumption. The change of fuel from gas oil to wood has resulted in a 25 % increase of N_2O emission since 1990 due to a higher emission factor for wood than for gas oil.

The large decrease (61 %) of SO_2 emission from residential plants is mainly a result of a change of sulphur content in gas oil since 1995. The lower sulphur content (0.05 %) is a result of Danish tax laws (Bek. 688, 1998).

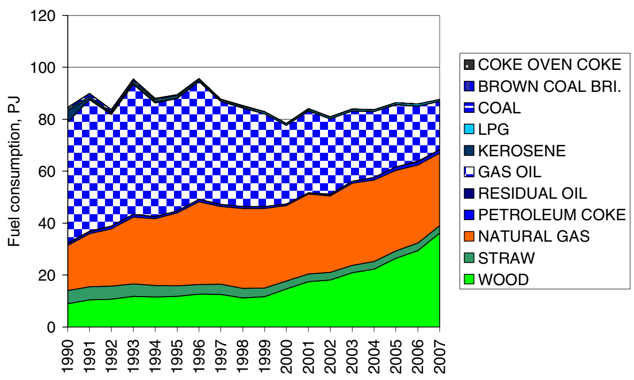
The NO_x emission has increased 35 % since 1990 due to the increased emission from wood combustion. The emission factor for wood is higher than for gas oil.

The emission of NMVOC increased to 2.4 times the 1990 level due to the increased combustion of wood. The emission factor for wood has decreased since 1990, but not as much as the increase in consumption of wood. The emission factor for wood and straw is much higher than for other fuels.

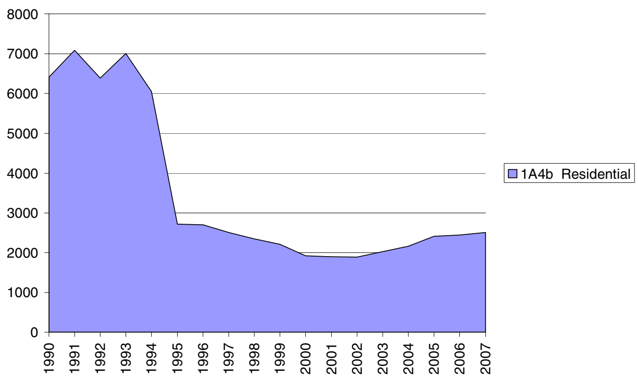
The CO emission increased 63 % due to the increased use of wood that is the main source of emission. The emission from combustion of straw has decreased since 1990.

1A4b Residential plants

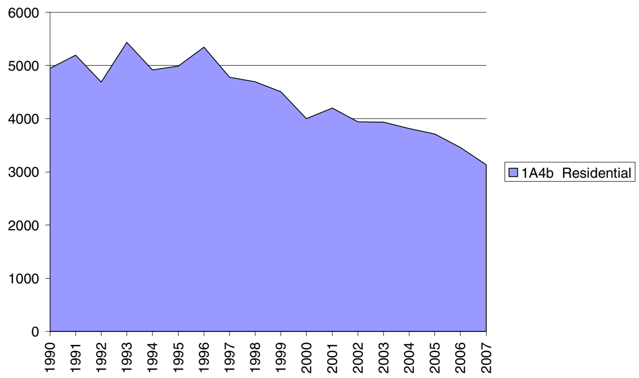
Fuel consumption, PJ



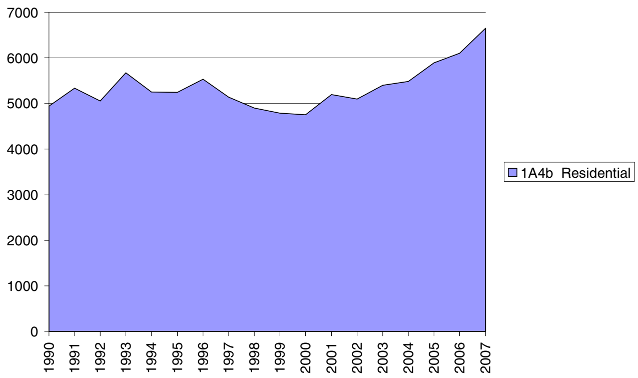
SO_2, Gg



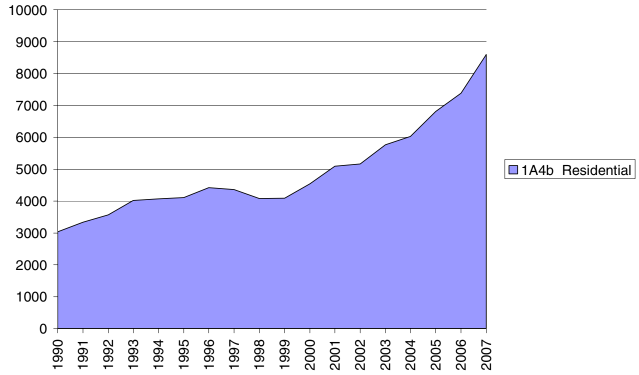
CO_2, Tg



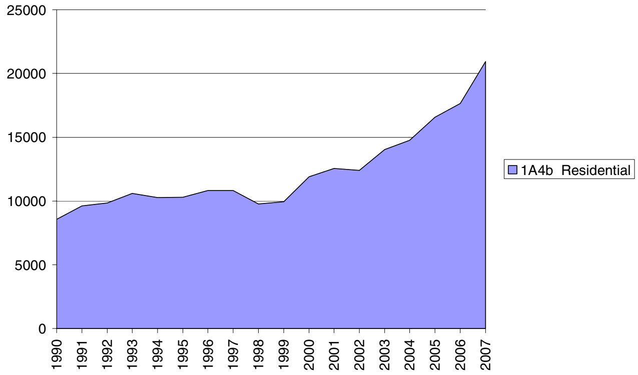
NO_x, Gg



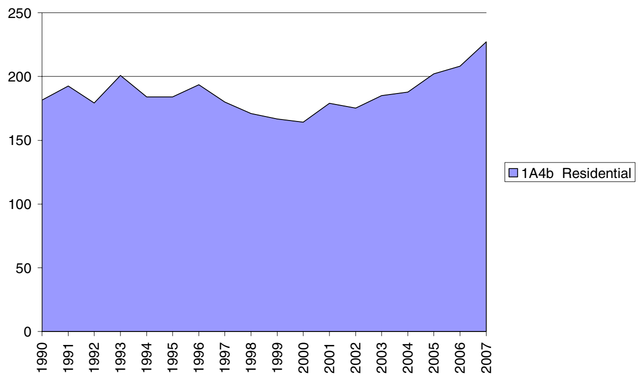
CH_4, Gg



NMVOC, Gg



N_2O, Gg



CO, Gg

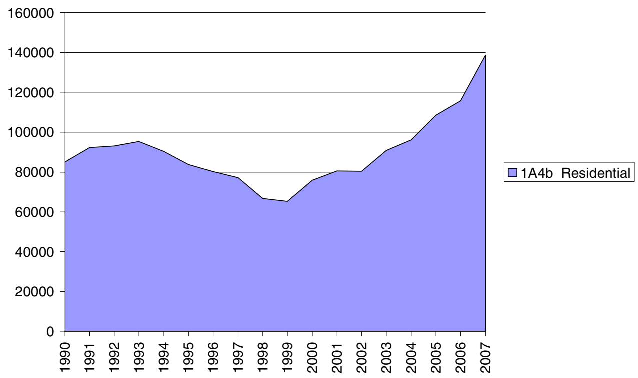


Figure 3A-34 Time-series for 1A4b Residential plants.

4.3.3 1A4c Agriculture/forestry

The IPCC sector 1A4c Agriculture/forestry consists of both stationary and mobile sources. In this chapter only stationary sources are included. Figure 3A-35 shows the time-series for fuel consumption and emissions.

For plants in agriculture/forestry the fuel consumption has decreased 23 % since 1990. A remarkable decrease of fuel consumption took place in resent years.

The type of fuel that have been applied has changed since 1990. In the years 1994-2004 the consumption of natural gas was high, but in reasent years the consumption decreased again. A large part of the natural gas consumption has been applied in gas engines (Figure 3A-33). Most CHP plants in agriculture/forestry based on gas engines came in operation in 1995-1999. The decrease in later years is a result of the liberalisation of the electricity market.

The consumption of straw has decreased since 1990. The consumption of both residual oil and gas oil has increased after 1990 and decreased again in resent years.

The CO_2 emission in 2007 was 28 % lower than in 1990. The CO_2 emission increased from 1990 to 1996 due to increased fuel consumption. Since 1996 the CO_2 emission has decreased in line with the decrease in fuel consumption.

The CH_4 emission in 2007 was 39 % higher than the emission in 1990. The emission time-series follows the time-series for natural gas combusted in gas engines (Figure 3A-33). The emission from combustion of straw has decreased as a result of the decreasing consumption of straw in the sector.

The emission of N_2O has decreased 34 % since 1990. The decrease is a result of both the lower fuel consumption and the change of fuel. The decreasing consumption of straw contribute considerably to the decrease of emission.

The SO_2 emission in 2007 was 47 % lower than in 1990. The emission has decreased in 1990-2002 and increased after 2002. The main emission sources are coal, residual oil and straw, and it is the increase of coal combustion in the sector that has caused the increase of SO_2 emission in resent years.

The emission of NO_x in 2007 was 23 % lower than in 1990. This is in line with the decrease of fuel consumption.

The emission of NMVOC decreased 36 % since 1990. The major emission source is combustion of straw. The consumption of straw has decreased since 1990.

The CO emission decreased 73 % since 1990. The major emission source is combustion of straw. In addition to the decrease of straw consumption the emission factor for straw also decreased since 1990.

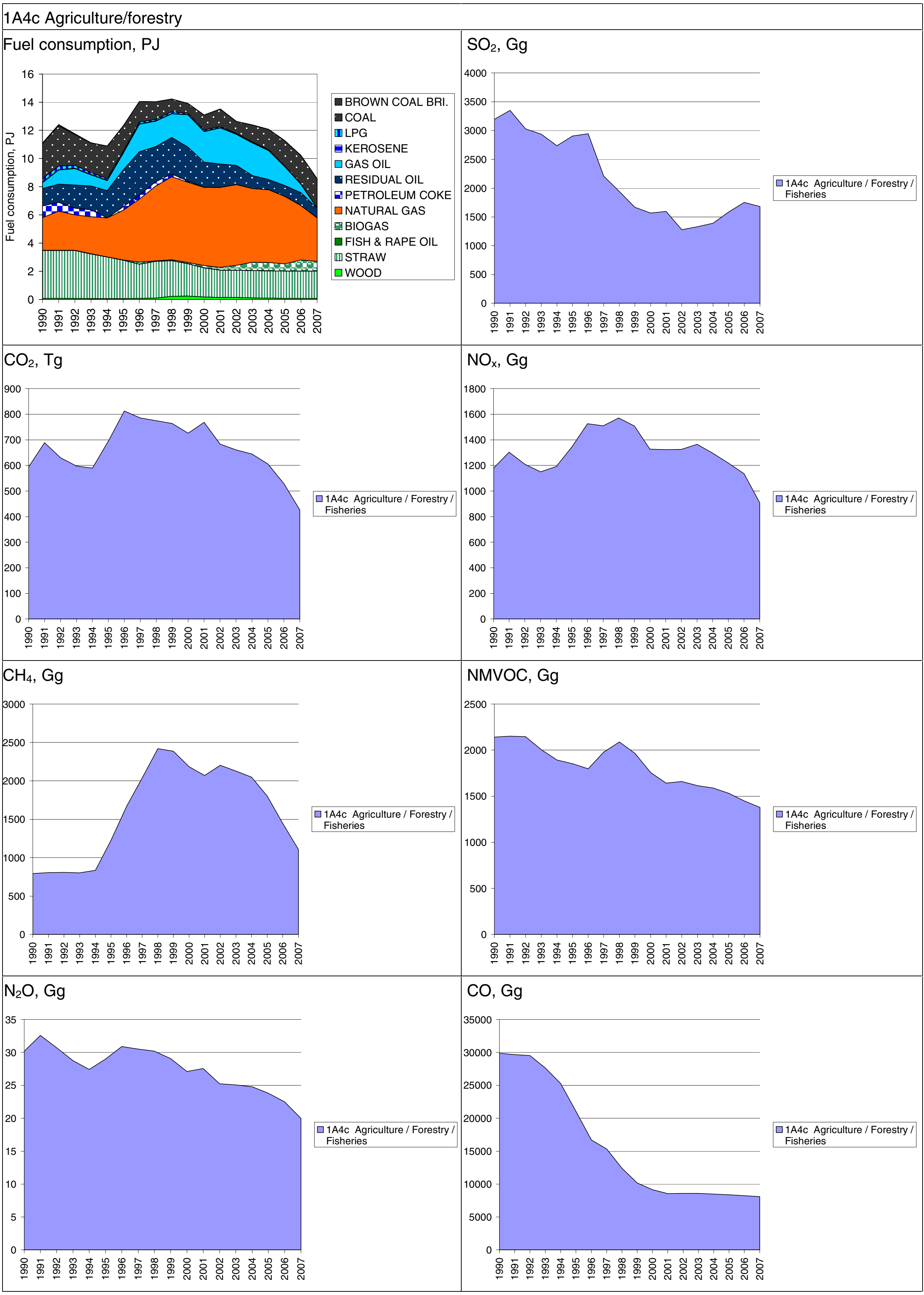


Figure 3A-35 Time-series for 1A4c Agriculture/Forestry.

5 Methodological issues

The Danish emission inventory is based on the CORINAIR (CORe INventory on AIR emissions) system, which is a European program for air emission inventories. CORINAIR includes methodology structure and software for inventories. The methodology is described in the EMFP/CORINAIR Emission Inventory Guidebook 3rd edition 2007 update, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections (EEA, 2007). Emission data are stored in an Access database, from which data are transferred to the reporting formats.

The emission inventory for stationary combustion is based on activity rates from the Danish energy statistics. General emission factors for various fuels, plants and sectors have been determined. Some large plants, such as power plants, are registered individually as large point sources and plant-specific emission data are used.

5.1 Emission source categories

In the Danish emission database all activity rates and emissions are defined in SNAP sector categories (Selected Nomenclature for Air Pollution) according the CORINAIR system. The emission inventories are prepared from a complete emission database based on the SNAP sectors. Aggregation to the sector codes used for the Climate Convention is based on a correspondence list between SNAP and IPCC sectors enclosed in Appendix 3A-2.

The sector codes applied in the reporting activity will be referred to as IPCC sectors. The IPCC sectors define six main source categories, listed in Table 3A-11, and a number of subsectors. Stationary combustion is part of the IPCC sector 1, *Energy*. Table 3A-12 presents subsectors in the IPCC energy sector. The table also presents the sector in which the NERI documentation is included. Though industrial combustion is part of the stationary combustion detailed documentation for some of the specific industries is discussed in the industry chapters/reports. Stationary combustion is defined as combustion activities in the SNAP sectors 01-03.

Table 3A-11 IPCC main sectors.

1. Energy
2. Industrial Processes
3. Solvent and Other Product Use
4. Agriculture
5. Land-Use Change and Forestry
6. Waste

Table 3A-12 IPCC energy sectors.

IPCC id	IPCC sector name	NERI documentation
1	Energy	Stationary combustion, Transport, Fugitive, Industry
1A	Fuel Combustion Activities	Stationary combustion, Transport, Industry
1A1	Energy Industries	Stationary combustion
1A1a	Electricity and Heat Production	Stationary combustion
1A1b	Petroleum Refining	Stationary combustion
1A1c	Solid Fuel Transf./Other Energy Industries	Stationary combustion
1A2	Fuel Combustion Activities/Industry (ISIC)	Stationary combustion, Transport, Industry
1A2a	Iron and Steel	Stationary combustion, Industry
1A2b	Non-Ferrous Metals	Stationary combustion, Industry
1A2c	Chemicals	Stationary combustion, Industry
1A2d	Pulp, Paper and Print	Stationary combustion, Industry
1A2e	Food Processing, Beverages and Tobacco	Stationary combustion, Industry
1A2f	Other (please specify)	Stationary combustion, Transport, Industry
1A3	Transport	Transport
1A3a	Civil Aviation	Transport
1A3b	Road Transportation	Transport
1A3c	Railways	Transport
1A3d	Navigation	Transport
1A3e	Other (please specify)	Transport
1A4	Other Sectors	Stationary combustion, Transport
1A4a	Commercial/Institutional	Stationary combustion
1A4b	Residential	Stationary combustion, Transport
1A4c	Agriculture/Forestry/Fishing	Stationary combustion, Transport
1A5	Other (please specify)	Stationary combustion, Transport
1A5a	Stationary	Stationary combustion
1A5b	Mobile	Transport
1B	Fugitive Emissions from Fuels	Fugitive
1B1	Solid Fuels	Fugitive
1B1a	Coal Mining	Fugitive
1B1a1	Underground Mines	Fugitive
1B1a2	Surface Mines	Fugitive
1B1b	Solid Fuel Transformation	Fugitive
1B1c	Other (please specify)	Fugitive
1B2	Oil and Natural Gas	Fugitive
1B2a	Oil	Fugitive
1B2a2	Production	Fugitive
1B2a3	Transport	Fugitive
1B2a4	Refining/Storage	Fugitive
1B2a5	Distribution of oil products	Fugitive
1B2a6	Other	Fugitive
1B2b	Natural Gas	Fugitive
1B2b1	Production/processing	Fugitive
1B2b2	Transmission/distribution	Fugitive
1B2c	Venting and Flaring	Fugitive
1B2c1	Venting and Flaring Oil	Fugitive
1B2c2	Venting and Flaring Gas	Fugitive
1B2d	Other	Fugitive

Stationary combustion plants are included in the emission sectors:

- 1A1 Energy, Fuel consumption, Energy Industries
- 1A2 Energy, Fuel consumption, Manufacturing Industries and Construction
- 1A4 Energy, Fuel consumption, Other Sectors

The sectors *1A2* and *1A4*, however also include emission from transport subsectors. The sector *1A2* includes emissions from some off-road machinery in the industry. The sector *1A4* includes off-road machinery in agriculture, forestry and household/gardening. Further emissions from national fishing are included in sector *1A4*.

The emission and fuel consumption data included in tables and figures in this report only include emissions originating from stationary combustion plants of a given IPCC sector. The IPCC sector codes have been applied unchanged, but some sector names have been changed to reflect the stationary combustion element of the source.

The CO_2 from calcination is not part of the energy sector. This emission is included in the IPCC sector 2 Industrial processes.

5.2 Large point sources

Large emission sources such as power plants, industrial plants and refineries are included as large point sources in the Danish emission database. Each point source may consist of more than one part, e.g. a power plant with several units. By registering the plants as point sources in the database it is possible to use plant-specific emission factors.

In the inventory for the year 2007, 71 stationary combustion plants are specified as large point sources. These point sources include:

- Power plants and decentralised CHP plants (combined heat and power plants)
- Municipal waste incineration plants
- Large industrial combustion plants
- Petroleum refining plants

The criteria for selection of point sources consist of the following:

- All centralized power plants, including smaller units.
- All units with a capacity of above 25 MW_e.
- All district heating plants with an installed effect of 50 MW or above and a significant fuel consumption
- All waste incineration plants included in the Danish law "Bekendtgørelse om visse listevirksomheders pligt til at udarbejde grønt regnskab" (Plants obliged to publish annual environmental reports).
- Industrial plants
    - With an installed effect of 50 MW or above and significant fuel consumption.
    - With a significant process related emission.

The fuel consumption of stationary combustion plants registered as large point sources is 333 PJ (2007). This corresponds to 60 % of the overall fuel consumption for stationary combustion.

A list of the large point sources for 2007 and the fuel consumption rates is provided in Appendix 3A-7. The number of large point sources registered in the databases increased from 1990 to 2007.

The emissions from a point source are based either on plant specific emission data or, if plant specific data are not available, on fuel consumption data and the general Danish emission factors. Appendix 3A-7 shows which of the emission data for large point sources are plant-specific and which are based on emission factors.

SO_2 and NO_x emissions from large point sources are often plant-specific based on emission measurements. CO_2 emission factors are plant specific for some of the major power plants. Emissions of CO and NMVOC are also plant-specific for some plants. Plant-specific emission data are obtained from:

- Annual environmental reports
- Annual plant-specific reporting of SO_2 and NO_x from power plants >25MW_e prepared for the Danish Energy Authority due to Danish legislatory requirement
- Emission data reported by DONG Energy and Vattenfall, the two major electricity suppliers
- CO_2 data reported under the EU Emission Trading Scheme
- Emission data reported from industrial plants

Annual environmental reports for the plants include a considerable number of emission data sets. Emission data from annual environmental reports are, in general, based on emission measurements, but some emissions have potentially been calculated from general emission factors.

If plant-specific emission factors are not available, general area source emission factors are used. Emissions of the greenhouse gases CH_4 and N_2O from the large point sources are all based on the area source emission factors.

5.3 Area sources

Fuels not combusted in large point sources are included as sector specific area sources in the emission database. Plants such as residential boilers, small district heating plants, small CHP plants and some industrial boilers are defined as area sources. Emissions from area sources are based on fuel consumption data and emission factors. Further information on emission factors is provided below.

5.4 Activity rates, fuel consumption

The fuel consumption rates are based on the official Danish energy statistics prepared by the Danish Energy Authority (DEA). The Danish Energy Authority aggregates fuel consumption rates to SNAP sector categories (DEA, 2008a). Some fuel types in the official Danish energy statistics are added to obtain a less detailed fuel aggregation level see Appendix 3A-4. The calorific values on which the energy statistics are based are also enclosed in Appendix 3A-4. The correspondence list between the energy statistics and SNAP sectors are enclosed in Appendix 3A-12.

The fuel consumption of the IPCC sector *1A2 Manufacturing industries and construction* (corresponding to SNAP sector *03 Combustion in manufacturing industries)* is not disaggregated into specific industries in the NERI emission database. So far disaggregation into specific industries is only estimated for the reporting to the Climate Convention. The disaggregation of fuel consumption and emissions from the industrial sector is discussed in Chapter 4.6.

Both traded and non-traded fuels are included in the Danish energy statistics. Thus, for example, estimation of the annual consumption of non-traded wood is included.

Petroleum coke purchased abroad and combusted in Danish residential plants (border trade of 251 TJ) is added to the apparent consumption of petroleum coke and the emissions are included in the inventory.

The Danish Energy Authority (DEA) compiles a database for the fuel consumption of each district heating and power-producing plant, based on data reported by plant operators. The fuel consumption of large point sources specified in the Danish emission database refers to the DEA database (DEA, 2008c).

The fuel consumption of area sources is calculated as total fuel consumption minus fuel consumption of large point sources.

The Danish national energy statistics includes three fuels used for non-energy purposes, bitumen, white spirit and lubricants. The total consumption for non-energy purposes is relatively low, e.g. 13.2 PJ in 2007. The use of white spirit is included in the inventory for solvent use, please see chapter 5 of the NIR. The emissions associated with the use of bitumen and lubricants are included under industrial processes IPCC sectors 2A and 2G respectively, please see chapter 4 of the Danish NIR. The non-energy use of fuels is included in the reference approach for Climate Convention reporting.

In Denmark all municipal waste incineration is utilised for heat and power production. Thus, incineration of waste is included as stationary combustion in the IPCC Energy sector (source categories *1A1*, *1A2* and *1A4)*.

Fuel consumption data are presented in Chapter 1.

5.5 Town gas

The consumption of town gas in Denmark is very low, e.g. 0.4 PJ in 2007. In 1990 the town gas consumption was 1.5 PJ and the consumption has been steadily decreasing though the time-series. Until now the emission factors for town gas has been assumed equal to those for natural gas. In Denmark town gas is produced based on natural gas, the use of coal for town gas production ceased in the early 1980'es.

An indicative composition of town gas according to the largest supplier of town gas in Denmark is shown in Table 3A-13 below (KE, 2009).

Table 3A-13 Composition of town gas currently used (KE, 2009).

Component	Town gas, % (mol.)
Methane	43.9
Ethane	2.9
Propane	1.1
Butane	0.5
Carbon dioxide	0.4
Nitrogen	40.5
Oxygen	10.7

The lower heating value is listed as 19.3 MJ per Nm^3. This would lead to a CO_2 emission factor of 56.4 kg per GJ, which is very close to the emission factor used for natural gas of 56.78 kg per GJ. According to the supplier both the composition and heating value will change during the year. It is not possible to obtain a yearly average.

In earlier years the composition of natural gas was somewhat different. Table 3A-14 below is constructed with the input of KE and DGC. (Jeppesen, 2008 and Kristensen, 2007) The data are from 3 measurements performed several years apart the first in 2000 and the latest in 2005.

Table 3A-14 Composition of town gas, information from the period 2000-2005.

Component	Town gas, % (mol.)
Methane	22.3-27.8
Ethane	1.2-1.8
Propane	0.5-0.9
Butane	0.13-0.2
Higher hydrocarbons	0-0.6
Carbon dioxide	8-11.6
Nitrogen	15.6-20.9
Oxygen	2.3-3.2
Hydrogen	35.4-40.5
Carbon monoxide	2.6-2.8

The lower calorific value has been between 15.6 and 17.8 MJ per Nm^3. The CO_2 emission factors derived from the few available measurements is in the range of 52-57 kg per GJ. The Danish approach of assuming the same emission factors as for natural gas is a conservative approach ensuring that the emissions are not underestimated.

Due to the scarce data available and the very low consumption of town gas compared to both the natural gas use and the overall fuel use, it is not thought to be reasonable to expend more resources on this issue.

5.6 Emission factors

For each fuel and SNAP category (sector and e.g. type of plant) a set of general area source emission factors has been determined. The emission factors are either nationally referenced or based on the international guidebooks: EMEP/CORINAIR Guidebook (EEA, 2007) and IPCC Reference Manual (IPCC, 1997).

A complete list of emission factors including time-series and references is provided in Appendix 3A-5.

A considerable part of the emission data for municipal waste incineration plants and large power plants are plant-specific. The area source emission factors do not, therefore, necessarily represent average values for these plant categories. To attain a set of emission factors that expresses the average emission for power plants combusting coal and for municipal waste incineration plants, implied emission factors have been calculated for these two plant categories. The implied emission factors are presented in Appendix 3A-6. The implied emission factors are calculated as total emission divided by total fuel consumption.

5.6.1 CO_2, use of EU ETS data

The use of the EU Emission Trading Scheme (EU ETS) data started in the 2008 submission, this is therefore the second year where the inventory includes EU ETS data. NERI performs QA/QC checks on the emission reports made by the plants.

The rules for measuring, reporting and verifying are established by an EU Commission decision (EU Commission, 2004). For more information regarding the specifics of the EU ETS please refer to the Commission webpage:
http://ec.europa.eu/environment/climat/emission/implementation_en.htm

The Danish emission inventory only includes data from plants using higher tier methods as defined in the EU decision, where the specific methods for determining carbon contents, oxidation factor and calorific value are specified.

The 14 coal fired plants where plant specific information is used accounts for roughly 85 % of the Danish coal consumption and 34 % of the total CO_2 emission from stationary combustion plants. The average CO_2 emission factor for coal for these 14 plants was 94.1 kg pr GJ (Table 3A-15).

Table 3A-15 Data from reports for 14 coal fired power plants made under the EU ETS.

	Heating value, GJ pr tonne	Oxidation factor	CO_2 implied emission factor, kg pr GJ
Minimum value	23.8	0.97	93.2
Maximum value	24.9	0.998	95.1
Average	24.3	0.99	94.1

Regarding the historic time-series the emission factor were held constant from 1990 to 2005, due to lack of better information. During the UNFCCC review the Expert Review Team suggested using the heating values provided by the DEA in the formula provided in the 1996 IPCC Guidelines (IPCC, 1997. p. 1.25). However the Guidelines specify that the gross heating value should be between 31 and 37 TJ pr. ktonnes for the formula to be valid, this is not the case for electricity plant coal used in Denmark. Using the formula anyway leads to CO_2 emission factors in the range of 93.3 to 94.6 kg pr. GJ. It is not believed that this improves the accuracy of the inventory, therefore no changes are made to the CO_2 emission factor for coal from 1990 to 2005.

Data for residual oil and gas oil is also available through EU ETS. For residual oil information from 17 units is available, for gas oil only two plants provide detailed data. See the tables below.

Table 3A-16 Data from reports for 17 residual oil fired power plants made under the EU ETS.

	Heating value, GJ pr tonne	Oxidation factor	CO_2 implied emission factor, kg pr GJ
Minimum value	40.2	0.995	76.4
Maximum value	41.9	0.995	79.5
Average	40.8	0.995	78.3

Table 3A-17 Data from reports for 2 gas oil fired power plants made under the EU ETS.

	Heating value, GJ pr tonne	Oxidation factor	CO_2 implied emission factor, kg pr GJ
Minimum value	42.5	0.995	74.0
Maximum value	42.7	0.995	75.7
Average	42.6	0.995	74.9

Plant specific CO_2 emission factors have also been applied for cement production which is part of sector 1A2f Industry. These data also refer to EU ETS. The applied fuels are: Coal, residual oil, petroleum coke and waste (biomass and fossil). This is further discussed in the industry chapter of the National Inventory Report 2009 (Nielsen et al 2009). The emission is however included as part of stationary combustion.

5.6.2 CO_2, other emission factors

The CO_2 emission factors applied for 2007 are presented in Table 3A-18. For municipal waste and natural gas, time-series have been estimated. For all other fuels the same emission factor is applied for 1990-2007.

In reporting for the Climate Convention, the CO_2 emission is aggregated to five fuel types: Solid fuel, Liquid fuel, Gas, Biomass and Other fuels. The correspondence list between the NERI fuel categories and the IPCC fuel categories is also provided in Table 3A-18.

Only emissions from fossil fuels are included in the national total CO_2 emission. The biomass emission factors are also included in the table, because emissions from biomass are reported to the Climate Convention as a memo item.

The CO_2 emission from incineration of municipal waste (94,5 + 17,6 kg pr GJ) is divided into two parts: The emission from combustion of the plastic content of the waste, which is included in the national total, and the emission from combustion of the rest of the waste – the biomass part, which is reported as a memo item. In the IPCC reporting, the CO_2 emission from combustion of the plastic content of the waste is reported in the fuel category, *Other fuels*. However, this split is not applied in either fuel consumption or other emissions, because it is only relevant for CO_2. Thus, the full consumption of municipal waste is included in the fuel category, *Biomass,* and the full amount of non-CO_2 emissions from municipal waste combustion is also included in the *Biomass*-category.

The CO_2 emission factors have been confirmed by the two major power plant operators, both directly (Christiansen, 1996 and Andersen, 1996) and indirectly, by applying the NERI emission factors in the annual environmental reports for the large power plants and by accepting use of the NERI factors in Danish legislation.

Table 3A-18 CO_2 emission factors 2007.

Fuel	Emission factor kg pr GJ		Reference type	IPCC fuel
	Biomass	Fossil fuel		Category
Coal		95 [1)]	Country specific	Solid
Brown coal briquettes		94,6 [2)]	IPCC, 2007	Solid
Coke oven coke		108	IPCC, 2007	Solid
Petroleum coke		92 [1)]	Country specific	Liquid
Wood	102		EEA, 2004	Biomass
Municipal waste	94,5 [1)]	17,6 [1)]	Country specific	Biomass/Other fuels
Straw	102		Country specific	Biomass
Residual oil		78 [1)]	EEA, 2004	Liquid
Gas oil		74 [1)]	EEA, 2004	Liquid
Kerosene		72	EEA, 2004	Liquid
Fish & rape oil	74		Country specific	Biomass
Orimulsion		80 [2)]	Country specific	Liquid
Natural gas		56.78	Country specific	Gas
LPG		65	EEA, 2004	Liquid
Refinery gas		56,9	Country specific	Liquid
Biogas	83,6		Country specific	Biomass

Plant specific data from EU ETS incorporated for individual plants.

Not applied in 2007.

Coal

The emission factor 95 kg pr GJ is based on Fenhann & Kilde (1994). The CO_2 emission factors have been confirmed by the two major power plant operators in 1996 (Christiansen, 1996 and Andersen, 1996). Elsam reconfirmed the factor in 2001 (Christiansen, 2001). The same emission factor is applied for 1990-2007.

As mentioned above EU ETS data were utilised for the 2006 and 2007 emission inventory. The implied emission factors for the power plants using coal ranged from 93.2 to 95.1 kg pr GJ. Detailed data were available from 14 coal powered units, which allowed the information to be included in the emission inventory.

Brown coal briquettes

The emission factor 94.6 kg pr GJ is based on a default value from the IPCC Guidelines assuming full oxidation. The default value in the IPCC Guidelines is 25.8 t C pr TJ, corresponding to $25.8 \cdot (12+2 \cdot 16)/12 = 94.6$ kg CO_2 pr GJ assuming full oxidation. The same emission factor is applied for 1990-2007.

Coke oven coke

The emission factor 108 kg pr GJ is based on a default value from the IPCC Guidelines assuming full oxidation. The default value in the IPCC Guidelines is 29.5 t C pr TJ, corresponding to $29.5 \cdot (12+2 \cdot 16)/12 = 108$ kg CO_2 pr GJ assuming full oxidation. The same emission factor is applied for 1990-2007.

Petroleum coke

The emission factor 92 kg pr GJ has been estimated by SK Energy (a former major power plant operator in eastern Denmark) in 1999 based on a fuel analysis carried out by dk-Teknik in 1993 (Bech, 1999). The emission factor level was confirmed by a new fuel analysis, which, however, is considered confidential. The same emission factor is applied for 1990-2007.

As mentioned above plant specific EU ETS data were utilised for cement production in the 2006 and 2007 emission inventory.

Wood

The emission factor for wood, 102 kg pr GJ, refers to Fenhann & Kilde (1994). The factor is based on the interval stated in a former edition of the EMEP/CORINAIR Guidebook (EEA, 2004) and the actual value is the default value from the Collector database. The same emission factor is applied for 1990-2007.

Municipal waste

The CO_2 emission from incineration of municipal waste is divided into two parts: The emission from combustion of the plastic content of the waste, which is included in the national total, and the emission from combustion of the rest of the waste – the biomass part, which is reported as a memo item.

The plastic content of waste was estimated to be 6.6 w/w % in 2003 (Hulgaard, 2003). The weight share, lower heating values and CO_2 emission factors for different plastic types are estimated by Hulgaard in 2003 (Table 3A-19). The total weight share for plastic and for the various plastic types is assumed to be the same for all years (NERI assumption).

Table 3A-19 Data for plastic waste in Danish municipal waste (Hulgaard, 2003)[1)2)].

Plastic type	Mass share of plastic in municipal waste in Denmark		Lower heating value of plastic	Energy content of plastic	CO_2 emission factor for plastic	CO_2 emission factor
	kg plastic pr kg municipal waste	% of plastic	MJ pr kg plastic	MJ pr kg municipal waste	G pr MJ plastic	G pr kg municipal waste
PE	0.032	48	41	1.312	72.5	95
PS/EPS	0.02	30	37	0.74	86	64
PVC	0.007	11	18	0.126	79	10
Other (PET, PUR, PC, POM, ABS, PA etc.)	0.007	11	24	0.168	95	16
Total	0.066	100	35.5	2.346	78.7	185

Hulgaard (2003) refers to:
1) TNO report 2000/119, Eco-efficiency of recovery scenarios of plastic packaging, Appendices, July 2001 by P.G. Eggels, A.M.M. Ansems, B.L. van der Ven, for Association of Plastic Manufacturers in Europe
2) Kost, Thomas, Brennstofftechnische Charakterisierung von Haushaltabfällen, Technische Universität Dresden, Eigenverlag des Forums für Abfallwirtschaft und Altlasten e.V., 2001

Based on emission measurements on 5 municipal waste incineration plants (Jørgensen & Johansen, 2003) the total CO_2 emission factor for municipal waste incineration has been determined to be 112.1 kg pr GJ. The CO_2 emission from the biomass part is the total CO_2 emission minus the CO_2 emission from the plastic part.

Thus, in 2003 the CO_2 emission factor for the plastic content of waste was estimated to be 185g pr kg municipal waste (Table 3A-19). The CO_2 emission per GJ of waste is calculated based on the lower heating values for waste listed in Table 3A-20 (DEA, 2008b). It has been assumed that the plastic content as a weight percentage is constant; resulting in a decreasing energy percentage since the lower heating value (LHV) is increasing. However, the increasing LHV may be a result of increasing plastic content in the municipal waste. Time-series for the CO_2 emission factor for plastic content in waste are included in Table 3A-20.

Emission data from four waste incineration plants (Jørgensen & Johansen, 2003) demonstrate the fraction of the carbon content of the waste not oxidised to be approximately 0.3 %. The un-oxidised fraction of the carbon content is assumed to originate from the biomass content, and all carbon originating from plastic is assumed to be oxidised.

Table 3A-20 CO_2 emission factor for municipal waste, plastic content and biomass content.

Year	Lower heating value of munici-pal waste [1]	Plastic content	CO_2 emission factor for plastic [3]	CO_2 emission factor for plastic	CO_2 emission factor for municipal waste, total [2]	CO_2 emission factor for biomass content of waste
	GJ pr Mg	% of energy	G pr kg waste	Kg pr GJ waste	Kg pr GJ waste	Kg pr GJ waste
1990	8.20	28,6	185	22.5	112.1	89.6
1991	8.20	28,6	185	22.5	112.1	89.6
1992	9.00	26,1	185	20.5	112.1	91.6
1993	9.40	25,0	185	19.6	112.1	92.5
1994	9.40	25,0	185	19.6	112.1	92.5
1995	10.00	23,5	185	18.5	112.1	93.6
1996	10.50	22.3	185	17.6	112.1	94.5
1997	10.50	22.3	185	17.6	112.1	94.5
1998	10.50	22.3	185	17.6	112.1	94.5
1999	10.50	22.3	185	17.6	112.1	94.5
2000	10.50	22.3	185	17.6	112.1	94.5
2001	10.50	22.3	185	17.6	112.1	94.5
2002	10.50	22.3	185	17.6	112.1	94.5
2003	10.50	22.3	185	17.6	112.1	94.5
2004	10.50	22.3	185	17.6	112.1	94.5
2005	10.50	22.3	185	17.6	112.1	94.5
2006	10.50	22.3	185	17.6	112.1	94.5
2007	10.50	22.3	185	17.6	112.1	94.5

1) DEA, 2008b.

2) Based on data from Jørgensen & Johansen (2003).

3) From Table 3A-19.

As mentioned above plant specific EU ETS data were utilised for cement production in the 2006 and 2007 emission inventory.

Straw

The emission factor for straw, 102 kg pr GJ refers to Fenhann & Kilde (1994). The factor is based on the interval stated in the EMEP/VORINAIR Guidebook (EEA, 2004) and the actual value is the default value from the Collecter database. The same emission factor is applied for 1990-2007.

Residual oil

The emission factor 78 kg pr GJ refers to Fenhann & Kilde (1994). The factor is based on the interval stated in the EEA Guidebook (EEA, 2004). The factor is slightly higher than the IPCC default emission factor for residual fuel oil (77.4 kg pr GJ assuming full oxidation). The CO_2 emission factors have been confirmed by the two major power plant operators in 1996 (Christiansen, 1996 and Andersen, 1996). The same emission factor is applied for 1990-2007.

As mentioned above plant specific EU ETS data were utilised for some power plants and for cement production in the 2006 and 2007 emission inventory.

The implied emission factors for the power plants using residual oil ranged from 76.4 to 79.5 kg pr GJ. Detailed data were available from 17 units using residual oil, which allowed the information to be included in the emission inventory.

Gas oil

The emission factor 74 kg pr GJ refers to Fenhann & Kilde (1994). The factor is based on the interval stated in the EEA Guidebook (EEA, 2004). The factor agrees with the IPCC default emission factor for gas oil (74.1 kg pr GJ assuming full oxidation). The CO_2 emission factors have been confirmed by the two major power plant operators in 1996 (Christiansen, 1996 and Andersen, 1996). The same emission factor is applied for 1990-2007.

As mentioned above plant specific EU ETS data were utilised for some power plants in the 2006 and 2007 emission inventory. The implied emission factors for the power plants using gas oil ranged from 74.0 to 75.7 kg pr GJ. Detailed data were available from 2 units using gas oil, which allowed the information to be included in the emission inventory.

Kerosene

The emission factor 72 kg pr GJ refers to Fenhann & Kilde (1994). The factor agrees with the IPCC default emission factor for other kerosene (71.9 kg pr GJ assuming full oxidation). The same emission factor is applied for 1990-2007.

Fish & rape oil

The emission factor is assumed to be the same as for gas oil – 74 kg pr GJ. The consumption of fish and rape oil is relatively low.

Orimulsion

The emission factor 80 kg pr GJ refers to the Danish Energy Authority (DEA 2007). The IPCC default emission factor is almost the same: 80.7 kg pr GJ assuming full oxidation. The CO_2 emission factors have been confirmed by the only major power plant operator using orimulsion (Andersen 1996). The same emission factor is applied for all years. Orimulsion have not been applied in Denmark in resent years.

Natural gas

The emission factor for natural gas is estimated by the Danish gas transmission company, Energinet.dk[2]. Only natural gas from the Danish gas fields is utilised in Denmark. The calculation is based on gas analysis carried out daily by Energinet.dk. Energinet.dk and the Danish Gas Technology Centre have calculated emission factors for 2000-2007. The emission factor applied for 1990-1999 refers to Fenhann & Kilde (1994). This emission factor was confirmed by the two major power plant operators in 1996 (Christiansen, 1996 and Andersen, 1996). Time-series for the CO_2 emission factors is provided in Table 3A-21.

[2] Former Gastra and before that part of DONG. Historical data refer to these companies.

Table 3A-21 CO_2 emission factor for natural gas.

Year	CO_2 emission factor kg pr GJ
1990-1999	56.9
2000	57.1
2001	57.25
2002	57.28
2003	57.19
2004	57.12
2005	56.96
2006	56.78
2007	56.78

LPG

The emission factor 65 kg pr GJ refers to Fenhann & Kilde (1994). The emission factor is based on the EEA Guidebook (EEA, 2004). The emission factor is somewhat higher than the IPCC default emission factor (63 kg pr GJ assuming full oxidation). The same emission factor is applied for 1990-2007.

Refinery gas

The emission factor applied for refinery gas is the same as the emission factor for natural gas 1990-1999. The emission factor is within the interval of the emission factor for refinery gas stated in the EMEP/CORINAIR Guidebook (EEA, 2007). The same emission factor is applied for 1990-2007.

Biogas

The emission factor 83.6 kg pr GJ is based on a biogas with 65 % (vol.) CH_4 and 35 % (vol.) CO_2. Danish Gas Technology Centre has stated that this is a typical manure-based biogas as utilised in stationary combustion plants (Kristensen, 2001). The same emission factor is applied for 1990-2007.

5.6.3 CH_4

The CH_4 emission factors applied for 2007 are presented in Table 3A-22. In general, the same emission factors have been applied for 1990-2007. However, time-series have been estimated for both natural gas fuelled engines and biogas fuelled engines.

Emission factors for gas engines, gas turbines and CHP plants combusting wood, straw or municipal waste all refer to emission measurements carried out on Danish plants (Nielsen & Illerup, 2003). For natural gas fired gas engines the emission factor refers to an updated study (Nielsen et al., 2008). Most other emission factors refer to the EMEP/CORINAIR Guidebook (EEA, 2004).

Gas engines combusting natural gas or biogas accounts for approximately half the CH_4 emission from stationary combustion plants. The relatively high emission factor for gas engines is well-documented and further discussed below.

A time-series for the CH_4 emission factor for wood combustion in residential plants have not been estimated. Due to the increasing importance of this sector this will be considered in future inventories.

Table 3A-22 CH_4 emission factors 2007.

Fuel group	Fuel	IPCC sector	IPCC sector	SNAP	Emission factor, g pr GJ	Reference
BIOMASS	WOOD	1A1a	Electricity and heat production	010102, 010103, 010104	2	Nielsen & Illerup 2003
				010202, 010203	32	EEA 2004
		1A2	Industry	030100, 030102, 030103	32	EEA 2004
		1A4a	Commercial/Institutional	020100, 020105	200	EEA 2004
		1A4b i	Residential	020200	200	EEA 2004
		1A4c i	Agriculture/Forestry	020300	200	EEA 2004
	STRAW	1A1a	Electricity and heat production	010101, 010102, 010103, 010104	0,5	Nielsen & Illerup 2003
				010202, 010203	32	EEA 2004
		1A4b i	Residential	020200	200	EEA 2004
		1A4c i	Agriculture/Forestry	020300	200	EEA 2004
				020302	32	EEA 2004
	FISH & RAPE OIL	1A1a	Electricity and heat production	010101, 010102, 010103, 010202, 010203	1,5	EEA 2004, assuming same emission factor as for gas oil
		1A2	Industry	030105	1,5	EEA 2004, assuming same emission factor as for gas oil
		1A4a	Commercial/Institutional	020105	1,5	EEA 2004, assuming same emission factor as for gas oil
	BIOGAS	1A1a	Electricity and heat production	010102, 010103, 010203	4	EEA 2004
				010105, 010205	323	Nielsen & Illerup 2003
		1A1c	Other energy industries	010505	323	Nielsen & Illerup 2003
		1A2	Industry	030100, 030102	4	EEA 2004
				030105	323	Nielsen & Illerup 2003
		1A4a	Commercial/Institutional	020100, 020103	4	EEA 2004
				020105	323	Nielsen & Illerup 2003
		1A4c i	Agriculture/Forestry	020300	4	EEA 2004
				020304	323	Nielsen & Illerup 2003
OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010102, 010103	0,59	Nielsen & Illerup 2003
				010203	6	EEA 2004
		1A4a	Commercial/Institutional	020103	6	EEA 2004
GAS	NATURAL GAS	1A1a	Electricity and heat production	010100, 010101, 010102, 010202	6	DGC 2001
				010103, 010203	15	Gruijthuijsen & Jensen 2000
				010104 (Gas turbines)	1,5	Nielsen & Illerup 2003
				010105, 010205 (Gas engines)	465	Nielsen et al. 2008
		1A1c	Other energy industries	010504 (Gas turbines)	1,5	Nielsen & Illerup 2003
				010505 (Gas engines)	465	Nielsen et al. 2008
		1A2	Industry	030100	6	DGC 2001
				030103	15	Gruijthuijsen & Jensen 2000
				030104 (Gas turbines)	1,5	Nielsen & Illerup 2003
				030105 (Gas engines)	465	Nielsen et al. 2008
		1A4a	Commercial/Institutional	020100	6	DGC 2001
				020103	15	Gruijthuijsen & Jensen 2000
				020104 (Gas turbines)	1,5	Nielsen & Illerup 2003
				020105 (Gas engines)	465	Nielsen et al. 2008
		1A4b i	Residential	020200	6	DGC 2001
				020202	15	Gruijthuijsen & Jensen 2000
				020204 (Gas engines)	465	Nielsen et al. 2008
		1A4c i	Agriculture/Forestry	020300	6	DGC 2001
				020303 (Gas turbines)	1,5	Nielsen & Illerup 2003
				020304 (Gas engines)	465	Nielsen et al. 2008
LIQUID	PETROLEUM COKE	1A4a	Commercial/Institutional	020100	15	EEA 2004
		1A4b i	Residential	020200	15	EEA 2004
	RESIDUAL OIL	1A1a	Electricity and heat production	010101, 010102, 010104, 010202, 010203	3	EEA 2004
		1A1b	Petroleum refining	010306	3	EEA 2004
		1A2	Industry	030100, 030102	3	EEA 2004
		1A4a	Commercial/Institutional	020100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004
		1A4c i	Agriculture/Forestry	020300, 020302	3	EEA 2004
	GAS OIL	1A1a	Electricity and heat production	010101, 010102, 010103, 010104, 010105, 010201, 010202, 010203, 010204, 010205	1,5	EEA 2004
		1A1b	Petroleum refining	010306	1,5	EEA 2004
		1A1c	Other energy industries	010505	1,5	EEA 2004
		1A2	Industry	030100, 030102, 030104	1,5	EEA 2004
		1A4a	Commercial/Institutional	020100, 020103, 020105	1,5	EEA 2004
		1A4b i	Residential	020200	1,5	EEA 2004
		1A4c i	Agriculture/Forestry	020304	1,5	EEA 2004
	KEROSENE	1A2	Industry	030100	7	EEA 2004
		1A4a	Commercial/Institutional	020100	7	EEA 2004
		1A4b i	Residential	020200	7	EEA 2004
		1A4c i	Agriculture/Forestry	020300	7	EEA 2004
	LPG	1A2	Industry	030100	1	EEA 2004
		1A4a	Commercial/Institutional	020100, 020105	1	EEA 2004
		1A4b i	Residential	020200	1	EEA 2004
		1A4c i	Agriculture/Forestry	020300	1	EEA 2004
	REFINERY GAS	1A1b	Petroleum refining	010304, 010306	1,5	EEA 2004
SOLID	COAL	1A1a	Electricity and heat production	010101, 010102	1,5	EEA 2004

Fuel group	Fuel	IPCC sector	IPCC sector	SNAP	Emission factor, g pr GJ	Reference
Continued						
				010202	15	EEA 2004
		1A2	Industry	030100	15	EEA 2004
		1A4b i	Residential	020200	15	EEA 2004
		1A4c i	Agriculture/Forestry	020300	15	EEA 2004
	COKE OVEN COKE	1A2	Industry	030100	15	EEA 2004, assuming same emission factor as for coal
		1A4b i	Residential	020200	15	EEA 2004, assuming same emission factor as for coal

CHP plants

A considerable part of the electricity production in Denmark is based on decentralised CHP plants, and well-documented emission factors for these plants are, therefore, of importance. In a project carried out for the electricity transmission company in Western Denmark, Eltra, emission factors for CHP plants <25MW_e have been estimated. The work was reported in 2003 (Nielsen & Illerup, 2003).

The work included municipal waste incineration plants, CHP plants combusting wood and straw, natural gas and biogas-fuelled (reciprocating) engines, and natural gas fuelled gas turbines. CH_4 emission factors for these plants all refer to Nielsen & Illerup (2003). The estimated emission factors were based on existing emission measurements as well as on emission measurements carried out within the project. The number of emission data sets was comprehensive. Emission factors for subgroups of each plant type were estimated, e.g. the CH_4 emission factor for different gas engine types has been determined.

A study conducted in 2006/2007 produced updated emission factors for natural gas powered gas engines including start/stop emissions (Nielsen et al., 2008). Ongoing work will update emission factors for all CHP plants. In addition oil fuelled engines are included in this project.

Gas engines, natural gas

SNAP 010105, 010205, 010505, 030105, 020105, 020204 and 020304

The emission factor for natural gas engines refer to the Nielsen et al (2008). Emission factor time-series up till 2006 have been estimated. However the full load emission factors up till year 2000 on which the time-series is based refer to Nielsen & Illerup (2003). These two references are discussed below.

Nielsen & Illerup (2003):

> *The emission factor for natural gas engines was based on 291 emission measurements in 114 different plants. The plants from which emission measurements were available represented 44 % of the total gas consumption in gas engines (year 2000). The emission factor was estimated based on fuel consumption for each gas engine type and the emission factor for each engine type. The majority of emission measurements that were not performed within the project related solely to the emission of total unburned hydrocarbon (CH_4 + NMVOC). A constant disaggregation factor was estimated based on a number of emission measurements including both CH_4 and NMVOC.*

Nielsen et al. (2008):

The new study (Nielsen et al., 2008) calculated a start/stop correction factor. This factor was applied to the time-series estimated in Nielsen & Illerup, 2003. Further a new full load emission factors for 2006 was estimated. A full load time-series for the years 2000-2006 was estimated and the same start/stop correction factors applied for all years.

The emission factor for lean-burn gas engines is relatively high, especially for pre-chamber engines, which account for more than half the gas consumption in Danish gas engines. However, the emission factors for different pre-chamber engine types differ considerably.

The installation of natural gas engines in decentralised CHP plants in Denmark has taken place since 1990. The first engines installed were relatively small open-chamber engines and, in later years, mainly pre-chamber engines were installed. As mentioned above, pre-chamber engines have a higher emission factor than open-chamber engines; therefore, the emission factor has changed during the period 1990-2006. The time-series was based on:

- Emission factors for different engine types
- Data for year of installation for each engine and fuel consumption of each engine 1994-2002 from the Danish Energy Authority (DEA 2003)
- Research concerning the CH_4 emission from gas engines carried out in 1997 (Nielsen & Wit, 1997)

Table 3A-23 Time-series for the CH_4 emission factor for natural gas fuelled engines.

Year	Emission factor g pr GJ
1990	266
1991	309
1992	359
1993	562
1994	623
1995	632
1996	615
1997	551
1998	542
1999	541
2000	537
2001	537
2002	537
2003	537
2004	513
2005	489
2006	465
2007	465

Gas engines, biogas
SNAP 010105, 010505, 020105, 020304 and 030105

The emission factor for biogas engines was estimated to 323 g pr GJ in 2000 and the same emission factor has been applied for 2001 - 2007. The emission factor for biogas engines was based on 18 emission measurements on 13 different plants. The plants from which emission measurements were available represented 18 % of the total gas consumption in gas engines (year 2000).

The emission factor is lower than the factor for natural gas, mainly because most engines are lean-burn open-chamber engines - not pre-chamber engines. A time-series for the emission factor has been estimated (Nielsen & Illerup 2003).

Table 3A-24 Time-series for the CH_4 emission factor for biogas fuelled engines.

Year	Emission factor g pr GJ
1990	239
1991	251
1992	264
1993	276
1994	289
1995	301
1996	305
1997	310
1998	314
1999	318
2000	323
2001	323
2002	323
2003	323
2004	323
2005	323
2006	323
2007	323

Gas turbines, natural gas

SNAP 010104, 010504, 020104, 020303 and 030104

The emission factor for gas turbines was estimated to be below 1.5 g pr GJ and the emission factor 1.5 g pr GJ has been applied for all years. The emission factor was based on emission measurements on 9 plants.

CHP, wood

SNAP 010102 and, 010103 and 010104

The emission factor for CHP plants combusting wood was estimated to be below 2.1 g pr GJ and the emission factor 2 g pr GJ has been applied for all years. The emission factor was based on emission measurements on 3 plants.

CHP, straw

SNAP 010102 and 010103

The emission factor for CHP plants combusting straw was estimated to be below 0.5 g pr GJ and the emission factor 0.5 g pr GJ has been applied for all years. The emission factor was based on emission measurements on 4 plants.

CHP, municipal waste

SNAP 010102, 010103, 010104 and 010105

The emission factor for CHP plants combusting municipal waste was estimated to be below 0.59 g pr GJ and the emission factor 0.59 g pr GJ has been applied for all years. The emission factor was based on emission measurements on 16 plants.

Other stationary combustion plants

Emission factors for other plants refer to the EEA Guidebook (EEA 2007 and EEA 2004), the Danish Gas Technology Centre (DGC, 2001) or Gruijthuijsen & Jensen (2000). The same emission factors are applied for 1990-2007.

5.6.4 N_2O

The N_2O emission factors applied for the 2007 inventory are listed in Table 3A-25. The same emission factors have been applied for 1990-2007.

Emission factors for gas engines, gas turbines and CHP plants combusting wood, straw or municipal waste all refer to emission measurements carried out on Danish plants (Nielsen & Illerup 2003). Emission factor for coal-powered plants in the public power sector refers to research conducted by Elsam (now part of DONG Energy). Other emission factors refer to the EEA Guidebook (EEA, 2007).

Table 3A-25 N_2O emission factors 1990-2007.

Fuel group	Fuel	IPCC sector	IPCC sector	SNAP	Emission factor g pr GJ	Reference
BIOMASS	WOOD	1A1a	Electricity and heat production	010102, 010103, 010104 010202, 010203	0,8 4	Nielsen & Illerup 2003 EEA 2004
		1A2	Industry	all	4	EEA 2004
		1A4a	Commercial/Institutional	all	4	EEA 2004
		1A4b i	Residential	020200	4	EEA 2004
		1A4c i	Agriculture/Forestry	020300	4	EEA 2004
	STRAW	1A1a	Electricity and heat production	010101, 010102, 010103, 010104 010202, 010203	1,4 4	Nielsen & Illerup 2003 EEA 2004
		1A4b i	Residential	020200	4	EEA 2004
		1A4c i	Agriculture/Forestry	all	4	EEA 2004
	FISH & RAPE OIL	1A1a	Electricity and heat production	all	2	EEA 2004, assuming same emission factor as gas oil
		1A2	Industry	030105	2	EEA 2004, assuming same emission factor as gas oil
		1A4a	Commercial/Institutional	020105	2	EEA 2004, assuming same emission factor as gas oil
	BIOGAS	1A1a	Electricity and heat production	010102, 010103, 010203 010105, 010205 (Gas engines)	2 0,5	EEA 2004 Nielsen & Illerup 2003
		1A1c	Other energy industries	010505 (Gas engines)	0,5	Nielsen & Illerup 2003
		1A2	Industry	030100, 030102 030105 (Gas engines)	2 0,5	EEA 2004 Nielsen & Illerup 2003
		1A4a	Commercial/Institutional	020100, 020103 020105 (Gas engines)	2 0,5	EEA 2004 Nielsen & Illerup 2003
		1A4c i	Agriculture/Forestry	020300 020304 (Gas engines)	2 0,5	EEA 2004 Nielsen & Illerup 2003
OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010102, 010103 010203	1,2 4	Nielsen & Illerup 2003 EEA 2004
		1A4a	Commercial/Institutional	020103	4	EEA 2004
GAS	NATURAL GAS	1A1a	Electricity and heat production	010100, 010101, 010102, 010103, 010202, 010203 010104 (Gas turbines) 010105, 010205 (Gas engines)	1 2,2 1,3	EEA 2004 Nielsen & Illerup 2003 Nielsen et al. 2008
		1A1c	Other energy industries	010504 (Gas turbines) 010505 (Gas engines)	2,2 1,3	Nielsen & Illerup 2003 Nielsen et al. 2008
		1A2	Industry	030100, 030103 030104 (Gas turbines) 030105 (Gas engines)	1 2,2 1,3	EEA 2004 Nielsen & Illerup 2003 Nielsen et al. 2008
		1A4a	Commercial/Institutional	020100, 020103 020104 (Gas turbines)	1 2,2	EEA 2004 Nielsen & Illerup 2003
				020105 (Gas engines)	1,3	Nielsen et al. 2008
		1A4b i	Residential	020200, 020202	1	EEA 2004

Continued						
				020204 (Gas engines)	1,3	Nielsen et al. 2008
		1A4c i	Agriculture/Forestry	020300 020303 (Gas turbines) 020304 (Gas engines)	1 2,2 1,3	EEA 2004 Nielsen & Illerup 2003 Nielsen et al. 2008
LIQUID	PETROLEUM COKE	1A4a	Commercial/Institutional	020100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004
	RESIDUAL OIL	1A1a	Electricity and heat production	all	2	EEA 2004
		1A1b	Petroleum refining	010306	2	EEA 2004
		1A2	Industry	all	2	EEA 2004
		1A4a	Commercial/Institutional	020100	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/Forestry	all	2	EEA 2004
	GAS OIL	1A1a	Electricity and heat production	all	2	EEA 2004
		1A1b	Petroleum refining	010306	2	EEA 2004
		1A1c	Other energy industries	010505	2	EEA 2004
		1A2	Industry	all	2	EEA 2004
		1A4a	Commercial/Institutional	all	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/Forestry	020304	2	EEA 2004
	KEROSENE	1A2	Industry	030100	2	EEA 2004
		1A4a	Commercial/Institutional	020100	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/Forestry	020300	2	EEA 2004
	LPG	1A2	Industry	030100	2	EEA 2004
		1A4a	Commercial/Institutional	all	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/Forestry	020300	2	EEA 2004
	REFINERY GAS	1A1b	Petroleum refining	010304, 010306	2,2	Nielsen & Illerup 2003, assuming same emission factor as for natural gas
SOLID	COAL	1A1a	Electricity and heat production	010101, 010102 010202	0,8 3	Elsam 2005 EEA 2004
		1A2	Industry	030100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004
		1A4c i	Agriculture/Forestry	020300	3	EEA 2004
	COKE OVEN COKE	1A2	Industry	030100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004

5.6.5 SO_2, NO_x, NMVOC and CO

Emission factors for SO_2, NO_x, NMVOC and CO are listed in Appendix 3A-5. The appendix includes references and time-series.

The emission factors refer to:

- The EMEP/CORINAIR Guidebook (EEA 2004 and EEA 2007)
- The IPCC Guidelines, Reference Manual (IPCC, 1997)
- Danish legislation:
  - Miljøstyrelsen, 2001 (Danish Environmental Protection Agency)
  - Miljøstyrelsen, 1990 (Danish Environmental Protection Agency)
  - Miljøstyrelsen, 1998 (Danish Environmental Protection Agency)
- Danish research reports including:
  - An emission measurement program for decentralised CHP plants (Nielsen & Illerup 2003)
  - Measurement program for natural gas powered gas engines (Nielsen et al., 2008)
  - Research and emission measurements programs for biomass fuels:
    - Nikolaisen et al., 1998
    - Jensen & Nielsen, 1990
    - Serup et al., 1999
  - Research and environmental data from the gas sector:
    - Gruijthuijsen & Jensen (2000)
    - Danish Gas Technology Centre (DGC, 2001)
- Calculations based on plant-specific emissions from a considerable number of power plants (Nielsen, 2003).

- Calculations based on plant-specific emission data from a considerable number of municipal waste incineration plants. These data refer to annual environmental reports published by plant operators.
- Sulphur content data from oil companies and the Danish gas transmission company.
- Additional personal communication.

Emission factor time-series have been estimated for a considerable number of the emission factors. These are provided in Appendix 3A-5.

5.7 Disaggregation to specific industrial subsectors

The national statistics, on which the emission inventories are based, does not include a direct disaggregation to specific industrial subsectors. However, separate national statistics from Statistics Denmark includes a disaggregation to industrial subsectors. This part of the energy statistics is also included in the official energy statistics from the Danish Energy Authority.

Every other year Statistics Denmark collects fuel consumption data for all industrial companies of a considerable size. The deviation between the total fuel consumption from the Danish Energy Authority and the data collected by Statistics Denmark is rather small. Thus the disaggregation to industrial subsectors available from Statistics Denmark can be applied for estimating disaggregation keys for fuel consumption and emissions.

The industrial fuel consumption is considered in three aspects:

- Fuel consumption for transport. This part of the fuel consumption is not disaggregated to subsectors.
- Fuel consumption applied in power or district heating plants. Disaggregation of fuel and emissions is plant specific.
- Fuel consumption for other purposes. The total fuel consumption and the total emissions are disaggregated to subsectors.

All pollutants included in the Climate Convention reporting have been disaggregated to industrial subsectors.

6 Uncertainty

According to the IPCC Good Practice Guidance (IPCC, 2000) uncertainty estimates should be included in the annual National Inventory Report (NIR).

Uncertainty estimates include uncertainty with regard to the total emission inventory as well as uncertainty with regard to trends. The GHG emission from stationary combustion plants has been estimated with an uncertainty interval of ±8.5 % and the decrease in the GHG emission since 1990 has been estimated to be 8.5 % ± 2.1 %-age-points.

6.1 Methodology

6.1.1 Greenhouse gases

The Danish uncertainty estimates for GHGs are based on the tier 1 approach in IPCC Good Practice Guidance (IPCC, 2000). The estimates are based on uncertainties for emission factors and fuel consumption rates, respectively. The input data required for the uncertainty calculations are:

- Emission data for the base year and the last year
- Uncertainty for activity rates
- Uncertainty for emission factors

The uncertainty levels have been estimated for the following emission source subcategories within stationary combustion:

- CO_2 emission from each of the applied fuel categories
- CH_4 emission from gas engines
- CH_4 emission from all other stationary combustion plants
- N_2O emission from all stationary combustion plants

The separate uncertainty estimation for gas engine CH_4 emission and CH_4 emission from other plants does not follow the recommendations in the IPCC Good Practice Guidance. Disaggregation is applied, because in Denmark the CH_4 emission from gas engines is much larger than the emission from other stationary combustion plants, and the CH_4 emission factor for gas engines is estimated with a much smaller uncertainty level than for other stationary combustion plants.

Most of the applied uncertainty estimates for activity rates and emission factors are default values from the IPCC Reference Manual. A few of the uncertainty estimates are, however, based on national estimates.

Table 3A-26 Uncertainty rates for activity rates and emission factors.

IPCC Source category	Gas	Activity data uncertainty %	Emission factor uncertainty %
Stationary Combustion, Coal	CO_2	1 1)	5 3)
Stationary Combustion, BKB	CO_2	3 1)	5 1)
Stationary Combustion, Coke oven coke	CO_2	3 1)	5 1)
Stationary Combustion, Petroleum coke	CO_2	3 1)	5 1)
Stationary Combustion, Plastic waste	CO_2	5 4)	5 4)
Stationary Combustion, Residual oil	CO_2	2 1)	2 3)
Stationary Combustion, Gas oil	CO_2	4 1)	5 1)
Stationary Combustion, Kerosene	CO_2	4 1)	5 1)
Stationary Combustion, Orimulsion	CO_2	1 1)	2 3)
Stationary Combustion, Natural gas	CO_2	3 1)	1 3)
Stationary Combustion, LPG	CO_2	4 1)	5 1)
Stationary Combustion, Refinery gas	CO_2	3 1)	5 1)
Stationary combustion plants, gas engines	CH_4	2,2 1)	40 2)
Stationary combustion plants, other	CH_4	2,2 1)	100 1)
Stationary combustion plants	N_2O	2,2 1)	1000 1)

1) IPCC Good Practice Guidance (default value).
2) Kristensen (2001).
3) Jensen & Lindroth (2002).
4) NERI assumption.

6.1.2 Other pollutants

With regard to other pollutants, IPCC methodologies for uncertainty estimates have been adopted for the LRTAP Convention reporting activities (Pulles & Aardenne, 2003). The Danish uncertainty estimates are based on the simple tier 1 approach.

The uncertainty estimates are based on emission data for the base year and year 2007 as well as on uncertainties for fuel consumption and emission factors for each of the main SNAP sectors. The base year is 1990. The applied uncertainties for activity rates and emission factors are default values referring to Pulles & Aardenne (2003). The default uncertainties for emission factors are given in letter codes representing an uncertainty range. It has been assumed that the uncertainties were in the lower end of the range for all sources and pollutants. The applied uncertainties for emission factors are listed in Table 3A-27. The uncertainty for fuel consumption in stationary combustion plants was assumed to be 2 %.

Table 3A-27 Uncertainty rates for emission factors, %.

SNAP sector	SO_2	NO_x	NMVOC	CO
01	10	20	50	20
02	20	50	50	50
03	10	20	50	20

6.2 Results

The uncertainty estimates for stationary combustion emission inventories are shown in Table 3A-28. Detailed calculation sheets are provided in Appendix 3A-9.

The uncertainty interval for GHG is estimated to be ±8.5 % and the trend in GHG emission is -8.5 %±2.1 %-age points. The main sources of uncertainty for GHG emission are N_2O emission (all plants) and CO_2 emission from coal combustion. The main source of uncertainty in the trend in GHG emission is CO_2 emission from the combustion of coal and natural gas and N_2O emission (all plants).

The total emission uncertainty is 7 % for SO_2, 16 % for NO_x, 44 % for NMVOC and 43 % for CO.

Table 3A-28 Danish uncertainty estimates, 2007.

Pollutant	Uncertainty Total emission, %	Trend 1990-2007, %	Uncertainty Trend, %-age points
GHG	8.5	-8,5	±2.1
CO_2	2.9	-9,6	±1.5
CH_4	54	256	±169
N_2O	1000	15,2	±3.6
SO_2	7.1	-87	±0.7
NO_x	16	-46	±3
NMVOC	44	+109	±6
CO	43	+22	±4

7 QA/QC and verification

The elaboration of a formal QA/QC plan started in 2004. A first version is available, Sørensen et al., 2005.

The quality manual describes the concepts of quality work and definitions of sufficient quality, critical control points and a list of Point for Measuring (PM). Please see the general chapter on QA/QC.

The work on expanding the QC will be ongoing in future years.

Data storage level 1

Table 3A-29 List of external data sources.

Dataset	Description	AD or Emf.	Reference	Contact(s)	Data agreement/ Comment
Energiproducenttællingen.xls	Data set for all electricity and heat producing plants.	Activity data	The Danish Energy Authority (DEA)	Peter Dal	Data agreement in place
Gas consumption for gas engines and gas turbines 1990-1994		Activity data	DEA	Peter Dal	No data agreement. Historical data
Basic data (Grunddata.xls)	Data set used for IPCC reference approach	Activity data	DEA	Peter Dal	Not necessary. Published as part of national energy statistics
Energy statistics	The Danish energy statistics on SNAP level	Activity data	DEA	Peter Dal	Data agreement in place
SO_2 & NO_x data, plants>25 MW_e		Emissions	DEA	Marianne Nielsen	No data agreement in place
Emission factors	Emission factors stems from a large number of sources	Emission factors	See chapter regarding emission factors		
Environmental reports	Emissions from plants defined as large point sources	Emissions	Various plants		No data agreement necessary. Plants are obligated by law.
Additional data	Fuel consumption and emissions from large industrial plants	AD & emissions	Aalborg Portland Statoil Shell	Henrik M. Thomsen Peder Nielsen Lis R. Rasmussen	No formal data agreement in place

Data Storage level 1	1. Accuracy	DS.1.1.1	General level of uncertainty for every dataset including the reasoning for the specific values

Since the DEA are responsible for the official Danish energy statistics as well as reporting to the IEA, NERI regards the data as being complete and in accordance with the official Danish energy statistics and IEA reporting. The uncertainties connected with estimating fuel consumption do not, therefore, influence the accordance between IEA data, the energy statistics and the dataset on SNAP level utilised by NERI. For the remainder of the datasets, it is assumed that the level of uncertainty is relatively low. For further comments regarding uncertainties, see Chapter 7.

Data Storage level 1	1. Accuracy	DS.1.1.2	Quantification of the uncertainty level of every single data value including the reasoning for the specific values.

The uncertainty for external data is not quantified. The uncertainties of activity data and emission factors are quantified see Chapter 7.

Data Storage level 1	2.Comparability	DS.1.2.1	Comparability of the data values with similar data from other countries, which are comparable with Denmark, and evaluation of discrepancy.

On the external data the comparability has not been checked. However, at CRF level a project has been carried out comparing the Danish inventories with those of other countries.

Data Storage level 1	3.Completeness	DS.1.3.1	Documentation showing that all possible national data sources are included by setting up the reasoning for the selection of datasets.

See the above Table 3A-29 for an overview of external datasets.

Danish Energy Authority

Statistic on fuel consumption from district heating and power plants
A spreadsheet from DEA listing fuel consumption of all plants included as large point sources in the emission inventory. The statistic on fuel consumption from district heating and power plants is regarded as complete and with no significant uncertainty since the plants are bound by law to report their fuel consumption and other information.

Gas consumption for gas engines and gas turbines 1990-1994
For the years 1990-1994 DEA has estimated consumption of natural gas and biogas in gas engines and gas turbines. NERI assesses that the estimation by the DEA are the best available data.

Basic data
A spreadsheet from DEA used for the CO_2 emission calculation in accordance with the IPCC reference approach. It is published annually on DEA's webpage; therefore, a formal data delivery agreement is not deemed necessary.

Energy statistics on SNAP level
The DEA reports fuel consumption statistics on SNAP level based on a correspondence table developed in co-operation with NERI. Both traded and non-traded fuels are included in the Danish energy statistics. Thus, for example, estimation of the annual consumption of non-traded wood is included. Petroleum coke, purchased abroad and combusted in Danish residential plants (border trade), is added to the apparent consumption of petroleum coke and the emissions are included in the inventory.

Emissions from non-energy use of fuels have been included in other sectors of the Danish inventory. The non-energy use of fuels is, however, included in the reference approach for Climate Convention reporting.

SO_2 and NO_x emission data from electricity producing plants > 25MWe

Plants larger than 25 MW_e are obligated to report emission data for SO_2 and NO_x to the DEA annually. Data is on block level and are classified. The data on plant level are part of the plants annually environmental reports. NERI's QC of the data consists of a comparison with data from previous years and with data from the plants' annual environmental reports.

Emission factors from a wide range of sources

For specific references, see the chapter regarding emission factors.

Annual environmental reports from plants defined as large point sources

A large number of plants are obligated by law to publish an environmental report annually with information on, among other things, emissions. NERI compares data with those from previous years large discrepancies are checked.

Supplementing data from large industrial combustion plants

Fuel consumption and emissions from a few large industrial combustion plants are obtained directly from the plants. NERI compares the data with those from previous years and large discrepancies are checked.

Data Storage level 1	4.Consistency	DS.1.4.1	The origin of external data has to be preserved whenever possible without explicit arguments (referring to other PM's)

It is ensured that all external data are archived at NERI. Subsequent data processing takes place in other spreadsheets or databases. The datasets are archived annually in order to ensure that the basic data for a given report are always available in their original form.

Data Storage level 1	6.Robustness	DS.1.6.1	Explicit agreements between the external institution of data delivery and NERI about the condition of delivery

For stationary combustion a data delivery agreement is made with the DEA. Most of the other external data sources are available due to legislatory requirements. See Table 3A-29.

Data Storage level 1	7.Transparency	DS.1.7.1	Summary of each dataset including the reasoning for selecting the specific dataset

See DS 1.3.1

Data Storage level 1	7.Transparency	DS.1.7.3	References for citation for any external data set have to be available for any single number in any dataset.

See Table 3A-29 for general references. Much documentation already exists. However, some of the information used is classified and therefore not publicly available.

Data Storage level 1	7.Transparency	DS.1.7.4	Listing of external contacts for every dataset

See Table 3A-29.

Data Processing Level 1

Data Processing level 1	1. Accuracy	DP.1.1.1	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to type of variability. (Distribution as: normal, log normal or other type of variability)

The uncertainty assessment of activity data and emission factors and discussed in the chapter concerning uncertainties.

Data Processing level 1	1. Accuracy	DP.1.1.2	Uncertainty assessment for every data source as input to Data Storage level 2 in relation to scale of variability (size of variation intervals)

The uncertainty assessment of activity data and emission factors are discussed in the chapter concerning uncertainties.

Data Processing level 1	1. Accuracy	DP.1.1.3	Evaluation of the methodological approach using international guidelines

The methodological approach is consistent with international guidelines.

Data Processing level 1	1. Accuracy	DP.1.1.4	Verification of calculation results using guideline values

Calculated emission factors are compared with guideline emission factors to ensure that they are within reason.

Data Processing level 1	2.Comparability	DP.1.2.1	The inventory calculation has to follow the international guidelines suggested by UNFCCC and IPCC.

The calculations follow the principle in international guidelines.

Data Processing level 1	3.Completeness	DP.1.3.1	Assessment of the most important quantitative knowledge which is lacking.

Regarding the distribution of energy consumption for industrial sources, a more detailed and frequently updated data material would be preferred. There is ongoing work to increase the accuracy and completeness of this sector. It is not assessed that this has any influence on the emission of greenhouse gases.

Data Processing level 1	3.Completeness	DP.1.3.2	Assessment of the most important cases where accessibility to critical data sources that could improve quantitative knowledge is missing.

There is no missing accessibility to critical data sources.

Data Processing level 1	4.Consistency	DP.1.4.1	In order to keep consistency at a higher level, an explicit description of the activities needs to accompany any change in the calculation procedure.

A change in calculation procedure would entail that an updated description would be elaborated.

Data Processing level 1	5.Correctness	DP.1.5.1	Show at least once, by independent calculation, the correctness of every data manipulation.

During data processing it is checked that calculations are done correctly. However, documentation for this needs to be elaborated.

Data Processing level 1	5.Correctness	DP.1.5.2	Verification of calculation results using time-series

A time-series for activity data on SNAP level, as well as emission factors, is used to identify possible errors in the calculation procedure.

Data Processing level 1	5.Correctness	DP.1.5.3	Verification of calculation results using other measures

The IPCC reference approach validates the fuel consumption rates and CO_2 emissions of fuel combustion. Fuel consumption rates and CO_2 emissions differ by less than 1.7 % (1990-2006). The reference approach is further discussed below.

Data Processing level 1	5.Correctness	DP.1.5.4	Show one-to-one correctness between external data sources and the databases at Data Storage level 2.

There is a direct line between the external datasets, the calculation process and the input data used to Data Storage level 2. During the calculation process numerous controls are in place to ensure correctness, e.g. sum checks of the various stages in the calculation procedure.

Data Processing level 1	7.Transparency	DP.1.7.1	The calculation principle and equations used must be described.
Data Processing level 1	7.Transparency	DP.1.7.2	The theoretical reasoning for all methods must be described.
Data Processing level 1	7.Transparency	DP.1.7.3	Explicit listing of assumptions behind all methods

Where appropriate, this is included in the present report with annexes.

Data Processing level 1	7.Transparency	DP.1.7.4	Clear reference to dataset at Data Storage level 1

There is a clear line between the external data and the data processing.

Data Processing level 1	7.Transparency	DP.1.7.5	A manual log to collect information about recalculations

At present, a manual log table is not in place on this level. However, this feature will be implemented in the future. A manual log table is incorporated in the national emission database, Data Storage level 2.

Data Storage level 2	5.Correctness	DS.2.5.1	Documentation of a correct connection between all data types at level 2 to data at level 1

To ensure a correct connection between data on level 2 to data on level 1, different controls are in place, e.g. control of sums and random tests.

Data Storage level 2	5.Correctness	DS.2.5.2	Check if a correct data import to level 2 has been made.

Data import is checked by use of sum control and random testing. The same procedure is applied every year in order to minimise the risk of data import errors.

Other QC procedures

The emission from each large point source is compared with the emission reported the previous year.

Some automated checks have been prepared for the emission databases:

- Check of units for fuel rate, emission factors and plant-specific emissions
- Check of emission factors for large point sources. Emission factors for pollutants that are not plant-specific should be the same as those defined for area sources.
- Additional checks on database consistency
- Most emission factor references are now incorporated in the emissions database, itself.
- Annual environmental reports are kept for subsequent control of plant-specific emission data.

- QC checks of the country-specific emission factors have not been performed, but most factors are based on input from companies that have implemented some QA/QC work. The major power plant owner/operators in Denmark, DONG Energy has obtained the ISO 14001 certification for an environmental management system. The Danish Gas Technology Centre and Force both run accredited laboratories for emission measurements.

Suggested QA/QC plan for stationary combustion

The following points make up the list of QA/QC tasks to be carried out directly in relation to the stationary combustion part of the Danish emission inventories. The time plan for the individual tasks has not yet been made.

Data storage level 1

A fully comprehensive list of references for emission factors and activity data.

A comparison with external data from other countries in order to evaluate discrepancies.

Data processing level 1

Documentation list of model and independent calculations to test every single mathematical relation

7.1 Reference approach

In addition to the sector-specific CO_2 emission inventories (the national approach), the CO_2 emission is also estimated using the reference approach described in the IPCC Reference Manual (IPCC, 1997). The reference approach is based on data for fuel production, import, export and stock change. The CO_2 emission inventory based on the reference approach is reported to the Climate Convention and used for verification of the official data in the national approach.

Data for import, export and stock change used in the reference approach originate from the annual "basic data" table prepared by the Danish Energy Authority and published on their home page (DEA, 2008b). The fraction of carbon oxidised has been assumed to be 1.00. The carbon emission factors are default factors originating from the IPCC Reference Manual (IPCC, 1997). The country-specific emission factors are not used in the reference approach, the approach being for the purposes of verification.

The Climate Convention reporting tables include a comparison of the national approach and the reference approach estimates. To make results comparable, the CO_2 emission from incineration of the plastic content of municipal waste is added in the reference approach while the fuel consumption is subtracted.

Three fuels are used for non-energy purposes: lube oil, bitumen and white spirit. The total consumption for non-energy purposes is relatively low – 13.2 PJ in 2007.

In 2007 the fuel consumption rates in the two approaches differ by -0.44 % and the CO_2 emission differs by -0.004 %. In the period 1990-2007 both the fuel consumption and the CO_2 emission differ by less than 1.7 %. The differences are below 1 % for all years except 1998 and 2006. According to IPCC Good Practice Guidance (IPCC, 2000) the difference should be within 2 %. A comparison of the national approach and the reference approach is illustrated in Figure 3A-36.

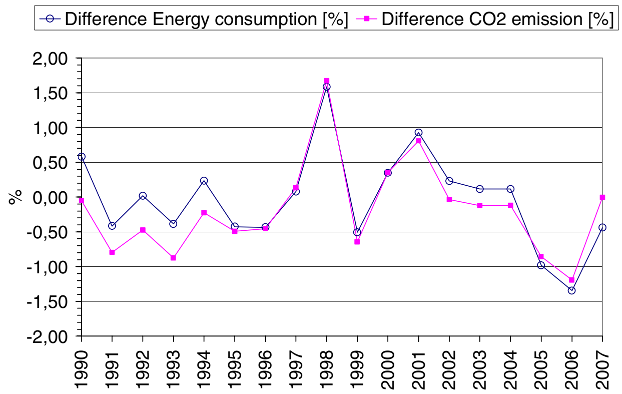


Figure 3A-36 Comparison of the reference approach and the national approach.

7.2 External review

The 2005 and 2007 updates of the sector report for stationary combustion were reviewed by Jan Erik Johnsson from the Technical University of Denmark and Bo Sander from Elsam Engineering. This annex is based on an update of the sector report that has not yet been reviewed (March 2009).

7.3 Key source analysis

7.3.1 Greenhouse gases

The reporting of the Danish GHG emission includes a key source analysis. A key source is a source that has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emission, the trend in emissions, or both.

This year the key source analysis for stationary combustion plants have been improved and now follow Tier 1 approach of the 2006 IPCC Guidelines (IPCC, 2006). Further a separate key source analysis has been estimated for stationary combustion.

The aggregation level of the key source analysis is shown in Table 3A-30. Emission of CH_4 from gas engines have been treated as a separate source due to the fact that the emission factor for gas engines is much higher for gas engines than for other plants. The uncertainty estimates also treats gas engines separately.

Table 3A-30 Aggregation level for key source analysis.

Category Code	Category Title	Gas	Disaggregation level for fuel
1A1	Energy Sector	CO_2	Disaggregation to all fuel types
1A2	Industry	CO_2	
1A4	Other Sectors	CO_2	
1A1	Energy Sector	CH_4	Disaggregation to mail fuel types: Solid, Liquid, Gas and Biomass
1A2	Industry	CH_4	
1A4	Other Sectors	CH_4	
1A1, 1A2 and 1A4	Natural gas fuelled engines	CH_4	-
1A1, 1A2 and 1A4	Biogas fuelled engines	CH_4	-
1A1	Energy Sector	N_2O	Disaggregation to mail fuel types: Solid, Liquid, Gas and Biomass
1A2	Industry	N_2O	
1A4	Other Sectors	N_2O	

Emission from key sources adds up to 95 % of the total emission. The key sources for stationary combustion plants are shown below. Most of the key sources are key sources for both level (1990 and 2007) and trend. Detailed calculation sheets are shown in Appendix 3A-13.

All emission level key sources are CO_2 emissions. CO_2 emission from coal combustion in the energy sector (1A1) is the largest source of GHG emission accounting for 50 % of the emission in 2007. CH_4 emission from natural gas fuelled reciprocating engines is a emission trend key source. All other trend key sources are CO_2 emissions. The largest trend key sources are CO_2 emission from combustion of coal and natural gas in *1A1 Energy Sector* and combustion of gas oil in *1A4 Other Sectors*.

Several of the key sources are also key sources in the Danish inventory as a whole (Nielsen et al. 2009).

Table 3A-31 Key source analysis.

IPCC Category Code	IPCC Category	Fuel	Greenhouse gas	Identification criteria[1)]	Comments
1A1	Energy Sector	COAL	CO_2	$L1_{2007}$, $L1_{1990}$, T1	Level 2007: 50 %, Level 1990: 59 %, Trend 21 %
1A1	Energy Sector	NATURAL GAS	CO_2	$L1_{2007}$, $L1_{1990}$, T1	Trend 25 %
1A4	Other Sectors	NATURAL GAS	CO_2	$L1_{2007}$, $L1_{1990}$, T1	
1A2	Industry	NATURAL GAS	CO_2	$L1_{2007}$, $L1_{1990}$, T1	
1A4	Other Sectors	GAS OIL	CO_2	$L1_{2007}$, $L1_{1990}$, T1	Trend 16 %
1A1	Energy Sector	RESIDUAL OIL	CO_2	$L1_{2007}$, $L1_{1990}$, T1	
1A1	Energy Sector	REFINERY GAS	CO_2	$L1_{2007}$, $L1_{1990}$, T1	
1A2	Industry	PETROLEUM COKE	CO_2	$L1_{2007}$, T1	
1A2	Industry	COAL	CO_2	$L1_{2007}$, $L1_{1990}$, T1	
1A2	Industry	RESIDUAL OIL	CO_2	$L1_{2007}$, $L1_{1990}$, T1	
1A1	Energy Sector	PLASTIC WASTE	CO_2	$L1_{2007}$, $L1_{1990}$, T1	
1A4	Other Sectors	KEROSENE	CO_2	$L1_{1990}$, T1	
1A1, 1A2 and 1A4	Natural gas fuelled engines	NATURAL GAS	CH_4	T1	

L1: Level, Tier 1 approach, T1: Trend, Tier 1 approach.

The key source analysis will be implemented as part of the QA/QC in future inventories.

8 Recalculations since reporting in 2008

Improvements and recalculations since the 2008 emission inventory submission include:

- The national energy statistics has been updated for the years 1990-2006. This has primarily resulted in small differences, however a larger recalculation of the residential wood consumption was made by the DEA resulting in higher emissions of a number of air pollutants in 2006.
- Data from the EU ETS has been utilised for the second time in the 2009 inventory submission. It was mainly coal and residual oil fuelled power plants where detailed information was available. One of the reports for 2007 was judged by NERI to be incorrect, and therefore not incorporated in the 2007 inventory. Following this the 2006 report for the same plant, which was also an outlier, was removed from the inventory.
- Based on the centralised review in September 2008 several improvements have been made to the NIR.
  - An improved documentation for the use of town gas has been included in the NIR.
  - An improved documentation concerning emissions from non-energy use of fuels has been incorporated.
  - The documentation for the use of EU ETS data has been improved.
  - Improved documentation for QA/QC of plant specific emission factors. (In connection with EU ETS data)
- The NMVOC emission factor for straw in residential plants has been updated to reflect the value provided in the EMEP/Corinair Guidebook (EEA, 2007). The emission factor was reduced from 600 g pr GJ to 400 g pr GJ. This change was made for the whole time-series.
- The emission factor for CO for residential wood combustion was updated based on the technology distribution of stoves and boilers together with default emission factors from the EMEP/Corinair Guidebook (EEA, 2007). This reduced the emissions factor from 6000 g pr GJ to 3441 g pr GJ in 2007. A time-series for the emission factor was elaborated.

9 Planned improvements

Some planned improvements to the emission inventories are discussed below.

1) Improved documentation for emission factors
The reporting of, and references for, the applied emission factors will be further developed in future inventories. This will on the advice of the ERT include further QA/QC checks on plant specific emission factors.

2) Uncertainty estimates
Uncertainty estimates are based mainly on default uncertainty levels for activity rates and emission factors. More country-specific uncertainty estimates will be incorporated for greenhouse gases in future inventories.

3) Further use of EU ETS data
The use of data from the EU ETS will continue and hopefully be expanded as more companies will provide detailed information, which can be utilised in the emission inventory.

4) Emission factors for CHP plants
Updated emission factors for CHP plants will be estimated this year and will be applied in the next inventory.

10 Conclusion

The annual Danish emission inventories are prepared and reported by NERI. The inventories are based on the Danish energy statistics and on a set of emission factors for various sectors, technologies and fuels. Plant-specific emissions for large combustion sources are incorporated in the inventories.

Since 1990 fuel consumption has increased by 12 % - fossil fuel consumption, however, decreased by 2 %. The use of coal has decreased whereas the use of natural gas and renewable fuels has increased. The fuel consumption for stationary combustion plants fluctuates due to variation in the import/export of electricity from year to year.

Stationary combustion plants account for more than 50 % of the national emission of CO_2 and SO_2. Furthermore, the emission from stationary combustion plants accounts for more than 10 % of the national emission of NO_x, CO and NMVOC. Stationary combustion plants account for less than 10 % of the national CH_4 and N_2O emission.

Public electricity and heat production are the most important stationary combustion emission source for CO_2, N_2O, SO_2 and NO_x.

Lean-burn gas engines installed in decentralised CHP plants and combustion of biomass in residential plants are the two largest emission sources for CH_4.

Residential plants represent the most important stationary combustion source for CO and NMVOC. Wood combustion in residential plants is the predominant emission source.

The greenhouse gas emission (GHG) development follows the CO_2 emission development closely. Both the CO_2 and the total GHG emission were lower in 2007 than in 1990: CO_2 by 10 % and GHG by 9 %. However fluctuations in the GHG emission level are great. The fluctuations in the time-series are a result of electricity import/export and of outdoor temperature variations from year to year.

The CH_4 emission from stationary combustion increased by a factor of 3.6 since 1990. This is mainly a result of the considerable number of lean-burn gas engines installed in CHP plants in Denmark during the 1990-ties. In resent years the emission has declined. This is due to structural changes in the Danish electricity market, which means that the fuel consumption in gas engines has been decreasing. The CH_4 emission from residential plants has increased since 1990 due to increased combustion of wood in residential plants.

The emission of N_2O was 16 % higher in 2007 than in 1990. The fluctuations follows the fluctuations of the fuel consumption that is a result of import/export of electricity.

SO_2 emission from stationary combustion plants has decreased by 87 % since 1990. The considerable emission decrease is mainly a result of the reduced emission from electricity and heat production due to installation of desulphurisation technology and the use of fuels with lower sulphur content.

The NO_x emission from stationary combustion plants has decreased by 46 % since 1990. The reduced emission is mainly a result of the reduced emission from electricity and heat production that is a result of installation of low NO_x burners and selective catalytic reduction (SCR) units. The fluctuations in the emission time-series follow fluctuations in electricity import/export.

Wood consumption in residential plants 2007 is 4.1 times the 1990 level. This has caused a considerable increase in the emission of CO and NMVOC. A change of technology (installation of modern stoves) has however caused decreasing emission factors for both pollutants.

The CO emission has increased by 22 % from 1990 to 2007. The increase in CO emission from residential plants is less than the increase in wood consumption, because the CO emission factor for wood combustion in residential plants decreased since 1990. Furthermore the emission from straw-fired farmhouse boilers has decreased considerably.

The NMVOC emission from stationary combustion plants has increased 109 % from 1990. The increased NMVOC emission is mainly a result of the increasing wood combustion in residential plants and the increased use of lean-burn gas engines. The emission from straw-fired farmhouse boilers has decreased.

The uncertainty level of the Danish greenhouse gas emission from stationary combustion is estimated to be within a range of ±8.5 % and the trend in GHG emission is -8.5 % ± 2.1 %-age points.

References

Andersen, M.A. 1996: Elkraft, personal communication letter 07-05-1996.

Bech, N. 1999: Personal communication, letter 05-11-1999, Sjællandske Kraftværker, SK Energi.

Berdowski, J.J.M., Veldt, C., Baas, J., Bloos, J.P.J. & Klein, A.E. 1995: Technical Paper to the OSPARCOM-HELCOM-UNECE Emission Inventory of heavy Metals and Persistent Organic Pollutants, TNO-report, TNO-MEP – R 95/247.

CEPMEIP, 2001: The **C**o-ordinated **E**uropean Programme on **P**articulate **M**atter **E**mission **I**nventories, **P**rojections and Guidance. Available at: http://www.air.sk/tno/cepmeip/ (2009-03-03).

Christiansen, M. 1996: Elsam, personal communication, letter 07-05-1996.

Christiansen, M. 2001: Elsam, personal communication, e-mail 23-08-2001 to Jytte Boll Illerup.

Danish Energy Authority (DEA), 2003: Data for installation and fuel consumption for each gas engine 1994-2002. Not published.

Danish Energy Authority (DEA), 2008a: The Danish energy statistics aggregated to SNAP sectors. Not published.

Danish Energy Authority (DEA), 2008b: The Danish energy statistics, Available at: http://www.ens.dk/graphics/UK_Facts_Figures/Statistics/yearly_statistics/2007/BasicData2007.xls (2009-03-03).

Danish Energy Authority (DEA), 2008c: The Danish energy statistics, Energiproducenttællingen 2003. Not published.

Danish Gas Technology Centre (DGC), 2001: Naturgas – Energi og miljø (In Danish). Available at: http://www.dgc.dk/publikationer/rapporter/data/PDF/enermilbroch.pdf (2009-03-03).

European Environment Agency (EEA), 2007: EMEP/CORINAIR Emission Inventory Guidebook – 2007, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections. Technical Report No 16/2007.Available at: http://www.eea.europa.eu/publications/EMEPCORINAIR5 (2009-03-03). Older versions can be linked from this page.

Fenhann, J., Kilde, N.A., 1994: Inventory of Emissions to the air from Danish Sources 1972-1992, RISØ.

Finstad, A., Haakonsen, G., Kvingedal, E. & Rypdal, K. 2001: Utslipp til luft av noen miljøgifter i Norge, Dokumentasjon av metode og resultater, Statistics Norway Report 2001/17 (In Norwegian).

Gruijthuijsen, L.v. & Jensen, J.K. 2000: Energi- og miljøoversigt, Danish Gas Technology Centre 2000 (In Danish). Available at: http://www.dgc.dk/publikationer/rapporter/data/PDF/energi_og_miljoedata.pdf (2009-03-03).

Henriksen, T.C., Illerup, J.B. & Nielsen, O.-K. 2006: Dioxin Air Emission Inventory 1990-2004. National Environmental Research Institute, Denmark. 90 pp. – NERI Technical report no 602. Available at: http://www2.dmu.dk/Pub/FR602.pdf (2009-03-03).

Hulgaard, T. 2003: Personal communication, e-mail 02-10-2003, Rambøll.

Illerup, J.B., Geertinger, A., Hoffmann, L. & Christiansen, K., 1999: Emissionsfaktorer for tungmetaller 1990-1996. Danmarks Miljøundersøgelser. 66 s. – Faglig rapport fra DMU nr. 301. (In Danish) Available at: http://www2.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/fr301.pdf (2009-03-03).

Nielsen, O.-K., Lyck, E., Mikkelsen, M.H., Hoffmann, L., Gyldenkærne, S., Winther, M., Nielsen, M., Fauser, P., Thomsen, M., Plejdrup, M.S., Illerup, J.B., Sørensen, P.B. & Vesterdal, L. 2008a: Denmark's National Inventory Report 2008 - Emission Inventories 1990-2006 - Submitted under the United Nations Framework Convention on Climate Change. National Environmental Research Institute, University of Aarhus. 701 pp. – NERI Technical Report no. 667. Available at: http://www2.dmu.dk/Pub/FR667.pdf (2009-03-03).

Nielsen, O-K., Winther, M., Mikkelsen, M.H., Hoffmann, L., Nielsen, M., Gyldenkærne, S., Fauser, P., Jensen, M.T., Plejdrup, M.S. & Illerup, J.B. 2008b: Annual Danish Emission Inventory Report to UNECE. Inventories from the base year of the protocols to year 2006. National Environmental Research Institute, University of Aarhus. 504 pp. – NERI Technical Report No. 675. Available at: http://www.dmu.dk/Pub/FR675.pdf (2009-03-03).

IPCC, 1997: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3). Available at: http://www.ipcc-nggip.iges.or.jp/public/gl/invs6.html (2009-03-03).

Intergovernmental Panel on Climate Change (IPCC), 2000: Penman, J., Kruger, D., Galbally, I., Hiraishi, T., Nyenzi, B., Emmanuel, S., Buendia, L., Hoppaus, R., Martinsen, T., Meijer, J., Miwa, K. & Tanabe, K. (Eds). Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Published: IPCC/OECD/IEA/IGES, Hayama, Japan. Available: http://www.ipcc-nggip.iges.or.jp/public/gp/english/index.html (2009-03-03).

Jensen, B.G. & Lindroth, M. 2002: Kontrol af indberetning af CO_2-udledning fra el-producenter i 2001, Carl Bro for Energistyrelsens 6. Kontor (in Danish).

Jensen, J. 2001: Danish Gas Technology Centre, Personal communication e-mail 11-10-2001.

Jensen, L. & Nielsen, P.A. 1990: Emissioner fra halm- og flisfyr, dk-Teknik & Levnedsmiddelstyrelsen 1990 (In Danish).

Jensen, L. & Nielsen, P.B. 1996: Emissioner fra halm- og flisfyr, Arbejdsrapport fra Miljøstyrelsen nr 5 1996, Bilagsrapport (In Danish).

Jørgensen, L. & Johansen, L. P. 2003: Eltra PSO 3141, Kortlægning af emissioner fra decentrale kraftvarmeværker, Anlæg A1-A5, dk-Teknik (In Danish). Available at: http://www.energinet.dk/da/menu/Forskning/ForskEL-programmet/Projekter/Afsluttede/Projekt+3141.htm (2009-03-03).

Kristensen, P.G. 2001: Personal communication, e-mail 10-04-2001, Danish Gas Technology Centre.

Livbjerg, H. Thellefsen, M. Sander, B. Simonsen, P., Lund, C., Poulsen, K. & Fogh, C.L. 2001: Feltstudier af Forbrændingsaerosoler, EFP -98 Projekt, Aerosollaboratoriet DTU, FLS Miljø, Forskningscenter Risø, Elsam, Energi E2 (in Danish).

Miljøstyrelsen, 1990: Bekendtgørelse om begrænsning af emissioner af svovl-dioxid, kvælstofoxider og støv fra store fyringsanlæg, Bekendtgørelse 689 af 15/10/1990, (Danish legislation).

Miljøstyrelsen, 1998: Bekendtgørelseom begrænsning af svovlindholdet i visse flydende og faste brændstoffer, Bekendtgørelse 698 af 22/09/1998 (Danish legislation).

Miljøstyrelsen, 2001: Luftvejledningen, Begrænsning af luftforurening fra virksomheder, Vejledning fra Miljøstyrelsen nr. 2 2001 (Danish legislation).

Nielsen, M. & Illerup, J.B. 2003: Emissionsfaktorer og emissionsopgørelse for decentral kraftvarme. Eltra PSO projekt 3141. Kortlægning af emissioner fra decentrale kraftvarmeværker. Delrapport 6. Danmarks Miljøundersøgelser. 116 s. –Faglig rapport fra DMU nr. 442. (In Danish, with an English summary). Available at: http://www2.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR442.pdf (2009-03-03).

Nielsen M., 2003. Estimates based on a large number of plant specific emission data. Not published.

Nielsen, M. Winther, M., Illerup, J.B. & Mikkelsen, M.H. 2003: Danish emission inventory for particulate matter (PM). National Environmental Research Institute, Denmark. 126 p. – Research Notes from NERI No. 189. Available at:

http://www2.dmu.dk/1_viden/2_Publikationer/3_arbrapporter/rapporter/AR189.pdf (2009-03-03).

Nielsen, M. & Wit, J. 1997: Emissionsforhold for gasdrevne kraftvarmeænlæg < $25MW_e$, Miljøstyrelsen, Arbejdsrapport Nr. 17 1997 (In Danish). Available at: http://www2.mst.dk/Udgiv/publikationer/1997/87-7810-759-8/pdf/87-7810-759-8.pdf (2009-03-03).

Nielsen, M., Illerup, J.B. & Birr-Petersen, K. 2008: Revised emission factors for gas engines including start/stop emissions. Sub-report 3 (NERI). National Environmental Research Institute, University of Aarhus. 69 pp. - NERI Technical Report No. 672. Available at: http://www.dmu.dk/Pub/FR672.pdf (2009-02-27).

Nikolaisen, L., Nielsen, C., Larsen, M.G., Nielsen, V. Zielke, U., Kristensen, J.K. & Holm-Christensen, B. 1998: Halm til energiformål, Teknik – Miljø – Økonomi, 2. udgave, 1998, Videncenter for halm og flisfyring (In Danish).

Pulles, T. & Aardenne,. J.v. 2004: Good Practice Guidance for LRTAP Emission Inventories, 24. Juni 2004. Available at: http://www.eea.europa.eu/publications/EMEPCORINAIR5/BGPG.pdf (2009-03-03).

Sander, B. 2003: Personal communication, e-mail 11-10-2003.

Serup, H., Falster, H., Gamborg, C., Gundersen, P., Hansen, L. Heding, N., Jacobsen, H.H., Kofman, P., Nikolaisen, L. & Thomsen, I.M. 1999: Træ til energiformål, Teknik – Miljø – Økonomi, 2. udgave, 1999, Videncenter for halm og flisfyring (In Danish).

Sternhufvud, C., Karvosenoja, N., Illerup, J., Kindbom, K., Lükewille, A., Johansson, M., & Jensen, D. 2007: Particulate matter emissions and abatement options in residential wood burning in the Nordic countries.

EU Commission, 2004: COMMISSION DECISION of 29 January 2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. Available in English: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:059:0001:0074:EN:PDF. Official translation to Danish with comments available: http://www.ens.dk/graphics/Energipolitik/dansk_energipolitik/CO2_kvoter/publ/Vejledning %20om %20CO2-kvoteordningen_dec08.pdf

Kristensen, P., 2007: Danish Gas Technology Centre, Per Kristensen, personal communication.

Jeppesen, J.S., 2008: København energi (Copenhagen Energy), Jørgen Steen Jeppesen, personal communication.

KE, 2009: København energi (Copenhagen Energy) fact sheet on town gas. Available at: http://www.ke.dk/portal/pls/portal/docs/346012.PDF

KEMIN, 2008: Ministry of Climate and Energy. Law on CO_2 quotas, nr. 348 of 09/05/2008. (Danish legislation – only available in Danish) https://www.retsinformation.dk/Forms/R0710.aspx?id=117147 (2009-03-01).

Appendix

Appendix 3A-1:	The Danish emission inventory for the year 2007 reported to the Climate Convention in 2009
Appendix 3A-2:	IPCC/SNAP source correspondence list
Appendix 3A-3:	Fuel rate
Appendix 3A-4:	Lower Calorific Value (LCV) of fuels
Appendix 3A-5:	Emission factors
Appendix 3A-6:	Implied emission factors for power plants and municipal waste incineration plants
Appendix 3A-7:	Large point sources
Appendix 3A-8:	Adjustment of CO_2 emission
Appendix 3A-9:	Uncertainty estimates
Appendix 3A-10:	Reference approach
Appendix 3A-11:	Emission inventory 2007 based on SNAP sectors
Appendix 3A-12:	Description of the Danish energy statistics
Appendix 3A-13:	Key source analysis

Appendix 3A-1 The Danish emission inventory for the year 2007 reported to the Climate Convention

Table 3A-32 The Danish emission inventory for the year 2007 reported to the Climate Convention in 2009 (Nielsen et al. 2009a).

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		Net CO_2 emissions/removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6	
					P	A	P	A	P	A
		(Gg)			CO_2 equivalent (Gg)				(Gg)	
Total National Emissions and Removals		**51.085,18**	**273,70**	**20,79**	**792,13**	**840,00**	**5,46**	**15,36**	**0,01**	**0,00**
1. Energy		**51.493,70**	**28,32**	**1,48**						
A. Fuel Combustion	Reference Approach [2]	51.125,03								
	Sectoral Approach [2]	51.127,06	22,21	1,47						
1. Energy Industries		25.132,33	9,18	0,48						
2. Manufacturing Industries and Construction		5.686,05	0,97	0,19						
3. Transport		13.985,63	1,23	0,45						
4. Other Sectors		6.148,19	10,82	0,35						
5. Other		174,87	0,01	0,01						
B. Fugitive Emissions from Fuels		366,64	6,11	0,00						
1. Solid Fuels		NA,NO	NA,NO	NA,NO						
2. Oil and Natural Gas		366,64	6,11	0,00						
2. Industrial Processes		**1.647,03**	**IE,NA,NO**	**IE,NA,NO**	**792,13**	**840,00**	**5,46**	**15,36**	**0,01**	**0,00**
A. Mineral Products		1.606,93	IE,NA	IE,NA						
B. Chemical Industry		2,16	NA,NO	NA,NO	NA	NA	NA	NA	NA	NA
C. Metal Production		NA,NO	NA,NO	NO				NO		NO
D. Other Production [3]		NE								
E. Production of Halocarbons and SF_6						NA,NO		NO		NO
F. Consumption of Halocarbons and SF_6					792,13	840,00	5,46	15,36	0,01	0,00
G. Other		37,94	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
3. Solvent and Other Product Use		**87,08**		**0,12**						
4. Agriculture			**182,60**	**19,04**						
A. Enteric Fermentation			132,69							
B. Manure Management			49,90	1,68						
C. Rice Cultivation			NO							
D. Agricultural Soils[4]			NE,NO	17,36						
E. Prescribed Burning of Savannas			NA	NA						
F. Field Burning of Agricultural Residues			NA,NO	NA,NO						
G. Other			NA	NA						
5. Land Use, Land-Use Change and Forestry		**-2.142,63**	**-0,02**	**0,00**						
A. Forest Land		-2.977,03	NO	NO						
B. Cropland		764,08	NA	NA						
C. Grassland		84,09	NA	NA						
D. Wetlands		-13,77	-0,02	0,00						
E. Settlements		NA,NE	NA,NE	NA,NE						
F. Other Land		NA,NE	NA,NE	NA,NE						
G. Other		NE	NE	NE						
6. Waste		**IE,NA,NE,NO**	**62,80**	**0,15**						
A. Solid Waste Disposal on Land		NA,NE,NO	50,62							
B. Waste-water Handling			12,18	0,15						
C. Waste Incineration		IE	IE	IE						
D. Other		NO	NO	NO						
7. Other *(please specify)* [7]		**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: [8]										
International Bunkers		**6.260,43**	**0,14**	**0,32**						
Aviation		2.701,41	0,05	0,09						
Marine		3.559,02	0,09	0,22						
Multilateral Operations		**NO**	**NO**	**NO**						
CO_2 Emissions from Biomass		**12.106,13**								

Appendix 3A-2 IPCC/SNAP source correspondence list

Table 3A-33 Correspondence list for IPCC sectors 1A1, 1A2 and 1A4 and SNAP (EEA, 2007).

SNAP_id	SNAP_name	IPCC source
01	Combustion in energy and transformation industries	
010100	Public power	1A1a
010101	Combustion plants >= 300 MW (boilers)	1A1a
010102	Combustion plants >= 50 and < 300 MW (boilers)	1A1a
010103	Combustion plants < 50 MW (boilers)	1A1a
010104	Gas turbines	1A1a
010105	Stationary engines	1A1a
010200	District heating plants	1A1a
010201	Combustion plants >= 300 MW (boilers)	1A1a
010202	Combustion plants >= 50 and < 300 MW (boilers)	1A1a
010203	Combustion plants < 50 MW (boilers)	1A1a
010204	Gas turbines	1A1a
010205	Stationary engines	1A1a
010300	Petroleum refining plants	1A1b
010301	Combustion plants >= 300 MW (boilers)	1A1b
010302	Combustion plants >= 50 and < 300 MW (boilers)	1A1b
010303	Combustion plants < 50 MW (boilers)	1A1b
010304	Gas turbines	1A1b
010305	Stationary engines	1A1b
010306	Process furnaces	1A1b
010400	Solid fuel transformation plants	1A1c
010401	Combustion plants >= 300 MW (boilers)	1A1c
010402	Combustion plants >= 50 and < 300 MW (boilers)	1A1c
010403	Combustion plants < 50 MW (boilers)	1A1c
010404	Gas turbines	1A1c
010405	Stationary engines	1A1c
010406	Coke oven furnaces	1A1c
010407	Other (coal gasification, liquefaction, ...)	1A1c
010500	Coal mining, oil/gas extraction, pipeline compressors	
010501	Combustion plants >= 300 MW (boilers)	1A1c
010502	Combustion plants >= 50 and < 300 MW (boilers)	1A1c
010503	Combustion plants < 50 MW (boilers)	1A1c
010504	Gas turbines	1A1c
010505	Stationary engines	1A1c
02	Non-industrial combustion plants	
020100	Commercial and institutional plants (t)	1A4a
020101	Combustion plants >= 300 MW (boilers)	1A4a
020102	Combustion plants >= 50 and < 300 MW (boilers)	1A4a
020103	Combustion plants < 50 MW (boilers)	1A4a
020104	Stationary gas turbines	1A4a
020105	Stationary engines	1A4a
020106	Other stationary equipments (n)	1A4a
020200	Residential plants	1A4b
020201	Combustion plants >= 50 MW (boilers)	1A4b
020202	Combustion plants < 50 MW (boilers)	1A4b
020203	Gas turbines	1A4b
020204	Stationary engines	1A4b
020205 [2)]	Other equipments (stoves, fireplaces, cooking,...) [2)]	1A4b
020300	Plants in agriculture, forestry and aquaculture	1A4c
020301	Combustion plants >= 50 MW (boilers)	1A4c
020302	Combustion plants < 50 MW (boilers)	1A4c
020303	Stationary gas turbines	1A4c
020304	Stationary engines	1A4c
020305	Other stationary equipments (n)	1A4c
03	Combustion in manufacturing industry	
030100	Comb. in boilers, gas turbines and stationary	1A2
030101	Combustion plants >= 300 MW (boilers)	1A2
030102	Combustion plants >= 50 and < 300 MW (boilers)	1A2
030103	Combustion plants < 50 MW (boilers)	1A2
030104	Gas turbines	1A2
030105	Stationary engines	1A2
030106	Other stationary equipments (n)	1A2
030200	Process furnaces without contact	
030203	Blast furnace cowpers	1A2a
030204	Plaster furnaces	1A2f
030205	Other furnaces	1A2f
0303	Processes with contact	
030301	Sinter and pelletizing plants	1A2a

Continued		
030302	Reheating furnaces steel and iron	1A2a
030303	Gray iron foundries	1A2a
030304	Primary lead production	1A2b
030305	Primary zinc production	1A2b
030306	Primary copper production	1A2b
030307	Secondary lead production	1A2b
030308	Secondary zinc production	1A2b
030309	Secondary copper production	1A2b
030310	Secondary aluminium production	1A2b
030311	Cement (f)	1A2f
030312	Lime (includ. iron and steel and paper pulp industr.)(f)	1A2f
030313	Asphalt concrete plants	1A2f
030314	Flat glass (f)	1A2f
030315	Container glass (f)	1A2f
030316	Glass wool (except binding) (f)	1A2f
030317	Other glass (f)	1A2f
030318	Mineral wool (except binding)	1A2f
030319	Bricks and tiles	1A2f
030320	Fine ceramic materials	1A2f
030321	Paper-mill industry (drying processes)	1A2d
030322	Alumina production	1A2b
030323	Magnesium production (dolomite treatment)	1A2b
030324	Nickel production (thermal process)	1A2b
030325	Enamel production	1A2f
030326	Other	1A2f
08 1)	Other mobile sources and machinery	
0804 1)	Maritime activities	
080403 1)	National fishing	1A4c
0806 1)	Agriculture	1A4c
0807 1)	Forestry	1A4c
0808 1)	Industry	1A2f
0809 1)	Household and gardening	1A4b

1) Not stationary combustion. Included in a IPCC sector that also includes stationary combustion plants.

2) Stoves, fireplaces and cooking is included in the sector 0202 or 020202 in the Danish inventory. It is not possible based on the Danish energy statistics to split the residential fuel consumption between stoves/fireplaces/cooking and residential boilers.

Appendix 3A-3 Fuel rate

Table 3A-34 Fuel consumption rate of stationary combustion plants 2007, GJ.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
BIOGAS	752001	910000	898999	1077001	1279488	1753645	1985110	2390005	2635029	2612573
BROWN COAL BRI.	115931	166823	95324	128246	91500	74609	56053	54331	47745	37607
COAL	253443653	344299909	286838436	300798816	323397473	270346013	371908020	276277338	234284903	196471581
COKE OVEN COKE	1275912	1449734	1181054	1154538	1226146	1272909	1226000	1253015	1346306	1422574
FISH & RAPE OIL	744000	744000	744000	800000	245419	250912	60409	13751	13619	27148
GAS OIL	61449256	64998154	56102476	62025402	53930105	53698269	58018611	51071033	48425146	47555370
KEROSENE	5086021	943393	783765	771272	649577	580777	539748	436636	417009	255606
LPG	2596144	2548699	2315050	2370506	2398317	2638278	2869571	2362592	2412781	2176932
MUNICIP. WASTES (Biomass part)	11064760	11953565	13158042	14565777	15242992	17532500	19377316	20788826	20649637	22627957
NAPHTA	0	0	0	0	0	0	0	0	0	0
NATURAL GAS	76092457	86106669	90466659	102475053	114585627	132698559	156276599	164489313	178706886	187876815
ORIMULSION	0	0	0	0	0	19913113	36766527	40488416	32580001	34190632
PETROLEUM COKE	4459523	4403568	4814028	6179382	4308897	4849824	6381422	6523131	5797915	7283513
PLASTIC WASTE	4434273	4790468	4639209	4844130	5069352	5373824	5575124	5981235	5941188	6510378
REFINERY GAS	14169000	14537000	14865000	15405000	16359999	20837864	21476000	16945381	15225340	15723812
RESIDUAL OIL	32118474	38252201	38505343	32823098	46228742	33008720	37766205	26579997	29985354	23696332
SEWAGE SLUDGE	0	0	0	0	0	0	0	0	0	0
STRAW	12481150	13306150	13880150	13366000	12662374	13053145	13545634	13911770	13903701	13668183
WOOD	18246813	20042437	21030660	22220198	21939961	21844810	23389205	23459225	22937838	24402569
Grand Total	498529367	609452770	550318195	581004419	619615969	599727770	757217553	653025995	615310399	586539582

Year	2000	2001	2002	2003	2004	2005	2006	2007
BIOGAS	2870670	3020152	3331898	3545061	3451790	3930140	3978152	3914004
BROWN COAL BRI.	25748	32903	18922	3056	0	0	0	0
COAL	164707937	174308632	174654028	238978034	182496587	154007923	231965884	194145940
COKE OVEN COKE	1187177	1109591	1068454	995409	1143051	979704	1010558	1122307
FISH & RAPE OIL	49046	191475	126772	258882	650447	731501	970010	835389
GAS OIL	41260017	43667641	38673521	38955371	35918638	31852171	26797658	21809088
KEROSENE	169963	286786	256128	338430	214577	280244	221223	118877
LPG	1885313	1609877	1477458	1554215	1668540	1671309	1719997	1387805
MUNICIP. WASTES (Biomass part)	23570138	25102244	27224180	28339868	28910923	29057059	30961566	30669611
NAPHTA	0	0	0	0	0	0	0	0
NATURAL GAS	186121970	193826826	193608713	196322338	194677694	187700819	191122163	170874742
ORIMULSION	34148181	30243677	23846404	1921399	18719	0	0	0
PETROLEUM COKE	7291583	8313464	8281655	8716515	9380530	9340778	9719587	10415098
PLASTIC WASTE	6781457	7222265	7832775	8153774	8318075	8360120	8908073	8824074
REFINERY GAS	15556268	15755428	15197000	16554512	15890576	15347072	16115632	15916264
RESIDUAL OIL	18835569	21090663	26160841	28430623	24499899	21939523	26094472	21185578
SEWAGE SLUDGE	40162	375148	64508	55369	58266	58000	0	0
STRAW	12219993	13698193	15651212	16718510	17938819	18483159	18624816	18330862
WOOD	27521693	30866936	31630227	39002025	43649055	49797489	51475513	59935629
Grand Total	544242885	570721900	569104696	628843391	568886186	533537010	619685304	559485267

Table 3A-35 Detailed fuel consumption data for stationary combustion plants, GJ.

fuel_type	fuel_gr_abbr	NFR	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
BIOMASS	BIOGAS	1A1	Electricity and heat production	010100	141178	218984	29049	41826						
				010101					16910	419	24075	19550		
				010102					9835		94326	40561	50269	29597
				010103					54324	118012	79237	111449	86924	103711
				010104			78865	89233	199961	169040	6536			
				010105	94822	175016	251085	405941	415191	599387	826301	1229745	1548936	1500477
				010200	30000	30000	53000	53000						
				010203					45538	43775	54145	33623	31287	25003
				010205					40607					
			Other energy industries	010505	6803	6803	6803	6803	5946	51779	60257	57462	31144	29028
		1A2	Industry	030100					13014	126131	96199	117439	73558	32726
				030102					6534	16370	16478	19080	16361	16116
				030104						1052	1265	1137		
				030105									381	269
		1A4	Commercial/Institutional	020100	199072	179112	83895	64492	112893	169712	173026	271951	225094	292653
				020103							14474	39396	71226	74379
				020104						27092				
				020105	270479	290438	386655	406059	349088	410626	389678	404594	439292	436918
			Agriculture/Forestry	020300					2750	4455	132108	26121	34614	30392
				020304	9647	9647	9647	9647	6897	15795	17005	17897	25943	41304
	FISH & RAPE OIL	1A1	Electricity and heat production	010103					33707	24000	21799	188	5212	6974
				010200	744000	744000	744000	800000						
				010203					211712	226912	38610	13563	8407	20174
	STRAW	1A1	Electricity and heat production	010100	479000	985000	1487000	1643000						
				010101					100254	82215	610290	740153	1013770	1339800
				010102					621557	1286955,5	1704388	1845052	1751934,5	1819429
				010103					1126908	1297258	1361686	1174181	1180826	1058038
				010200	3524000	3843000	3915000	3806000						
				010201					22040					
				010202					57304	179930	114376	95990	136488	141564
				010203					3378461	3409001	3699694	3564019	3525786	3565456
		1A2	Industry	030100									446	446
				030103						3085				
		1A4	Residential	020200	5086890	5086890	5086890	4750200	4413510	4076820	3633120	3891945	3773190	3442590
			Agriculture/Forestry	020300	3391260	3391260	3391260	3166800	2942340	2717880	2422080	2594630	2515460	2295060
				020302								5800	5800	5800
	WOOD	1A1	Electricity and heat production	010100			172000	515000						
				010101					42966				263719	
				010102					1053223	865377	861821,3	1001257	1371873	2377322
				010103					623575	671570	578451	644712	575350	732058
				010104					78890	4410				
				010105										1674
				010200	3217000	3648000	4096000	3751000						
				010201					8537					
				010202					44	43575	164768	190941	207278	193907
				010203					3337730	3490933	3857403	3795439	3971995	3928219
		1A2	Industry	030100	5783743	5690367	5750550	5821715	4464819	4254327	4097885	4166034	4273637	4250138
				030102									1776	1496
				030103					481414	412555	623748	523545	412235	413749
		1A4	Commercial/Institutional	020100	204488	204488	204488	204488	216160	273035	449435	471415	492803	642041
				020105									2096	2057
			Residential	020200	8954432	10412432	10720472	11859632	11564240	11760665	12668890	12569082	11134265	11615182
			Agriculture/Forestry	020300	87150	87150	87150	68363	68363	68363	86804	96800	230244	230875
				020304									567	13851
GAS	NATURAL GAS	1A1	Electricity and heat production	010100								5511	21264	16787
				010101	4005027,6	4394781	3279455	4422200	8437973,09	10453815,7	12217008	14600070	20808855	21307826

fuel_type	fuel_gr_abbr	NFR	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
					3					2				
				010102					295111	299964	1346036	5620044	5987198	2416146
				010103					2487008	1775265	1558418	1138214	958646	716525
				010104	1859206	2396900	4806049	7327221	7776734	8547638,05	14500108,5	12220262	13002948	21614378
				010105	677767	1291319	2199496	4168579	8358415	16419956	22162423	24109208	26700713	26833951
				010200	11033000	13655000	12350000	11420000						
				010202					1072469	1017168	844253	660506	539227	282207
				010203					6160497	5525191	3803076	2420020	1988837	1873511
				010205					131795	338556	377124	230400	235829	226189
			Other energy industries	010502						399247,39	390587,25	417415	413342	409043
				010504	9482284	9703068	11118697	11235480	12267791	12506433	14849859	19454575	21636547	23561526
				010505	1760	3520	3520	3520	2570	4494	7551	4939	15340	13883
		1A2	Industry	030100	22280195	23780869	23887554	25535326	29248293	30317635	29252137	29423362	29114015	31167462
				030102					862925	2661778,52	2464664,75	2971625	2961903	3100115
				030103					300216	64308	146812	169825	131608	126872
				030104	506337	608907	664092	729919	761202	909952	2562511	3366152	5106083	6501018
				030105	187	187	187	187	11210	172920	873431	960232	1157405	1160055
				030106	136059	24239	37695	70154	53489	24415	15283	5288	31735	38608
				030315								924066	903336	1005440
				030318						624960	590400	620640	671040	686880
		1A4	Commercial/Institutional	020100	6376293	6934201	7382035	8908566	7343015	8436587	11247402	9106736	8661696	7525335
				020103					2177			2434	49460	10801
				020104					11946	25798	31397	25514	22995	30739
				020105	45985	88875	278287	350372	473892	609395	681480	866185	959184	985839
			Residential	020200	17362132	20432645	21439693	24903983	24736624	26947401	30412122	28361811	29137977	28981613
				020202							25676	24503	18059	31289
				020204		7932	499046	776351	1022812	1094868	1448246	1488432	1575546	1554382
			Agriculture/Forestry	020300	2222000	2680002	2385006	2462538	2485322	2559680	2666407	2644836	2476128	2241939
				020303							5959	26127	65805	77171
				020304	104224	104224	135847	160657	282141	961133	1796227	2620381	3354165	3379285
LIQUID	GAS OIL	1A1	Electricity and heat production	010100	239170	416396	641323	245263						
				010101					12386	51300	41614	194854	108730	258004
				010102					42898	30019	153012	113506	82184,29	158532
				010103					59149	40405	78104	41727	44468	61232
				010104	43987	43987	43987	43987	43987	75632	81094	54042	146795	60385
				010105	16843	32617	34690	34750	116493	136913	99083	100449	133710	108002
				010200	1941000	813000	744000	947000						
				010201					27268	7000				
				010202					174046	360676	799818,1	514978	418139	257831
				010203					843648	444369	554844	509625	652349	296296
				010205					717					1055
			Petroleum refining	010306		40029	44476	29125	49319	33321	21879	87482		
		1A2	Industry	030100	537931	1369948	1430556	951740	812691	1460371	2251856	1895198	1799389	2477807
				030102						3438			440	1327
				030103					1678	1453	11390	1015	1623	64
				030104								244	377	6787
				030105			1447	1578	1578					
				030106	6098	6636	8644	2762	9433	7030	6743	8178	15603	70265
				030315								1040	603	4950
		1A4	Commercial/Institutional	020100	11794783	10622868	9062255	9007046	7156617	6556065	6619841	6093376	5442142	5781168
				020102					190782		215		75	
				020103					72		57796	58202	53618	39101
				020105			1361	1485	733	20330	1754	294	21	66
			Residential	020200	46463224	50638393	42913606	49967084	43678618	43287857	45295557	39595464	37849748	35675468
			Agriculture/Forestry	020300	406220	1014280	1176131	793582	707992	1182090	1940156	1799028	1675132	2297030
				020302								7		
				020304							3855	2324		
	KEROSENE	1A2	Industry	030100	69635	45692	38315	35461	30485	24464	30937	27840	16078	8909

fuel_type	fuel_gr_abbr	NFR	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
		1A4	Commercial/Institutional	020100	569083	209843	206978	188910	154647	124344	103314	96459	127964	117233
			Residential	020200	4404777	659635	512024	520836	437788	410845	382564	287211	251843	118954
			Agriculture/Forestry	020300	42526	28223	26448	26065	26657	21124	22933	25126	21124	10510
	LPG	1A1	Electricity and heat production	010100		1000	1000	3000						
				010103						736				
				010200	9000	13000	10000							
				010203					2732					9
			Petroleum refining	010306			4600		8004	15042	20654	18492		
		1A2	Industry	030100	1576175	1689355	1588914	1450676	1557782	1737694	1920315	1596586	1623548	1355035
		1A4	Commercial/Institutional	020100	82757	77097	76519	122201	125183	131001	137989	128417	116413	109573
				020103									9	
				020105									803	771
			Residential	020200	669665	521639	442269	672725	588599	628367	653211	510109	545681	624403
			Agriculture/Forestry	020300	258547	246608	191748	121904	116017	125438	137402	108988	126327	87141
	ORIMULSION	1A1	Electricity and heat production	010101						19913113	36766527	40488416	32580001	34190632
	PETROLEUM COKE	1A1	Electricity and heat production	010100				1239000						
		1A2	Industry	030100	300247		56107	122868		98156	110026	33598	25842	38999
				030311	2499251,6	2991306	3234048	3230651,8	3469025	3707398	4966161,2	5229890	4774684	6398880
		1A4	Commercial/Institutional	020100	62023	104190	90150	96354	91988	70415	90528	97770	70544	50434
			Residential	020200	760877	697484	961122	990337	747884	734273	928841	839269	725791	705961
			Agriculture/Forestry	020300	837124	610588	472601	500171		239582	285866	322604	201054	89239
	REFINERY GAS	1A1	Electricity and heat production	010101							35204	40077		
			Petroleum refining	010300	458000	926000	1526000	15917						
				010304				2067083	2355000	2289700	5069590	4081532	2996106	4172606
				010306	13520108	13485940	13236820	13213580	14004999,1	18548163,6	16336521,6	12771044	12202506	11551206
		1A2	Industry	030100	190892	125060	102180	108420			34684	52728	26728	
	RESIDUAL OIL	1A1	Electricity and heat production	010100	774830	364138	1742448	741228						
				010101	7171572,6	10052580	8691120	8420050	22142391,6	11174240,6	16072213,3	7736420	11557361	7213503
				010102	42264,6	16950	27100	24390	180489,8	253891,4	443478,7	420683	510374,3	762923
				010103					252297	173028	201180	159318	115535	101551
				010104					320163	347198	237194	302167	355440	118177
				010105	9332	9332	9332	9332	11554	4323	4888	2415	5984	4136
				010200	2006000	2236000	1141000	879000						
				010202					134116	172981	171394,6	140565	102376	135957
				010203					858909	938696	1201058	874538	779146	961623
			Petroleum refining	010306	1309202	2038140	3568653	3490237	3336716,8	2333786,8	2244019,4	1622382	1106086	1089501
		1A2	Industry	030100	16531282	19002497	18556701	14527324	12587628	10217307	10610245	9222966	9120750	8682720
				030102					741775	911132,6	788577,5	789663	663124	695536
				030103					200248	207326	165590	122783	121633	135661
				030104								54439		
				030311	1762853,4	2152997	2366678	2397243,2	2618777	2840310,6	1771379	1863965	2538540	885967
		1A4	Commercial/Institutional	020100	1070494	865011	600545	517393	718786	677072	717757	729305	383913	450237
				020103					87533	78081				
			Residential	020200	216927	218605	167748	129878	95249	62794	66254	45933	43266	50365
			Agriculture/Forestry	020300	1223716	1295951	1634018	1687023	1942109	2616552	3070976	2492455	2563430	2396266
				020302									9051	1105
				020304									9345	11104
OTHER 1	MUNICIP. WASTES	1A1	Electricity and heat production	010100	706761	2543625,7	4123982,74	6328376,19						
				010101									1000233,809	992599,3489
				010102					3834791,854	4995772,689	5554763,664	8411444,358	9097580,918	13153371,81
				010103					2183493,152	2874282,127	3884839,572	2387482,925	1519788,648	3136573,219
				010104					1249719,595	1551907,436	2478786,59	2349269,469	2179406,43	1904687,803
				010200	9685481,3	8668173,8	8214695,63	7383480,77						

fuel_type	fuel_gr_abbr	NFR	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
				010201					5238,0014					
				010202					2605709,084	2834480,562	3607994,153	3610340,715	3585970,395	
				010203					4434077,748	4255021,63	2872498,261	3089448,622	2685493,992	2264006,742
		1A2	Industry	030100	20012,7587	20012,7587	27540,78183	29196,98001	19763,32448	21826,1464	21698,91894	18526,63049	22407,15078	27402,82559
		1A4	Commercial/Institutional	020100	652504,6	721752,9	791822,43	824722,57	887273,9122	975541,3354	949283,8274	916117,2993	551310,3401	1143611,928
				020103					22925,6365	23668,4642	7451,18915	6196,25203	7445,75316	5703,13008
SOLID	BROWN COAL BRI.	1A2	Industry	030100	4374	6680	3806	17714	2745	2031	1464	1025		
		1A4	Commercial/Institutional	020100	1025	1720		8217	769	622	421	309		
			Residential	020200	50600	66685	39107	80209	75963	62403	47324	48550	43847	37607
			Agriculture/Forestry	020300	59932	91738	52411	22106	12023	9553	6844	4447	3898	
	COAL	1A1	Electricity and heat production	010100	8523090	12892052	10175750	8221270						
				010101	219780959	303105248	252745120	269458670	295430107,5	244510483	347251766	252648133	211429498	176640613
				010102	2118950,9	2653700	2250130	2269060	8604698,5	8380812,5	9032904,5	8671429	9022776	8238010
				010103					837469	526213	149470	38928	24300	33747
				010104					272428	269521	301136	74422		
				010105					20360					
				010200	6017000	6635000	5173000	3581000						
				010201					153003	20286				
				010202					1112251	789684	199724	64713	17914	371
				010203					377837	316754	228340	48919	48071	6562
		1A2	Industry	030100	8850301	8977254	6751419	7698631	5866929	4832666	4460978	4494493	4676030	3714901
				030102					614624	1051344	1449890	1466575	1405667	1411682
				030103					190179	182609	192925	192444		
				030311	5018873,4	6048697	6577274	6602369	6913652	7224933,5	7067608,6	7209034	6627624	5638061
		1A4	Commercial/Institutional	020100	87539	9010	95877	75870	90286	66064	41260	43062	2306	
			Residential	020200	589051	1125243	866285	785646	618696	376644	85595	86470	127147	79262
			Agriculture/Forestry	020300	2457889	2853705	2203581	2106300	2294953	1797999	1446423	1238716	903570	708372
	COKE OVEN COKE	1A2	Industry	030100	1169318	1351052	1077654	1073318	1163151	286685	303658	295421	319382	380768
				030318						937440	885600	930960	1006560	1030320
		1A4	Residential	020200	106594	98682	103400	81220	62995	48784	36742	26634	20364	11486
	PLASTIC WASTE	1A1	Electricity and heat production	010100	283239	1019374,3	1454017,26	2104623,81						
				010101									287781,1915	285584,6511
				010102					1275334,146	1531236,311	1598182,836	2420089,642	2617500,682	3784408,185
				010103					726162,8479	880985,8728	1117722,428	686912,0749	437264,3518	902435,7809
				010104					415618,4047	475669,5642	713181,4102	675917,5314	627045,5704	548005,197
				010200	3881518,7	3473826,2	2896304,37	2455519,23						
				010201					1741,9986					
				010202					866578,9162	868786,4382	1038070,147	1038745,285	1031733,605	
				010203					1474638,252	1304191,37	826457,7391	888877,3782	772654,0076	651386,258
		1A2	Industry	030100	8020,2413	8020,2413	9710,21817	9710,01999	6572,67552	6689,8536	6243,08106	5330,36951	6446,84922	7884,17441
		1A4	Commercial/Institutional	020100	261495,4	289247,1	279177,57	274277,43	295080,0878	299009,6646	273122,1726	263579,7007	158619,6599	329033,0724
				020103					7624,3635	7254,5358	2143,81085	1782,74797	2142,24684	1640,86992

fuel_gr_abbr	NFR	nfr_name	snap_id	2000	2001	2002	2003	2004	2005	2006	2007
BIOGAS	1A1	Electricity and heat production	010102	25771	23338	20466	21787	16857	17439	16560	15827
			010103	134968	123991	90125	97272	78245	69932	105259	108688
			010105	1548734	1589322	1686300	1704661	1435085	1535656	1287413	1417509
			010203	21733	11129	12650	17130	23466	40546	17297	17601
			010205					36380	110366	155450	148721
		Other energy industries	010505	32507	28627	31216	31791	61257	100137	115743	98052
	1A2	Industry	030100	32593	27929	37953	33614	45593	142521	136853	145385
			030102	15755	59220	71672	95546	112700	48144	51665,74	34543,46
			030105	1487	23805	18459	14205	16947		103779	73148
	1A4	Commercial/Institutional	020100	310904	354917	424989	321897	426323	473892	578066	657955
			020103	86680	84512	74286	85295	101260	354647	137540	101606,4
			020105	506512	504222	528119	531465	517152	543650	501074	421085
		Agriculture/Forestry	020300	76487	80321	96277	134632	169187	84327	296083	325166
			020304	76539	108819	239386	455766	411338	408883	475369	348717
FISH & RAPE OIL	1A1	Electricity and heat production	010101								24669
			010102					521	1765		30122
			010103				2168	54570	151598	254209	276943
			010105					1819			
			010202				18807	4662	21230	23554	33200
			010203	48900	190810	126336	237665	588875	556556	691920	469419
	1A2	Industry	030100						193	5	
			030105			334	242		159	322	140
	1A4	Commercial/Institutional	020105								896
		Agriculture/Forestry	020304	146	665	102					
SEWAGE SLUDGE	1A2	Industry	030311	40162	375148	64508	55369	58266	58000		
STRAW	1A1	Electricity and heat production	010101	1119600	1587710	2643060	3191917	4366424	4088038	4421693	4473730
			010102	1826796	1746166	1640945	1712033	1815157	1765236	1488982,78	1448163
			010103	640340	1905033	1754340	1927521	1336411	1393993	1357693	1258569,5
			010104		101730	1215692	1706623	2476858	3118372	3174908,55	3098655
			010202	150510	97600			95414	95677	81998	88091
			010203	3290636	3418313	3555625	3338866	3007005	3180273	3257991	3122243
	1A2	Industry	030105	386	91						
	1A4	Residential	020200	3111555	2901450	2901450	2901450	2901450	2901450	2904930	2901450
		Agriculture/Forestry	020300	2074370	1934300	1934300	1934300	1934300	1934300	1936620	1934300
			020302	5800	5800	5800	5800	5800	5820		5660
WOOD	1A1	Electricity and heat production	010101		920	65930	304980	231380	1246768	694801	621639
			010102	2274825	2186568	3175531	5854505	5626990	5965503	6354629,61	6086336,5
			010103	669817	747047	780122,8	446474	1061917	1078638	1128621	897366
			010104			120031	1656898	4488031	4478887	2608712,53	3758121
			010105	53468	60394	61748	369				
			010202	179937	249689	164347	196112	620370	416918	600053	581146
			010203	3882223	4297719	4650874	5066279	4798365	5017547	5312447	5394838
	1A2	Industry	030100	4450170	4596137	3313464	3534374	3425751	3763358	3784171	4178948
			030102	955	950					8586	1062759
			030103	439542	430608	410827	294774	342172	527045	521165	146610
	1A4	Commercial/Institutional	020100	775926	665349	672399	680509	681209	816284	951627	1012405
			020105		97	796		110	145	338	1171
		Residential	020200	14624521	17483859	18067157	20855031	22274480	26399876	29423842	36107769
		Agriculture/Forestry	020300	170093	147164	147000	111720	98280	86520	86520	86520
			020304	216	435						
NATURAL GAS	1A1	Electricity and heat production	010100	14558	11364	2	1188	1521		6126	27109
			010101	23541558,1	20514966	19246614	20165293	19287200	18925039	20812861,93	13886528
			010102	1589836	4250088	2893467,75	1877463	1581768	2007214	1080451,51	1469274,71
			010103	683789	733694	657392,37	1057907	837246	1651123	2238105,61	3195651,95
			010104	22973677,54	25003004,9	30030786,36	29928352	30713112	25116344	31959340,2	25440821,83
			010105	25639911	27865345	27701651	27012113	26392308	23502420	20418631	16283549
			010202	217700	286968	291201	278471	428248	319699	122889	251259

fuel_gr_abbr	NFR	nfr_name	snap_id	2000	2001	2002	2003	2004	2005	2006	2007
			010203	1427019	1768484	1482319	1849960	1611725	2256093	2136355	2140919
			010205	203414	228049	207211	171691	473922	552369	852803	302166
		Other energy industries	010502	340513,76	352650,31	379362,15	322830,99	360596,14	324727	379490,91	348025,1
			010504	25015663	24413386	26179968	26247274	27066780	27790542	28342254	28130892
			010505	13889	11887	11473	12396	12395	9150	7553	4708
	1A2	Industry	030100	28607521	30958244	29348181	28370078	26869444	27736761	27625245	29221598
			030102	2690206	2869051,5	1190135,91	2273628	2295787	2199817	2292944,76	1572608,78
			030103	116411	117965	14707	118562	124427	189988	130672	171882
			030104	6756339	6138931	6724144	6526151	6632596	5965285,12	4710799,26	4395576,71
			030105	1556394	1641970	1545466	1543942	1570267	1256372	951540	465230
			030106	50809	53712	25558	17229	22029	2196	2899	
			030315	1101274	1089048	1016242	945777	911205	874446	827157	833656
			030318	629280	588960	524160	552240	606880	557280	556560	631440
	1A4	Commercial/Institutional	020100	7233923	7323256	7623549	9215179	9200426	9744985	10727760	10220750
			020103	43211	67208	165296	11053	50446	36133	24575	17402
			020104	23335	31001	42862	33669	22070	13397	39915	23970
			020105	1033132	1044813	1079590	1023163	1033012	861729	946464	832242
		Residential	020200	27568914	29262248	28081591	30023311	29857726	29523597	28541836	26639574
			020202	55319	69007	30105	63281	63692	17611	26392	21346
			020204	1439173	1450266	1392257	1451228	1475531	1466761	1499188	1254324
		Agriculture/Forestry	020300	2383877	2687167	2543009	2319515	2257935	2248231	2008129	1897025
			020303	61906	59503	64374	53821	53805	57534	42023	29343
			020304	3109418	2934589	3116038	2855572	2863595	2493976	1811203	1165871
GAS OIL	1A1	Electricity and heat production	010101	135602,22	122718	92395	956997	220146	186474,23	476346,34	562765
			010102	278595	366847	279069,26	114717	138782	116061	93879,89	136248,24
			010103		34258	36567	16629	14604	22221	50943	4459,11
			010104	103191	40026	75242	79241	80590	125545	80601,32	96640
			010105	68733	84634	66390	63501	106919	72995	59934,03	46404
			010201					92649	52791	20717	25406
			010202	694229	830045	166763	256178	418842	178478	163714	304245
			010203	233116	354842	306816	1125856	492537	366718	301272	246371,4
			010204						7924	5882	7689
			010205					5416	574	865	865
		Petroleum refining	010306				3085	9469	2403	9613,01	8429,15
		Other energy industries	010505			151	116	114	172	98	69
	1A2	Industry	030100	2184437	3010994	2369234	2665880	2551498	1693595	664764	1600
			030102	3138	5071	222	3574	2830	3313	13021,16	10626,28
			030103	82107	19	165				7	
			030104	51		896,7			1848	83	225
			030105	103	511						
			030106	8070	9828	7066	6887	8716	9218	7353	
			030315	1650	2009	681	933	3802	6851	554	338
	1A4	Commercial/Institutional	020100	4957566	4685349	4031236	4288708	4411382	3754635	3028642	1674929
			020103	71306	44010	43889,5	29646	19369	47991	31510,04	15852,76
			020105	1277	673	743	727	756	1538	803	1191
		Residential	020200	30275667	31506271	28997757	27027087	25290533	23863456	21196989	18660380
		Agriculture/Forestry	020300	2156405	2566813	2193392	2309294	2049684	1335297	590044	
			020304	4774	2723	4846	6315		2073	22	4355
KEROSENE	1A2	Industry	030100	7552	25543	65146	48233	19836	13433	19279	13781
	1A4	Commercial/Institutional	020100	63008	79642	69668	74131	76734	100870	58700	15253
		Residential	020200	91190	159051	110143	205243	110525	158320	136284	85737
		Agriculture/Forestry	020300	8213	22550	11171	10823	7482	7621	6960	4106
LPG	1A1	Electricity and heat production	010101							108	
			010203	246					20		
	1A2	Industry	030100	1019122	761460	677846	730090	749425	739902	774840	492647
	1A4	Commercial/Institutional	020100	121621	119345	136552	169985	214880	217661	210757	198786
			020105					21	9	90	1

fuel_gr_abbr	NFR	nfr_name	snap_id	2000	2001	2002	2003	2004	2005	2006	2007
		Residential	020200	650995	648947	607682	596053	650748	667241	688592	669326
		Agriculture/Forestry	020300	93329	80125	55378	58087	53466	46476	45610	27045
ORIMULSION	1A1	Electricity and heat production	010101	34148181	30243677	23846404	1921399	18719			
PETROLEUM COKE	1A1	Electricity and heat production	010102					7130	1840		
	1A2	Industry	030100	285426	127929	223785	229902	180642	162602	163186	
			030311	6474742,8	7656728	7543476	7714392	8187958	7796337	8283791	9109000
	1A4	Commercial/Institutional	020100	12070	12086	5355	9003		65455	8770	13757
		Residential	020200	513190	513393	509008	762464	1004800	1314544	1263840	1292341
		Agriculture/Forestry	020300	6154	3328	31	754				
REFINERY GAS	1A1	Petroleum refining	010304	3907567	3978922	3855200	3804097	3796653	3219243	3533411	4357769
			010306	11648701	11776506	11341800	12750415	12093923	12127828,6	12582220,6	11558494,9
RESIDUAL OIL	1A1	Electricity and heat production	010101	4045724	5950549	5018057	7329328	5577981	5460921	4346080,41	5501698
			010102	513002	253635	278953	334256	595816	591328	884042,22	809557
			010103	108599	117384	120150	106040	17155			
			010104	117319	1767903	6694775	9358988	7484444	6336347	8396895,81	4501300
			010105	17206	533	656	5900	1681			
			010202	58729	86854	122795	83920	34421	26790	29550	56287
			010203	617493	611104	547566	323210	187263	259996	101773	85136
		Petroleum refining	010306	1322995	1442929	1362640	907082	1071635	690601,34	619384,48	821943
	1A2	Industry	030100	8156730	7629109	8617100	6610417	6144393	5040765	7764097	6016926
			030102	714098,55	791893,05	808652	1644621	1690130	1898209,2	1606035,2	1416846,5
			030103	140375	89987						
			030105		22	10	787	302	4949	28	
			030311	858853,2	501846	591804	587464	817378	694301	978754	1056000
	1A4	Commercial/Institutional	020100	343022	173185	478286	170881	107544	120604	252003	234478
		Residential	020200	35611	26881	148870	47430	44417	48504	195015	12702
		Agriculture/Forestry	020300	1778526	1640210	1365228	910801	720074	759139	903812	640319
			020302	3269	2069	1964	6081	5265	7068	17002	32385
			020304	4017	4570	3335	3417				
MUNICIP. WASTES	1A1	Electricity and heat production	010101	955849,7268	2181400,661	2719649,094	111391,2008				
			010102	14215671,19	13902383,68	14757023,69	17491557,42	19197071,33	19296004,02	20140015,94	20535243,62
			010103	6493126,199	6479050,091	6462179,807	6094679,004	6123453,252	6316218,117	6453597,077	6603369,163
			010104	323810,2758			485641,2512			51653,55355	
			010105							574863,7082	
			010203	1083772,55	1704600,66	1887340,239	1996005,446	1947214,329	1625738,423	1656643,191	2216482,988
	1A2	Industry	030100							201301,6988	
			030102				3573,77514	2774,68461	3100,06744	3363,32467	
			030311	392348,7908	824970,5018	1388206,627	1092162,612	1496111,029	1500333,24	1174173,84	1276681,08
	1A4	Commercial/Institutional	020100	94865,7912			1006750,007	85395,52005	181613,3196	564074,0446	
			020103	10693,3689	9838,36533	9780,060454	58106,85025	58902,8345	134051,5134	141879,339	37834,4904
BROWN COAL BRI.	1A4	Residential	020200	25748	32903	18922	3056				
COAL	1A1	Electricity and heat production	010101	146911420	158990462	161608390	225396935	167930883	140018854	218346519,5	180898293
			010102	6224846	4970502	4684578	4578267	4511500	4048151	3288908	3050071
			010103	35480	24354	15476	33831	23637			
			010202	371	1494	363	371	636	3519		19257
			010203	3551	439				375		
	1A2	Industry	030100	3667193	3554471	2126818	2826288	3338374	2724083	2526876	2716428
			030102	1063375	997380,5	998228,9	1569871	1498728	1498977	1430721,7	1372444,26
			030311	5708047	4522597	4348589	3368675	3754171	3916553	4364609	4030000
	1A4	Commercial/Institutional	020100					1298			
		Residential	020200	14442	12906	15370	318	292	7738	3975	6572
		Agriculture/Forestry	020300	1079212	1234026	856215	1203478	1437068	1786868	2004275	2052875
			020304						2805		
COKE OVEN COKE	1A2	Industry	030100	238247	223280	279401	276382	302127	240691	245771	206436
			030102								37065
			030318	943920	883440	786240	693360	814320	738720	764640	876960
	1A4	Residential	020200	5010	2871	2813	25667	26604	293	147	1846

fuel_gr_abbr	NFR	nfr_name	snap_id	2000	2001	2002	2003	2004	2005	2006	2007
PLASTIC WASTE	1A1	Electricity and heat production	010101	275011,2732	627619,3386	782480,9059	32048,7992				
			010102	4090046,506	3999909,325	4245801,156	5032564,578	5523264,672	5551728,984	5794562,964	5908275,47
			010103	1868162,801	1864112,909	1859259,093	1753523,996	1761802,748	1817263,883	1856789,723	1899881,237
			010104	93164,72425			139725,7488			14861,44645	
			010105							165396,2918	
			010203	311816,4503	490437,3403	543014,0612	574278,5541	560240,6707	467747,577	476639,309	637713,0123
	1A2	Industry	030100							57917,30117	
			030102				1028,22486	798,31539	891,93256	967,67533	
			030311	112884,2092	237355,4982	399406,3726	314230,388	430451,9711	431666,76	337826,16	367318,92
	1A4	Commercial/Institutional	020100	27294,2088			289655,9926	24569,47995	52252,68038	162291,9554	
			020103	3076,6311	2830,63467	2813,859546	16718,14975	16947,1655	38568,4866	40820,661	10885,5096

Appendix 3A-4 Lower Calorific Value (LCV) of fuels

Table 3A-36 Time-series for calorific values of fuels (Danish Energy Authority, DEA 2009b).

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Crude Oil, Average	GJ pr tonne	42,40	42,40	42,40	42,70	42,70	42,70	42,70	43,00	43,00	43,00
Crude Oil, Golf	GJ pr tonne	41,80	41,80	41,80	41,80	41,80	41,80	41,80	41,80	41,80	41,80
Crude Oil, North Sea	GJ pr tonne	42,70	42,70	42,70	42,70	42,70	42,70	42,70	43,00	43,00	43,00
Refinery Feedstocks	GJ pr tonne	41,60	41,60	41,60	41,60	41,60	41,60	41,60	42,70	42,70	42,70
Refinery Gas	GJ pr tonne	52,00	52,00	52,00	52,00	52,00	52,00	52,00	52,00	52,00	52,00
LPG	GJ pr tonne	46,00	46,00	46,00	46,00	46,00	46,00	46,00	46,00	46,00	46,00
Naphtha (LVN)	GJ pr tonne	44,50	44,50	44,50	44,50	44,50	44,50	44,50	44,50	44,50	44,50
Motor Gasoline	GJ pr tonne	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80
Aviation Gasoline	GJ pr tonne	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80
JP4	GJ pr tonne	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80
		34,80	34,80	34,80	34,80	34,80	34,80	34,80	34,80	34,80	34,80
Other Kerosene	GJ pr tonne	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50
JP1	GJ pr tonne	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50
		35,87	35,87	35,87	35,87	35,87	35,87	35,87	35,87	35,87	35,87
Gas/Diesel Oil	GJ pr tonne	42,70	42,70	42,70	42,70	42,70	42,70	42,70	42,70	42,70	42,70
Fuel Oil	GJ pr tonne	40,40	40,40	40,40	40,40	40,40	40,40	40,70	40,65	40,65	40,65
Orimulsion	GJ pr tonne	27,60	27,60	27,60	27,60	27,60	28,13	28,02	27,72	27,84	27,58
Petroleum Coke	GJ pr tonne	31,40	31,40	31,40	31,40	31,40	31,40	31,40	31,40	31,40	31,40
Waste Oil	GJ pr tonne	41,90	41,90	41,90	41,90	41,90	41,90	41,90	41,90	41,90	41,90
White Spirit	GJ pr tonne	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50
Bitumen	GJ pr tonne	39,80	39,80	39,80	39,80	39,80	39,80	39,80	39,80	39,80	39,80
Lubricants	GJ pr tonne	41,90	41,90	41,90	41,90	41,90	41,90	41,90	41,90	41,90	41,90
Natural Gas	GJ pr 1000 Nm3	39,00	39,00	39,00	39,30	39,30	39,30	39,30	39,60	39,90	40,00
Town Gas	GJ pr 1000 m3							17,00	17,00	17,00	17,00
Electricity Plant Coal	GJ pr tonne	25,30	25,40	25,80	25,20	24,50	24,50	24,70	24,96	25,00	25,00
Other Hard Coal	GJ pr tonne	26,10	26,50	26,50	26,50	26,50	26,50	26,50	26,50	26,50	26,50
Coke	GJ pr tonne	31,80	29,30	29,30	29,30	29,30	29,30	29,30	29,30	29,30	29,30
Brown Coal Briquettes	GJ pr tonne	18,30	18,30	18,30	18,30	18,30	18,30	18,30	18,30	18,30	18,30
Straw	GJ pr tonne	14,50	14,50	14,50	14,50	14,50	14,50	14,50	14,50	14,50	14,50
Wood Chips	GJ pr cubic metre	2,80	2,80	2,80	2,80	2,80	2,80	2,80	2,80	2,80	2,80
Firewood, Hardwood	GJ pr m3	10,40	10,40	10,40	10,40	10,40	10,40	10,40	10,40	10,40	10,40
Firewood, Conifer	GJ pr m3	7,60	7,60	7,60	7,60	7,60	7,60	7,60	7,60	7,60	7,60
Wood Pellets	GJ pr tonne	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50
Wood Waste	GJ pr tonne	14,70	14,70	14,70	14,70	14,70	14,70	14,70	14,70	14,70	14,70
Wood Waste	GJ pr cubic metre	3,20	3,20	3,20	3,20	3,20	3,20	3,20	3,20	3,20	3,20
Biogas	GJ pr 1000 m3								23,00	23,00	23,00
Waste Combustion	GJ pr tonne	8,20	8,20	9,00	9,40	9,40	10,00	10,50	10,50	10,50	10,50
Bioethanol	GJ pr tonne	26,70	26,70	26,70	26,70	26,70	26,70	26,70	26,70	26,70	26,70
Biodiesel	GJ pr tonne	37,60	37,60	37,60	37,60	37,60	37,60	37,60	37,60	37,60	37,60
Fish Oil	GJ pr tonne	37,20	37,20	37,20	37,20	37,20	37,20	37,20	37,20	37,20	37,20

		2000	2001	2002	2003	2004	2005	2006	2007
Crude Oil, Average	GJ pr tonne	43,00	43,00	43,00	43,00	43,00	43,00	43,00	43,00
Crude Oil, Golf	GJ pr tonne	41,80	41,80	41,80	41,80	41,80	41,80	41,80	41,80
Crude Oil, North Sea	GJ pr tonne	43,00	43,00	43,00	43,00	43,00	43,00	43,00	43,00
Refinery Feedstocks	GJ pr tonne	42,70	42,70	42,70	42,70	42,70	42,70	42,70	42,70
Refinery Gas	GJ pr tonne	52,00	52,00	52,00	52,00	52,00	52,00	52,00	52,00
LPG	GJ pr tonne	46,00	46,00	46,00	46,00	46,00	46,00	46,00	46,00
Naphtha (LVN)	GJ pr tonne	44,50	44,50	44,50	44,50	44,50	44,50	44,50	44,50
Motor Gasoline	GJ pr tonne	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80
Aviation Gasoline	GJ pr tonne	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80
JP4	GJ pr tonne	43,80	43,80	43,80	43,80	43,80	43,80	43,80	43,80
Other Kerosene	GJ pr tonne	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50
JP1	GJ pr tonne	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50
Gas/Diesel Oil	GJ pr tonne	42,70	42,70	42,70	42,70	42,70	42,70	42,70	42,70
Fuel Oil	GJ pr tonne	40,65	40,65	40,65	40,65	40,65	40,65	40,65	40,65
Orimulsion	GJ pr tonne	27,62	27,64	27,71	27,65	27,65	27,65	27,65	27,65
Petroleum Coke	GJ pr tonne	31,40	31,40	31,40	31,40	31,40	31,40	31,40	31,40
Waste Oil	GJ pr tonne	41,90	41,90	41,90	41,90	41,90	41,90	41,90	41,90
White Spirit	GJ pr tonne	43,50	43,50	43,50	43,50	43,50	43,50	43,50	43,50
Bitumen	GJ pr tonne	39,80	39,80	39,80	39,80	39,80	39,80	39,80	39,80
Lubricants	GJ pr tonne	41,90	41,90	41,90	41,90	41,90	41,90	41,90	41,90
Natural Gas	GJ pr 1000 Nm3	40,15	39,99	40,06	39,94	39,77	39,67	39,54	39,59
Town Gas	GJ pr 1000 m3	17,01	16,88	17,39	16,88	17,58	17,51	17,20	17,14
Electricity Plant Coal	GJ pr tonne	24,80	24,90	25,15	24,73	24,60	24,40	24,80	24,40
Other Hard Coal	GJ pr tonne	26,50	26,50	26,50	26,50	26,50	26,50	26,50	26,50
Coke	GJ pr tonne	29,30	29,30	29,30	29,30	29,30	29,30	29,30	29,30
Brown Coal Briquettes	GJ pr tonne	18,30	18,30	18,30	18,30	18,30	18,30	18,30	18,30
Straw	GJ pr tonne	14,50	14,50	14,50	14,50	14,50	14,50	14,50	14,50
Wood Chips	GJ pr cubic metre	2,80	2,80	2,80	2,80	2,80	2,80	2,80	2,80
Firewood, Hardwood	GJ pr m3	9,30	9,30	9,30	9,30	9,30	9,30	9,30	9,30
Firewood, Conifer	GJ pr m3	10,40	10,40	10,40	10,40	10,40	10,40	10,40	10,40
Wood Pellets	GJ pr tonne	17,50	17,50	17,50	17,50	17,50	17,50	17,50	17,50
Wood Waste	GJ pr tonne	14,70	14,70	14,70	14,70	14,70	14,70	14,70	14,70
Wood Waste	GJ pr cubic metre	3,20	3,20	3,20	3,20	3,20	3,20	3,20	3,20
Biogas	GJ pr 1000 m3	23,00	23,00	23,00	23,00	23,00	23,00	23,00	23,00
Waste Combustion	GJ pr tonne	10,50	10,50	10,50	10,50	10,50	10,50	10,50	10,50
Bioethanol	GJ pr tonne	26,70	26,70	26,70	26,70	26,70	26,70	26,70	26,70
Biodiesel	GJ pr tonne	37,60	37,60	37,60	37,60	37,60	37,60	37,60	37,60
Fish Oil	GJ pr tonne	37,20	37,20	37,20	37,20	37,20	37,20	37,20	37,20

Table 3A-37 Fuel category correspondence list, Danish Energy Authority, NERI and Climate convention reportings (IPCC).

Danish Energy Authority	NERI Emission database	IPCC fuel category
Other Hard Coal	Coal	Solid
Coke	Coke oven coke	Solid
Electricity Plant Coal	Coal	Solid
Brown Coal Briquettes	Brown coal briq.	Solid
Orimulsion	Orimulsion	Liquid
Petroleum Coke	Petroleum coke	Liquid
Fuel Oil	Residual oil	Liquid
Waste Oil	Residual oil	Liquid
Gas/Diesel Oil	Gas oil	Liquid
Other Kerosene	Kerosene	Liquid
LPG	LPG	Liquid
Refinery Gas	Refinery gas	Liquid
Town Gas	Natural gas	Gas
Natural Gas	Natural gas	Gas
Straw	Straw	Biomass
Wood Waste	Wood and simil.	Biomass
Wood Pellets	Wood and simil.	Biomass
Wood Chips	Wood and simil.	Biomass
Firewood, Hardwood & Conifer	Wood and simil.	Biomass
Waste Combustion	Municip. wastes	Biomass 1)
Fish Oil	Fish & Rape oil	Biomass
Biogas	Biogas	Biomass
Biogas, other	Biogas	Biomass
Biogas, landfill	Biogas	Biomass
Biogas, sewage sludge	Biogas	Biomass

1) CO_2 from plastic part included in Other fuels.

Appendix 3A-5 Emission factors

Table 3A-38 CO_2 emission factors 2007.

Fuel	Emission factor Kg pr GJ		Reference type	IPCC fuel
	Biomass	Fossil fuel		Category
Coal		95 [1)]	Country specific	Solid
Brown coal briquettes		94,6 [2)]	IPCC reference manual	Solid
Coke oven coke		108	IPCC reference manual	Solid
Petroleum coke		92 [1)]	Country specific	Liquid
Wood	102		Corinair	Biomass
Municipal waste	94,5 [1)]	17,6 [1)]	Country specific	Biomass/Other fuels
Straw	102		Country specific	Biomass
Residual oil		78 [1)]	Corinair	Liquid
Gas oil		74 [1)]	Corinair	Liquid
Kerosene		72	Corinair	Liquid
Fish & rape oil	74		Country specific	Biomass
Orimulsion		80 [2)]	Country specific	Liquid
Natural gas		56.78	Country specific	Gas
LPG		65	Corinair	Liquid
Refinery gas		56,9	Country specific	Liquid
Biogas	83,6		Country specific	Biomass

1. Plant specific data from EU ETS incorporated for individual plants.
2. Not applied in 2007.

Time-series for natural gas and municipal waste are shown below. All other emission factors are the same for 1990-2007.

Table 3A-39 CO_2 emission factors, time-series.

Year	Natural gas, kg pr GJ	Municipal waste, plastic part, Kg pr GJ	Municipal waste biomass part, kg pr GJ
1990	56.9	22.5	+89.6
1991	56.9	22.5	+89.6
1992	56.9	20.5	+91.6
1993	56.9	19.6	+92.5
1994	56.9	19.6	+92.5
1995	56.9	18.5	+93.6
1996	56.9	17.6	+94.5
1997	56.9	17.6	+94.5
1998	56.9	17.6	+94.5
1999	56.9	17.6	+94.5
2000	57.1	17.6	+94.5
2001	57.25	17.6	+94.5
2002	57.28	17.6	+94.5
2003	57.19	17.6	+94.5
2004	57.12	17.6	+94.5
2005	56.96	17.6	+94.5
2006	56.78	17.6	+94.5
2007	56.78	17.6	+94.5

Table 3A-40 CH_4 emission factors and references 2007.

Fuel group	Fuel	IPCC sector	IPCC sector	SNAP	Emission factor, g pr GJ	Reference
BIOMASS	WOOD	1A1a	Electricity and heat production	010102, 010103, 010104	2	Nielsen & Illerup 2003
				010202, 010203	32	EEA 2004
		1A2	Industry	030100, 030102, 030103	32	EEA 2004
		1A4a	Commercial/Institutional	020100, 020105	200	EEA 2004
		1A4b i	Residential	020200	200	EEA 2004
		1A4c i	Agriculture/Forestry	020300	200	EEA 2004
	STRAW	1A1a	Electricity and heat production	010101, 010102, 010103, 010104	0,5	Nielsen & Illerup 2003
				010202, 010203	32	EEA 2004
		1A4b i	Residential	020200	200	EEA 2004
		1A4c i	Agriculture/Forestry	020300	200	EEA 2004
				020302	32	EEA 2004
	FISH & RAPE OIL	1A1a	Electricity and heat production	010101, 010102, 010103, 010202, 010203	1,5	EEA 2004, assuming same emission factor as for gas oil
		1A2	Industry	030105	1,5	EEA 2004, assuming same emission factor as for gas oil
		1A4a	Commercial/Institutional	020105	1,5	EEA 2004, assuming same emission factor as for gas oil
	BIOGAS	1A1a	Electricity and heat production	010102, 010103, 010203	4	EEA 2004
				010105, 010205	323	Nielsen & Illerup 2003
		1A1c	Other energy industries	010505	323	Nielsen & Illerup 2003
		1A2	Industry	030100, 030102	4	EEA 2004
				030105	323	Nielsen & Illerup 2003
		1A4a	Commercial/Institutional	020100, 020103	4	EEA 2004
				020105	323	Nielsen & Illerup 2003
		1A4c i	Agriculture/Forestry	020300	4	EEA 2004
				020304	323	Nielsen & Illerup 2003
OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010102, 010103	0,59	Nielsen & Illerup 2003
				010203	6	EEA 2004
		1A4a	Commercial/Institutional	020103	6	EEA 2004
GAS	NATURAL GAS	1A1a	Electricity and heat production	010100, 010101, 010102, 010202	6	DGC 2001
				010103, 010203	15	Gruijthuijsen & Jensen 2000
				010104 (Gas turbines)	1,5	Nielsen & Illerup 2003
				010105, 010205 (Gas engines)	465	Nielsen et al. 2008
		1A1c	Other energy industries	010504 (Gas turbines)	1,5	Nielsen & Illerup 2003
				010505 (Gas engines)	465	Nielsen et al. 2008
		1A2	Industry	030100	6	DGC 2001
				030103	15	Gruijthuijsen & Jensen 2000
				030104 (Gas turbines)	1,5	Nielsen & Illerup 2003
				030105 (Gas engines)	465	Nielsen et al. 2008
		1A4a	Commercial/Institutional	020100	6	DGC 2001
				020103	15	Gruijthuijsen & Jensen 2000
				020104 (Gas turbines)	1,5	Nielsen & Illerup 2003
				020105 (Gas engines)	465	Nielsen et al. 2008
		1A4b i	Residential	020200	6	DGC 2001
				020202	15	Gruijthuijsen & Jensen 2000
				020204 (Gas engines)	465	Nielsen et al. 2008
		1A4c i	Agriculture/Forestry	020300	6	DGC 2001
				020303 (Gas turbines)	1,5	Nielsen & Illerup 2003
				020304 (Gas engines)	465	Nielsen et al. 2008
LIQUID	PETROLEUM COKE	1A4a	Commercial/Institutional	020100	15	EEA 2004
		1A4b i	Residential	020200	15	EEA 2004
	RESIDUAL OIL	1A1a	Electricity and heat production	010101, 010102, 010104, 010202, 010203	3	EEA 2004
		1A1b	Petroleum refining	010306	3	EEA 2004
		1A2	Industry	030100, 030102	3	EEA 2004
		1A4a	Commercial/Institutional	020100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004
		1A4c i	Agriculture/Forestry	020300, 020302	3	EEA 2004
	GAS OIL	1A1a	Electricity and heat production	010101, 010102, 010103, 010104, 010105, 010201, 010202, 010203, 010204, 010205	1,5	EEA 2004
		1A1b	Petroleum refining	010306	1,5	EEA 2004
		1A1c	Other energy industries	010505	1,5	EEA 2004
		1A2	Industry	030100, 030102, 030104	1,5	EEA 2004
		1A4a	Commercial/Institutional	020100, 020103, 020105	1,5	EEA 2004
		1A4b i	Residential	020200	1,5	EEA 2004
		1A4c i	Agriculture/Forestry	020304	1,5	EEA 2004
	KEROSENE	1A2	Industry	030100	7	EEA 2004
		1A4a	Commercial/Institutional	020100	7	EEA 2004
		1A4b i	Residential	020200	7	EEA 2004
		1A4c i	Agriculture/Forestry	020300	7	EEA 2004
	LPG	1A2	Industry	030100	1	EEA 2004
		1A4a	Commercial/Institutional	020100, 020105	1	EEA 2004
		1A4b i	Residential	020200	1	EEA 2004
		1A4c i	Agriculture/Forestry	020300	1	EEA 2004
	REFINERY GAS	1A1b	Petroleum refining	010304, 010306	1,5	EEA 2004
SOLID	COAL	1A1a	Electricity and heat production	010101, 010102	1,5	EEA 2004
				010202	15	EEA 2004
		1A2	Industry	030100	15	EEA 2004
		1A4b i	Residential	020200	15	EEA 2004
		1A4c i	Agriculture/ Forestry	020300	15	EEA 2004

Fuel group	Fuel	IPCC sector	IPCC sector	SNAP	Emission factor, g pr GJ	Reference
Continued						
	COKE OVEN COKE	1A2	Industry	030100	15	EEA 2004, assuming same emission factor as for coal
		1A4b i	Residential	020200	15	EEA 2004, assuming same emission factor as for coal

Time-series for CH_4 emission factors for gas engines are shown below. All other CH_4 emission factors are the same for 1990-2007.

Table 3A-41 CH_4 emission factors, time-series.

Year	Natural gas fuelled engines Emission factor, g pr GJ	Biogas fuelled engines Emission factor, g pr GJ
1990	266	239
1991	309	251
1992	359	264
1993	562	276
1994	623	289
1995	632	301
1996	615	305
1997	551	310
1998	542	314
1999	541	318
2000	537	323
2001	537	323
2002	537	323
2003	537	323
2004	513	323
2005	489	323
2006	465	323
2007	465	323

Table 3A-42 N_2O emission factors and references 2007.

Fuel group	Fuel	IPCC sector	IPCC sector	SNAP	Emission factor g pr GJ	Reference
BIOMASS	WOOD	1A1a	Electricity and heat production	010102, 010103, 010104 010202, 010203	0,8 4	Nielsen & Illerup 2003 EEA 2004
		1A2	Industry	all	4	EEA 2004
		1A4a	Commercial/Institutional	all	4	EEA 2004
		1A4b i	Residential	020200	4	EEA 2004
		1A4c i	Agriculture/Forestry	020300	4	EEA 2004
	STRAW	1A1a	Electricity and heat production	010101, 010102, 010103, 010104 010202, 010203	1,4 4	Nielsen & Illerup 2003 EEA 2004
		1A4b i	Residential	020200	4	EEA 2004
		1A4c i	Agriculture/Forestry	all	4	EEA 2004
	FISH & RAPE OIL	1A1a	Electricity and heat production	all	2	EEA 2004, assuming same emission factor as gas oil
		1A2	Industry	030105	2	EEA 2004, assuming same emission factor as gas oil
		1A4a	Commercial/Institutional	020105	2	EEA 2004, assuming same emission factor as gas oil
	BIOGAS	1A1a	Electricity and heat production	010102, 010103, 010203 010105, 010205 (Gas engines)	2 0,5	EEA 2004 Nielsen & Illerup 2003
		1A1c	Other energy industries	010505 (Gas engines)	0,5	Nielsen & Illerup 2003
		1A2	Industry	030100, 030102 030105 (Gas engines)	2 0,5	EEA 2004 Nielsen & Illerup 2003
		1A4a	Commercial/Institutional	020100, 020103 020105 (Gas engines)	2 0,5	EEA 2004 Nielsen & Illerup 2003
		1A4c i	Agriculture/Forestry	020300 020304 (Gas engines)	2 0,5	EEA 2004 Nielsen & Illerup 2003
OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010102, 010103 010203	1,2 4	Nielsen & Illerup 2003 EEA 2004
		1A4a	Commercial/Institutional	020103	4	EEA 2004
GAS	NATURAL GAS	1A1a	Electricity and heat production	010100, 010101, 010102, 010103, 010202, 010203 010104 (Gas turbines) 010105, 010205 (Gas engines)	1 2,2 1,3	EEA 2004 Nielsen & Illerup 2003 Nielsen et al. 2008
		1A1c	Other energy industries	010504 (Gas turbines) 010505 (Gas engines)	2,2 1,3	Nielsen & Illerup 2003 Nielsen et al. 2008
		1A2	Industry	030100, 030103 030104 (Gas turbines) 030105 (Gas engines)	1 2,2 1,3	EEA 2004 Nielsen & Illerup 2003 Nielsen et al. 2008
		1A4a	Commercial/Institutional	020100, 020103 020104 (Gas turbines) 020105 (Gas engines)	1 2,2 1,3	EEA 2004 Nielsen & Illerup 2003 Nielsen et al. 2008
		1A4b i	Residential	020200, 020202 020204 (Gas engines)	1 1,3	EEA 2004 Nielsen et al. 2008
		1A4c i	Agriculture/Forestry	020300 020303 (Gas turbines) 020304 (Gas engines)	1 2,2 1,3	EEA 2004 Nielsen & Illerup 2003 Nielsen et al. 2008
LIQUID	PETROLEUM COKE	1A4a	Commercial/Institutional	020100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004
	RESIDUAL OIL	1A1a	Electricity and heat production	all	2	EEA 2004
		1A1b	Petroleum refining	010306	2	EEA 2004
		1A2	Industry	all	2	EEA 2004
		1A4a	Commercial/Institutional	020100	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/Forestry	all	2	EEA 2004
	GAS OIL	1A1a	Electricity and heat production	all	2	EEA 2004
		1A1b	Petroleum refining	010306	2	EEA 2004
		1A1c	Other energy industries	010505	2	EEA 2004
		1A2	Industry	all	2	EEA 2004
		1A4a	Commercial/ Institutional	all	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/ Forestry	020304	2	EEA 2004
	KEROSENE	1A2	Industry	030100	2	EEA 2004
		1A4a	Commercial/Institutional	020100	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/ Forestry	020300	2	EEA 2004
	LPG	1A2	Industry	030100	2	EEA 2004
		1A4a	Commercial/ Institutional	all	2	EEA 2004
		1A4b i	Residential	020200	2	EEA 2004
		1A4c i	Agriculture/Forestry	020300	2	EEA 2004
	REFINERY GAS	1A1b	Petroleum refining	010304, 010306	2,2	Nielsen & Illerup 2003, assuming same emission factor as for natural gas
SOLID	COAL	1A1a	Electricity and heat production	010101, 010102 010202	0,8 3	Elsam 2005 EEA 2004
		1A2	Industry	030100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004
		1A4c i	Agriculture/Forestry	020300	3	EEA 2004
	COKE OVEN COKE	1A2	Industry	030100	3	EEA 2004
		1A4b i	Residential	020200	3	EEA 2004

The same N_2O emission factors are applied for 1990-2007.

Table 3A-43 SO_2, NO_x, NMVOC and CO emission factors and references 2007.

Fuel	IPCC sector	SNAP	SO_2 g pr GJ	Ref.	NO_x g pr GJ	Ref.	NMVOC g pr GJ	Ref.	CO g pr GJ	Ref.
COAL	1A1a	010101, 010102	40	18	98	18	1.5	1	10	3
COAL	1A1a, 1A2, 1A4c	010202, 030100, 020300	574	19	95	4	15	1	10	1
COAL	1A4b	020200	574	19	95	4	15	1	2000	32
COKE OVEN COKE	1A2	030100	574	29	95	29	15	29	10	29
COKE OVEN COKE	1A4b	020200	574	29	95	29	15	29	2000	29
PETROLEUM COKE	1A4a, 1A4b	020100, 020200	605	20	50	1	1.5	1	1000	1
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	1.74	31	69	31	3.3	31	79	31
WOOD AND SIMIL.	1A1a, 1A2	010202, 010203, 030100, 030102, 030103	25	22, 21	90	22, 21, 4	48	1	240	4
WOOD AND SIMIL.	1A4a, 1A4c	020100, 020105, 020300	25	22, 21	90	22, 21, 4	600	1	240	4
WOOD AND SIMIL.	1A4b	020200	25	22, 21	120	22	540	39	3441	39
MUNICIP. WASTES	1A1a	010102, 010103	23.9	31	124	31	0.98	31	7.4	31
MUNICIP. WASTES	1A1a, 1A4a	010203, 020103	67	9	164	9	9	1	10	9
STRAW	1A1a	010101, 010102, 010103, 010104	47.1	31	131	31	0.8	31	63	31
STRAW	1A1a, 1A4c	010202, 010203, 020302	130	5	90	4, 28	50	1	325	4, 5
STRAW	1A4c	020300	130	5	90	4, 28	600	1	4000	1,6,7
STRAW	1A4b	020200	130	5	90	4, 28	400	41	4000	1,6,7
RESIDUAL OIL	1A1a	010101, 010102, 010104	206	18	98	18	3	1	15	3
RESIDUAL OIL	1A1a, 1A4a, 1A4b, 1A4c	010202, 010203, 020100, 020200, 020300, 020302	344	25, 10, 24	142	4	3	1	30	1
RESIDUAL OIL	1A1b	010306	537	33	142	4	3	1	30	1
RESIDUAL OIL	1A2	030100, 030102	344	25, 10, 24	130	28	3	1	30	1
GAS OIL	1A1a	010101, 010102	23	27	249	18	1.5	1	15	3
GAS OIL	1A1a, 1A2	Gas turbines: 010104, 010204, 030104	23	27	350	9	2	1	15	3
GAS OIL	1A1a, 1A1c, 1A4a, 1A4c	Engines: 010105, 010205, 010505, 020105, 020304	23	27	700	1	100	1	100	1
GAS OIL	1A1a	010103	23	27	65	28	1.5	1	15	3
GAS OIL	1A1a, 1A1b, 1A2f	010201, 010202, 010203, 010306, 030100, 030102	23	27	65	28	1.5	1	30	1
GAS OIL	1A4a, 1A4c	020100, 020103	23	27	52	4	3	1	30	1
GAS OIL	1A4b	020200	23	27	52	4	3	1	43	1
KEROSENE	all	all	5	30	50	1	3	1	20	1
FISH & RAPE OIL	1A1a	010101, 010102, 010103	1	37	220	38	1.5	15	15	15
FISH & RAPE OIL	1A1a	010202, 010203	1	37	65	15	1.5	15	15	15
FISH & RAPE OIL	1A2, 1A4c	030105, 020105	1	37	700	15	100	15	100	15
NATURAL GAS	1A1a	010100, 010101, 010102	0.3	17	97	9	2	14	15	3
NATURAL GAS	1A1a, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 030104, 020104, 020303	0.3	17	124	31	1.4	31	6.2	31
NATURAL GAS	1A1a, 1A1c, 1A2, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	0.3	17	148	40	105	40	115	40
NATURAL GAS	1A1a, 1A2	010103, 010202, 010203, 030100, 030103	0.3	17	42	36	2	14	28	4
NATURAL GAS	1A1c	010504	0.3	17	250	1, 8, 32	1.4	31	6.2	31
NATURAL GAS	1A4a, 1A4c	020100, 020103, 020300	0.3	17	30	1, 4, 11	2	14	28	4
NATURAL GAS	1A4b	020200, 020202	0.3	17	30	1, 4, 11	4	11	20	11
LPG	1A2	030100	0.13	23	96	32	2	1	25	1
LPG	1A4a, 1A4c	020100, 020105, 020300	0.13	23	71	32	2	1	25	1
LPG	1A4b	020200	0.13	23	47	32	2	1	25	1
REFINERY GAS	1A1b	010304, 010306	1	2	170	9	1.4	35	6.2	35
BIOGAS	1A1a, 1A2, 1A4a, 1A4c	010102, 010103, 010203, 030100, 020100, 020103, 020300	25	26	28	4	4	1	36	4
BIOGAS	1A1a, 1A1c, 1A2, 1A4a, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020304	19.2	31	540	31	14	31	273	31
BIOGAS	1A2	030102	25	26	59	4	4	1	36	4

1. Emission Inventory Guidebook 3rd edition, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections, 2004 update (EEA 2004). Available on the Internet at http://reports.eea.eu.int/EMEPCORINAIR4/en (11-04-2005)

2. NERI calculation based on plant specific data 1995-2002
3. Sander, B. 2002. Elsam, personal communication, e-mail 17-05-2002
4. Miljøstyrelsen, 2001. Luftvejledningen, Begrænsning af luftforurening fra virksomheder, Vejledning fra Miljøstyrelsen Nr. 2 2001 (Danish legislation)
5. Nikolaisen L., Nielsen C., Larsen M.G., Nielsen V. Zielke U., Kristensen J.K. & Holm-Christensen B. 1998 Halm til energiformål, Teknik – Miljø – Økonomi, 2. udgave, 1998, Videncenter for halm og flisfyring (In Danish)
6. Jensen L. & Nielsen P.A. 1990. Emissioner fra halm- og flisfyr, dk-Teknik & Levnedsmiddelstyrelsen 1990 (In Danish)
7. Bjerrum M., 2002. Danish Technological Institute, personal communication 09-10-2002
8. Kristensen, P. (2004) Danish Gas Technology Centre, e-mail 31-03-2004
9. NERI calculation based on annual environmental reports of Danish plants year 2000
10. Risø National Laboratory home page - http://www.risoe.dk/sys/esy/emiss_e/emf25082000.xls
11. Gruijthuijsen L.v. & Jensen J.K., 2000. Energi- og miljøoversigt, Danish Gas Technology Centre 2000 (In Danish)
12. -
13. -
14. Danish Gas Technology Centre 2001, Naturgas – Energi og miljø (In Danish)
15. Same emission factors as for gas oil is assumed (NERI assumption)
16. -
17. NERI calculation based on S content of natural gas 6mg(S)/m_n^3 gas. The S content refers to the Danish natural gas transmission company Gastra (http://www.gastra.dk/dk/index.asp)
18. Estimated by NERI based on 2007 data reported by the plant owners to the electricity transmission companies and the Danish Energy Authority. NERI calculations are based on data forwarded by the Danish Energy Authority: Nielsen M. 2008. Energistyrelsen, personal communication, e-mail 11-11-2008 and 13-11-2008.
19. NERI calculation based on a sulphur content of 0,8 % and a retention of sulphur in ash of 5 %. The sulphur content has been assumed just below the limit value of 0,9 % (reference no. 24)
20. NERI calculation based on a sulphur content of 1 % (reference no. 24) and a retention of sulphur in ash of 5 %.
21. Christiansen, B.H., Evald, A., Baadsgaard-Jensen, J. Bülow, K. 1997. Fyring med biomassebaserede restprodukter, Miljøprojekt nr. 358, 1997, Miljøstyrelsen
22. Serup H., Falster H., Gamborg C., Gundersen P., Hansen L. Heding N., Jacobsen H.H., Kofman P., Nikolaisen L., Thomsen I.M. 1999. Træ til energiformål, Teknik – Miljø – Økonomi, 2. udgave, 1999, Videncenter for halm og flisfyring (In Danish)
23. NERI calculation based on a sulphur content of 0,0003 %. The approximate sulphur content is stated by Danish refineries.
24. Miljøstyrelsen, 2001.Bekendtgørelseom begrænsning af svovlindholdet i visse flydende og faste brændstoffer, Bekendtgørelse 532 af 25/05/2001 (Danish legislation)
25. NERI calculation based on a sulphur content of 0,7 %. The sulhpur content refer to product data from Shell and Statoil available at the internet at: http://www.statoil.dk/mar/svg01185.nsf/fs/erhverv-produkt (13-05-2004)
26. NERI calculation based on a H_2S content of 200 ppm. The H_2S content refer to Christiansen J. 2003, Personal communication and to Hjort-Gregersen K., 1999 Centralised Biogas Plants, Danish Institute of Agricultural and Fisheries Economics, 1999
27. NERI calculation based on a sulphur content of 0,05 % S. The sulphur content refers to Bilag 750, Kom 97/0105 (http://www.folketinget.dk/?/samling/20041/MENU/00000002.htm) and to product sheets from Q8, Shell and Statoil
28. Miljøstyrelsen 1990. Bekendtgørelse om begrænsning af emissioner af svovldioxid, kvælstofoxider og støv fra store fyringsanlæg, Bekendtgørelse 689 af 15/10/1990 (Danish legislation)
29. Same emission factor as for coal is assumed (NERI assumption)
30. Product sheet from Shell. Available on the internet at: http://www.shell.com/home/dk-da/html/iwgen/app_profile/app_products_0310_1510.html (13-05-2004)
31. Nielsen, M. & Illerup, J.B: 2003. Emissionsfaktorer og emissionsopgørelse for decentral kraftvarme. Eltra PSO projekt 3141. Kortlægning af emissioner fra decentrale kraftvarmeværker. Delrapport 6. Danmarks Miljøundersøgelser. 116 s. –Faglig rapport fra DMU nr. 442.(In Danish, whith an english summary). Available on the Internet at : http://www2.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR442.pdf (25-02-2009)
32. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, 1996. Available on the Internet at http://www.ipcc-nggip.iges.or.jp/public/gl/invs6.htm (25-02-2009)
33. NERI calculation based on plant specific data 2003
34. -
35. Same emission factor as for natural gas fuelled gas turbines is assumed
36. Wit, J. d & Andersen, S. D. 2003. Emissioner fra større gasfyrede kedler, Dansk Gasteknisk Center 2003. The emission factor have been assumed to be the average value of the stated interval (NERI assumption).
37. Folkecenter for Vedvarende Energi, 2000. http://www.folkecenter.dk/plant-oil/emission/emission_rapsolie.pdf
38. Assumed same emission factor as for gas oil (NERI assumption). However the emission factor is not correct – the emission factors 249 g/GJ and 65 g/GJ will be applied in future inventories.
39. Aggregated emission factor based on the technology distribution in the sector and guidebook (EEA, 2007) emission factors. Technology distribution based on: (Illerup, J. B., Henriksen, T. C., Lundhede, T., Breugel C. v., Jensen, N. Z. (2007) "Brændeovne og små kedler - partikelemissioner og reduktionstiltag". Miljøprojekt nr. 1164 2007. Miljøstyrelsen. Available on the Internet at: http://www2.mst.dk/common/Udgivramme/Frame.asp?pg=http://www2.mst.dk/Udgiv/publikationer/2007/978-87-7052-451-3/html/default.htm
40. Nielsen, M., Illerup, J.B. & Birr-Petersen K., 2008: Revised emission factors for gas engines including start/stop emissions. Sub report 3 (NERI) NERI technical report No. 672, 2008. Available on the internet at: http://www2.dmu.dk/Pub/FR672.pdf
41. EMEP/Corinair Emission Inventory Guidebook 2007 edition, (EEA, 2007). Available on the Internet at http://www.eea.europa.eu/publications/EMEPCORINAIR5 (25-02-2009)

Table 3A-44 SO_2, NO_x, NMVOC and CO emission factors time-series, g prGJ. (see next page).

pol_abbr	fuel_type	fuel_gr_abbr	nfr_id_E	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						Data																	
SO2	LIQUID	GAS OIL	1A1a	Electricity and heat production	010101					94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010102					94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010103					94	23	23	23	23	23		23	23	23	23	23	23	23
					010104	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010105	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010201					94	23									23	23	23	23
					010202					94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010203					94	23	23	23	23	23	23	23	23	23	23	23	23	23
					010205					94					23					23	23	23	23
			1A1b	Petroleum refining	010306		94	94	94	94	23	23	23						23	23	23	23	23
			1A2	Industry	030100	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
					030103					94	23	23	23	23	23	23	23	23				23	
					030105			94	94	94						23	23						
					030106	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	
			1A4a	Commercial/ Institutional	020100	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
					020102					94		23		23									
					020103					94		23	23	23	23	23	23	23	23	23	23	23	23
					020105			94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
			1A4b i	Residential	020200	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	23
			1A4c i	Agriculture/ Forestry	020300	94	94	94	94	94	23	23	23	23	23	23	23	23	23	23	23	23	
		ORIMULSION	1A1a	Electricity and heat production	010101							147	149				10	12	12	12			
		PETROLEUM COKE	1A2	Industry	030100	787		787	787		787	787	787	787	787	787	605	605	605	605	605	605	
			1A4a	Commercial/ Institutional	020100	787	787	787	787	787	787	787	787	787	787	787	605	605	605		605	605	605
			1A4b i	Residential	020200	787	787	787	787	787	787	787	787	787	787	787	605	605	605	605	605	605	605
			1A4c i	Agriculture/ Forestry	020300	787	787	787	787		787	787	787	787	787	787	605	605	605				
		REFINERY GAS	1A1b	Petroleum refining	010306	190	190	190	190												1	1	1
		RESIDUAL OIL	1A1a	Electricity and heat production	010100	446	470	490	475														
					010101						351	408	344	369	369	403	315	290	334	349	283	308	206
					010102	446	470	490	475	1564	351	408	344	369	369	403	315	290	334	349	283	308	206
					010103					1564	351	408	344	369	369	403	315	290	334	349			
					010104					1564	351	408	344	369	369	403	315	290	334	349	283	308	206
					010105	446	470	490	475	1564	351	408	344	369	369	403	315	290	334	349			
					010202					495	495	495	344	344	344	344	344	344	344	344	344	344	344
					010203					495	495	495	344	344	344	344	344	344	344	344	344	344	344
			1A1b	Petroleum refining	010306	643	38	222	389				537	537	537	537	537	537	537	537	537	537	537
			1A2	Industry	030100	495	495	495	495	495	495	495	344	344	344	344	344	344	344	344	344	344	344
					030102					495	495	495	344	344	344	344	344	344	344	344	344	344	344
					030103					495	495	495	344	344	344	344	344						
			1A4a	Commercial/ Institutional	020100	495	495	495	495	495	495	495	344	344	344	344	344	344	344	344	344	344	344
			1A4b i	Residential	020200	495	495	495	495	495	495	495	344	344	344	344	344	344	344	344	344	344	344
			1A4c i	Agriculture/ Forestry	020300	495	495	495	495	495	495	495	344	344	344	344	344	344	344	344	344	344	344
	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010100	138	116	95	73														
					010102					52	30			26	25	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9
					010103					52	30	29	28	26	25	23,9	23,9	23,9	23,9	23,9	23,9	23,9	23,9
					010104					52	30	29	28	26	25	23,9			23,9			23,9	
					010200	138	131	124	117														
					010202					110	103												
					010203					110	103	95	88	81	74	67	67	67	67	67	67	67	67
			1A2	Industry	030100	138	131	124	117	110	103	95	88	81	74							67	
			1A4a	Commercial/ Institutional	020100	138	131	124	117	110	103	95	88	81	74	67			67	67	67	67	
					020103					110	103	95	88	81	74	67	67	67	67	67	67	67	67
	SOLID	COAL	1A1a	Electricity and heat production	010100	506	571	454	386														
					010101	506	571	454	386	343	312	420	215	263	193	64	47	45	61	42	41	37	40
					010102	506	571	454	386	343	312	420	215	263	193	64	47	45	61	42	41	37	40
					010103					343	312	420	215	263	193	64	47	45	61	42			
					010104					343	312	420	215										

						1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						Data																	
pol_abbr	fuel_type	fuel_gr_abbr	nfr_id_E	nfr_name	snap_id																		
NOX	BIOMASS	BIOGAS	1A1a	Electricity and heat production	010105	711	696	681	665	650	635	616	597	578	559	540	540	540	540	540	540	540	540
					010205					650										540	540	540	540
			1A1c	Other energy industries	010505	711	696	681	665	650	635	616	597	578	559	540	540	540	540	540	540	540	540
			1A2	Industry	030105									578	559	540	540	540	540	540		540	540
			1A4a	Commercial/ Institutional	020105	711	696	681	665	650	635	616	597	578	559	540	540	540	540	540	540	540	540
			1A4c i	Agriculture/ Forestry	020304	711	696	681	665	650	635	616	597	578	559	540	540	540	540	540	540	540	540
		FISH & RAPE OIL	1A1a	Electricity and heat production	010200	100	95	90	85														
					010203					80	75	70	65	65	65	65	65	65	65	65	65	65	65
		WOOD	1A1a	Electricity and heat production	010202					130	130	130	130	130	90	90	90	90	90	90	90	90	90
					010203					130	130	130	130	130	90	90	90	90	90	90	90	90	90
			1A2	Industry	030100	130	130	130	130	130	130	130	130	130	90	90	90	90	90	90	90	90	90
					030102									130	90	90	90					90	90
					030103					130	130	130	130	130	90	90	90	90	90	90	90	90	90
			1A4a	Commercial/ Institutional	020100	130	130	130	130	130	130	130	130	130	90	90	90	90	90	90	90	90	90
					020105									130	90		90	90		90	90	90	90
			1A4c i	Agriculture/ Forestry	020300	130	130	130	130	130	130	130	130	130	90	90	90	90	90	90	90	90	90
					020304									130	90	90	90						
	GAS	NATURAL GAS	1A1a	Electricity and heat production	010100								115	115	115	115	115	115	115	97		97	97
					010101					115			115				115	115	115	97	97	97	97
					010102					115	115			115	115	115	115	115	115	97	97	97	97
					010104	161	157	153	149	145	141	138	134	131	127	124	124	124	124	124	124	124	124
					010105	276	241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
					010205					199	194	193	170	167	167	168	168	168	168	161	154	148	148
			1A1c	Other energy industries	010505	276	241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
			1A2	Industry	030104	161				145	141	138	134	131	127	124	124	124	124	124	124	124	124
					030105	276	241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
			1A4a	Commercial/ Institutional	020104					145	141	138	134	131	127	124	124	124	124	124	124	124	124
					020105	276	241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
			1A4b i	Residential	020204		241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
			1A4c i	Agriculture/ Forestry	020303							138	134	131	127	124	124	124	124	124	124	124	124
					020304	276	241	235	214	199	194	193	170	167	167	168	168	168	168	161	154	148	148
	LIQUID	GAS OIL	1A1a	Electricity and heat production	010103					80	75	65	65	65	65		65	65	65	65	65	65	65
					010200	100	95	90	85														
					010201					80	75									65	65	65	65
					010202					80	75	70	65	65	65	65	65	65	65	65	65	65	65
					010203					80	75	70	65	65	65	65	65	65	65	65	65	65	65
			1A1b	Petroleum refining	010306		95	90	85	80	75	70	65						65	65	65	65	65
			1A2	Industry	030100	100	95	90	85	80	75	70	65	65	65	65	65	65	65	65	65	65	65
					030102						75			65	65	65	65	65	65	65	65	65	65
					030103					80	75	70	65	65	65	65	65	65				65	
					030106	100	95	90	85	80	75	70	65	65	65	65	65	65	65	65	65	65	
		ORIMULSION	1A1a	Electricity and heat production	010101							139	138				88	86	86	86			
		PETROLEUM COKE	1A2	Industry	030100	200		200	200		200	200	200	200	200	95	95	95	95	95	95	95	
		REFINERY GAS	1A1b	Petroleum refining	010306	100	100	100	100												170	170	170
		RESIDUAL OIL	1A1a	Electricity and heat production	010100	342	384	294	289														
					010101						239	250	200	177	152	129	122	130	144	131	127	109	98
					010102	342	384	294	289	267	239	250	200	177	152	129	122	130	144	131	127	109	98
					010103					267	239	250	200	177	152	129	122	130	144	131			
					010104					267	239	250	200	177	152	129	122	130	144	131	127	109	98
					010105	342	384	294	289	267	239	250	200	177	152	129	122	130	144	131			
	SOLID	BROWN COAL BRI.	1A4b i	Residential	020200	200	200	200	200	200	200	200	200	200	200	95	95	95	95				
		COAL	1A1a	Electricity and heat production	010100	342	384	294	289														
					010101	342	384	294	289	267	239	250	200	177	152	129	122	130	144	131	127	109	98
					010102	342	384	294	289	267	239	250	200	177	152	129	122	130	144	131	127	109	98
					010103					267	239	250	200	177	152	129	122	130	144	131			
					010104					267	239	250	200										
					010202					200	200	200	200	200	200	95	95	95	95	95	95		95
					010203					200	200	200	200	200	200	95	95				95		
			1A2	Industry	030100	200	200	200	200	200	200	200	200	200	200	95	95	95	95	95	95	95	95
			1A4a	Commercial/ Institutional	020100	200	200	200	200	200	200	200	200	200						95			
			1A4b i	Residential	020200	200	200	200	200	200	200	200	200	200	200	95	95	95	95	95	95	95	95
			1A4c i	Agriculture/ Forestry	020300	200	200	200	200	200	200	200	200	200	200	95	95	95	95	95	95	95	95
		COKE OVEN COKE	1A2	Industry	030100	200	200	200	200	200	200	200	200	200	200	95	95	95	95	95	95	95	95
			1A4b i	Residential	020200	200	200	200	200	200	200	200	200	200	200	95	95	95	95	95	95	95	95

pol_abbr	fuel_type	fuel_gr_abbr	nfr_id_E	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						Data																	
NMVOC	BIOMASS	WOOD	1A4b i	Residential	020200	703	703	703	703	703	703	703	703	703	703	703	630	602	599	594	570	549	540
	GAS	NATURAL GAS	1A1a	Electricity and heat production	010105	60	69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
					010205					140	142	138	124	122	122	121	121	121	121	115	110	105	105
			1A1c	Other energy industries	010505	60	69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
			1A2	Industry	030105	60	69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
			1A4a	Commercial/ Institutional	020105	60	69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
			1A4b i	Residential	020204		69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
			1A4c i	Agriculture/ Forestry	020304	60	69	81	127	140	142	138	124	122	122	121	121	121	121	115	110	105	105
	LIQUID	REFINERY GAS	1A1b	Petroleum refining	010306	4	4	4	4												1,4	1,4	1,4

pol_abbr	fuel_type	fuel_gr_abbr	nfr_id_E	nfr_name	snap_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
						Data																	
CO	BIOMASS	BIOGAS	1A1a	Electricity and heat production	010105	230	234	239	243	248	252	256	260	265	269	273	273	273	273	273	273	273	273
					010205					248										273	273	273	273
			1A1c	Other energy industries	010505	230	234	239	243	248	252	256	260	265	269	273	273	273	273	273	273	273	273
			1A2	Industry	030105									265	269	273	273	273	273	273		273	273
			1A4a	Commercial/ Institutional	020105	230	234	239	243	248	252	256	260	265	269	273	273	273	273	273	273	273	273
			1A4c i	Agriculture/ Forestry	020304	230	234	239	243	248	252	256	260	265	269	273	273	273	273	273	273	273	273
		STRAW	1A1a	Electricity and heat production	010200	600	554	508	463														
					010202					417	371	325	325	325	325	325	325			325	325	325	325
					010203					417	371	325	325	325	325	325	325	325	325	325	325	325	325
			1A4b i	Residential	020200	8500	8500	8500	8500	8500	7500	6500	5500	4500	4000	4000	4000	4000	4000	4000	4000	4000	4000
			1A4c i	Agriculture/ Forestry	020300	8500	8500	8500	8500	8500	7500	6500	5500	4500	4000	4000	4000	4000	4000	4000	4000	4000	4000
		WOOD	1A1a	Electricity and heat production	010200	400	373	347	320														
					010202					293	267	240	240	240	240	240	240	240	240	240	240	240	240
					010203					293	267	240	240	240	240	240	240	240	240	240	240	240	240
			1A2	Industry	030100	400	373	347	320	293	267	240	240	240	240	240	240	240	240	240	240	240	240
					030103					293	267	240	240	240	240	240	240	240	240	240	240	240	240
			1A4a	Commercial/ Institutional	020100	400	373	347	320	293	267	240	240	240	240	240	240	240	240	240	240	240	240
			1A4b i	Residential	020200	4146	4146	4146	4146	4146	4146	4146	4146	4146	4146	4146	3779	3656	3659	3657	3546	3436	3441
			1A4c i	Agriculture/ Forestry	020300	400	373	347	320	293	267	240	240	240	240	240	240	240	240	240	240	240	240
	GAS	NATURAL GAS	1A1a	Electricity and heat production	010105	189	211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
					010205					226	222	221	182	182	182	183	183	183	183	160	137	115	115
			1A1c	Other energy industries	010505	189	211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
			1A2	Industry	030105	189	211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
			1A4a	Commercial/ Institutional	020105	189	211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
			1A4b i	Residential	020204		211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
			1A4c i	Agriculture/ Forestry	020304	189	211	212	227	226	222	221	182	182	182	183	183	183	183	160	137	115	115
	LIQUID	REFINERY GAS	1A1b	Petroleum refining	010306	15	15	15	15												6,2	6,2	6,2
	OTHER 1	MUNICIP. WASTES	1A1a	Electricity and heat production	010200	100	85	70	55														
					010202					40	25												
					010203					40	25	10	10	10	10	10	10	10	10	10	10	10	10
			1A2	Industry	030100	100	85	70	55	40	25	10	10	10	10							10	
			1A4a	Commercial/ Institutional	020100	100	85	70	55	40	25	10	10	10	10	10			10	10	10	10	
					020103					40	25	10	10	10	10	10	10	10	10	10	10	10	10
	SOLID	COAL	1A4a	Commercial/ Institutional	020100	10	10	10	10	10	10	10	10	10						2000			

Appendix 3A-6 Implied emission factors for municipal waste incineration plants and power plants combustion coal

Table 3A-45 Implied emission factors for municipal waste incineration plants 2007.

Pollutant	Implied Emission factor	Unit
SO_2	8	g pr GJ
NO_x	109	g pr GJ

Table 3A-46 Implied emission factors for power plants combusting coal, 2007.

Pollutant	Implied Emission factor	Unit
SO_2	26	g pr GJ
NO_x	109	g pr GJ

Appendix 3A-7 Large point sources

Table 3A-47 Large point sources, fuel consumption in 2007 (1A1, 1A2 and 1A4).

nfr_id_EA	nfr_name	snap_id	lps_id	lps_name	part_id	fuel	fuel_gr_abbr	lpsrat_val
1A1a	Electricity and heat production	010101	001	Amagervaerket	02	111	WOOD	452553
1A1a	Electricity and heat production	010101	001	Amagervaerket	02	117	STRAW	881728
1A1a	Electricity and heat production	010101	001	Amagervaerket	02	203	RESIDUAL OIL	43800
1A1a	Electricity and heat production	010101	001	Amagervaerket	03	102	COAL	14149700
1A1a	Electricity and heat production	010101	001	Amagervaerket	03	203	RESIDUAL OIL	104900
1A1a	Electricity and heat production	010101	003	H.C.Oerstedsvaerket	03	203	RESIDUAL OIL	532318
1A1a	Electricity and heat production	010101	003	H.C.Oerstedsvaerket	03	204	GAS OIL	22309
1A1a	Electricity and heat production	010101	003	H.C.Oerstedsvaerket	03	215	FISH & RAPE OIL	4774
1A1a	Electricity and heat production	010101	003	H.C.Oerstedsvaerket	03	301	NATURAL GAS	5116528
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	21	204	GAS OIL	281923
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	22	203	RESIDUAL OIL	571067
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	26	203	RESIDUAL OIL	112637
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	26	204	GAS OIL	137425
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	28	203	RESIDUAL OIL	46803
1A1a	Electricity and heat production	010101	004	Kyndbyvaerket	28	204	GAS OIL	3886
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	01	102	COAL	1264509
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	01	203	RESIDUAL OIL	158297
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	02	102	COAL	7999900
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	02	203	RESIDUAL OIL	200877
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	03	203	RESIDUAL OIL	99095
1A1a	Electricity and heat production	010101	007	Stigsnaesvaerket	03	204	GAS OIL	6152
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	02	102	COAL	4539556
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	02	203	RESIDUAL OIL	286726
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	04	102	COAL	2132827
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	04	203	RESIDUAL OIL	191138
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	05	102	COAL	26551311
1A1a	Electricity and heat production	010101	008	Asnaesvaerket	05	203	RESIDUAL OIL	837640
1A1a	Electricity and heat production	010101	010	Avedoerevaerket	01	102	COAL	14002300
1A1a	Electricity and heat production	010101	010	Avedoerevaerket	01	203	RESIDUAL OIL	308000
1A1a	Electricity and heat production	010101	011	Fynsvaerket+Odense kraftvarmevaerk	03	102	COAL	7122500
1A1a	Electricity and heat production	010101	011	Fynsvaerket+Odense kraftvarmevaerk	03	203	RESIDUAL OIL	440810
1A1a	Electricity and heat production	010101	011	Fynsvaerket+Odense kraftvarmevaerk	07	102	COAL	11378390
1A1a	Electricity and heat production	010101	011	Fynsvaerket+Odense kraftvarmevaerk	07	203	RESIDUAL OIL	240930
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	03	102	COAL	8030230
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	03	117	STRAW	411680
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	03	203	RESIDUAL OIL	195700
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	04	102	COAL	16341090
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	04	117	STRAW	1371740
1A1a	Electricity and heat production	010101	012	Studstrupvaerket	04	203	RESIDUAL OIL	334880
1A1a	Electricity and heat production	010101	014	Nordjyllandsvaerket	02	102	COAL	7155700
1A1a	Electricity and heat production	010101	014	Nordjyllandsvaerket	02	203	RESIDUAL OIL	97500
1A1a	Electricity and heat production	010101	014	Nordjyllandsvaerket	03	102	COAL	21953100
1A1a	Electricity and heat production	010101	014	Nordjyllandsvaerket	03	203	RESIDUAL OIL	116500
1A1a	Electricity and heat production	010101	018	Skaerbaekvaerket	03	204	GAS OIL	111070
1A1a	Electricity and heat production	010101	018	Skaerbaekvaerket	03	301	NATURAL GAS	8770000
1A1a	Electricity and heat production	010101	019	Enstedvaerket	03	102	COAL	19364700
1A1a	Electricity and heat production	010101	019	Enstedvaerket	03	203	RESIDUAL OIL	257310
1A1a	Electricity and heat production	010101	019	Enstedvaerket	04	111	WOOD	169086
1A1a	Electricity and heat production	010101	019	Enstedvaerket	04	117	STRAW	1808582
1A1a	Electricity and heat production	010101	019	Enstedvaerket	04	215	FISH & RAPE OIL	9820
1A1a	Electricity and heat production	010101	020	Esbjergvaerket	03	102	COAL	18912480
1A1a	Electricity and heat production	010101	020	Esbjergvaerket	03	203	RESIDUAL OIL	324770
1A1a	Electricity and heat production	010102	005	Masnedoevaerket	12	111	WOOD	86491
1A1a	Electricity and heat production	010102	005	Masnedoevaerket	12	117	STRAW	464757
1A1a	Electricity and heat production	010102	011	Fynsvaerket+Odense kraftvarmevaerk	08	114	MUNICIP. WASTES	2882000
1A1a	Electricity and heat production	010102	011	Fynsvaerket+Odense kraftvarmevaerk	08	204	GAS OIL	20000
1A1a	Electricity and heat production	010102	022	Oestkraft	05	203	RESIDUAL OIL	19218
1A1a	Electricity and heat production	010102	022	Oestkraft	06	102	COAL	590631
1A1a	Electricity and heat production	010102	022	Oestkraft	06	111	WOOD	29147
1A1a	Electricity and heat production	010102	022	Oestkraft	06	203	RESIDUAL OIL	29904
1A1a	Electricity and heat production	010102	025	Horsens Kraftvarmevaerk	01	111	WOOD	8657
1A1a	Electricity and heat production	010102	025	Horsens Kraftvarmevaerk	01	114	MUNICIP. WASTES	920885
1A1a	Electricity and heat production	010102	026	Herningvaerket	01	111	WOOD	2713530
1A1a	Electricity and heat production	010102	026	Herningvaerket	01	203	RESIDUAL OIL	111850
1A1a	Electricity and heat production	010102	026	Herningvaerket	01	301	NATURAL GAS	799604
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	01	114	MUNICIP. WASTES	2003946
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	01	204	GAS OIL	21449
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	02	114	MUNICIP. WASTES	676001
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	02	301	NATURAL GAS	13707
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	03	114	MUNICIP. WASTES	2772242
1A1a	Electricity and heat production	010102	027	I/S Vestforbraending	03	301	NATURAL GAS	25548
1A1a	Electricity and heat production	010102	028	Amagerforbraending	01	114	MUNICIP. WASTES	4390281
1A1a	Electricity and heat production	010102	029	Energi Randers Produktion	01	102	COAL	1932510
1A1a	Electricity and heat production	010102	029	Energi Randers Produktion	01	111	WOOD	1114443
1A1a	Electricity and heat production	010102	029	Energi Randers Produktion	01	309	BIOGAS	15827
1A1a	Electricity and heat production	010102	029	Energi Randers Produktion	02	204	GAS OIL	62920

nfr_id_EA	nfr_name	snap_id	lps_id	lps_name	part_id	fuel	fuel_gr_abbr	lpsrat_val
1A1a	Electricity and heat production	010102	030	Grenaa Kraftvarmevaerk	01	102	COAL	526930
1A1a	Electricity and heat production	010102	030	Grenaa Kraftvarmevaerk	01	111	WOOD	8991
1A1a	Electricity and heat production	010102	030	Grenaa Kraftvarmevaerk	01	117	STRAW	563406
1A1a	Electricity and heat production	010102	030	Grenaa Kraftvarmevaerk	01	203	RESIDUAL OIL	17780
1A1a	Electricity and heat production	010102	030	Grenaa Kraftvarmevaerk	01	204	GAS OIL	5129
1A1a	Electricity and heat production	010102	037	Maabjergvaerket	02	111	WOOD	336000
1A1a	Electricity and heat production	010102	037	Maabjergvaerket	02	114	MUNICIP. WASTES	1895000
1A1a	Electricity and heat production	010102	037	Maabjergvaerket	02	117	STRAW	420000
1A1a	Electricity and heat production	010102	037	Maabjergvaerket	02	301	NATURAL GAS	107604
1A1a	Electricity and heat production	010102	038	Soenderborg Kraftvarmevaerk	01	111	WOOD	2455
1A1a	Electricity and heat production	010102	038	Soenderborg Kraftvarmevaerk	01	114	MUNICIP. WASTES	714200
1A1a	Electricity and heat production	010102	039	I/S Kara Affaldsforbraendingsanlaeg	01	114	MUNICIP. WASTES	2145623
1A1a	Electricity and heat production	010102	039	I/S Kara Affaldsforbraendingsanlaeg	01	301	NATURAL GAS	8756
1A1a	Electricity and heat production	010102	042	I/S Nordforbraending	01	111	WOOD	149075
1A1a	Electricity and heat production	010102	042	I/S Nordforbraending	01	114	MUNICIP. WASTES	1334739
1A1a	Electricity and heat production	010102	046	Affaldscenter aarhus - Forbraendsanlaegget	01	114	MUNICIP. WASTES	2499357
1A1a	Electricity and heat production	010102	053	Svendborg Kraftvarmevaerk	01	114	MUNICIP. WASTES	503126
1A1a	Electricity and heat production	010102	053	Svendborg Kraftvarmevaerk	01	301	NATURAL GAS	2235
1A1a	Electricity and heat production	010102	054	Kommunekemi	01	114	MUNICIP. WASTES	450250
1A1a	Electricity and heat production	010102	054	Kommunekemi	01	203	RESIDUAL OIL	234078
1A1a	Electricity and heat production	010102	054	Kommunekemi	01	204	GAS OIL	6743
1A1a	Electricity and heat production	010102	054	Kommunekemi	02	114	MUNICIP. WASTES	475829
1A1a	Electricity and heat production	010102	054	Kommunekemi	02	203	RESIDUAL OIL	190526
1A1a	Electricity and heat production	010102	054	Kommunekemi	02	204	GAS OIL	6887
1A1a	Electricity and heat production	010102	054	Kommunekemi	03	114	MUNICIP. WASTES	509324
1A1a	Electricity and heat production	010102	054	Kommunekemi	03	203	RESIDUAL OIL	172791
1A1a	Electricity and heat production	010102	054	Kommunekemi	03	204	GAS OIL	6169
1A1a	Electricity and heat production	010102	085	L90 Affaldsforbraending	01	114	MUNICIP. WASTES	2270717
1A1a	Electricity and heat production	010102	085	L90 Affaldsforbraending	01	204	GAS OIL	6951
1A1a	Electricity and heat production	010102	087	Koege Kraftvarmevaerk	07	111	WOOD	1637548
1A1a	Electricity and heat production	010102	087	Koege Kraftvarmevaerk	07	203	RESIDUAL OIL	33410
1A1a	Electricity and heat production	010103	036	Kolding Forbraendingsanlaeg	01	111	WOOD	2232
1A1a	Electricity and heat production	010103	036	Kolding Forbraendingsanlaeg	01	114	MUNICIP. WASTES	662760
1A1a	Electricity and heat production	010103	047	I/S Reno Nord	01	114	MUNICIP. WASTES	1930173
1A1a	Electricity and heat production	010103	047	I/S Reno Nord	01	204	GAS OIL	4459
1A1a	Electricity and heat production	010103	051	AVV Forbraendingsanlaeg	01	114	MUNICIP. WASTES	865788
1A1a	Electricity and heat production	010103	052	Affaldsforbraendingsanlaeg I/S REFA	01	114	MUNICIP. WASTES	1232994
1A1a	Electricity and heat production	010103	058	I/S Reno Syd	01	114	MUNICIP. WASTES	660849
1A1a	Electricity and heat production	010103	059	I/S Kraftvarmevaerk Thisted	01	114	MUNICIP. WASTES	539270
1A1a	Electricity and heat production	010103	059	I/S Kraftvarmevaerk Thisted	01	117	STRAW	10078
1A1a	Electricity and heat production	010103	060	Knudmosevaerket	01	114	MUNICIP. WASTES	500890
1A1a	Electricity and heat production	010103	060	Knudmosevaerket	01	301	NATURAL GAS	38413
1A1a	Electricity and heat production	010103	061	Kavo I/S Energien+Slagelse Kraftvarmevaerk	01	114	MUNICIP. WASTES	220271
1A1a	Electricity and heat production	010103	061	Kavo I/S Energien+Slagelse Kraftvarmevaerk	02	114	MUNICIP. WASTES	484726
1A1a	Electricity and heat production	010103	061	Kavo I/S Energien+Slagelse Kraftvarmevaerk	02	117	STRAW	405282
1A1a	Electricity and heat production	010103	065	Haderslev Kraftvarmevaerk	01	114	MUNICIP. WASTES	614900
1A1a	Electricity and heat production	010103	065	Haderslev Kraftvarmevaerk	01	301	NATURAL GAS	15940
1A1a	Electricity and heat production	010103	066	Frederiskhavn Affaldskraftvarmevaerk	01	114	MUNICIP. WASTES	397630
1A1a	Electricity and heat production	010103	067	Vejen Kraftvarmevaerk	01	111	WOOD	2100
1A1a	Electricity and heat production	010103	067	Vejen Kraftvarmevaerk	01	114	MUNICIP. WASTES	393000
1A1a	Electricity and heat production	010104	002	Svanemoellevaerket	07	204	GAS OIL	20536
1A1a	Electricity and heat production	010104	002	Svanemoellevaerket	07	301	NATURAL GAS	4279718
1A1a	Electricity and heat production	010104	004	Kyndbyvaerket	51	204	GAS OIL	12539
1A1a	Electricity and heat production	010104	004	Kyndbyvaerket	52	204	GAS OIL	12685
1A1a	Electricity and heat production	010104	005	Masnedoevaerket	31	204	GAS OIL	17123
1A1a	Electricity and heat production	010104	010	Avedoerevaerket	02	111	WOOD	3758121
1A1a	Electricity and heat production	010104	010	Avedoerevaerket	02	117	STRAW	2510576
1A1a	Electricity and heat production	010104	010	Avedoerevaerket	02	203	RESIDUAL OIL	4501300
1A1a	Electricity and heat production	010104	010	Avedoerevaerket	02	301	NATURAL GAS	8442481
1A1a	Electricity and heat production	010104	025	Horsens Kraftvarmevaerk	02	301	NATURAL GAS	651396
1A1a	Electricity and heat production	010104	031	Hilleroed Kraftvarmevaerk	01	301	NATURAL GAS	2873789
1A1a	Electricity and heat production	010104	032	Helsingoer Kraftvarmevaerk	01	301	NATURAL GAS	1352468
1A1a	Electricity and heat production	010104	038	Soenderborg Kraftvarmevaerk	02	301	NATURAL GAS	1042438
1A1a	Electricity and heat production	010104	040	Viborg Kraftvarme	01	301	NATURAL GAS	2109698
1A1a	Electricity and heat production	010104	048	Silkeborg Kraftvarmevaerk	01	301	NATURAL GAS	2997034
1A1a	Electricity and heat production	010104	069	DTU	01	301	NATURAL GAS	1191908
1A1a	Electricity and heat production	010104	070	Naestved Kraftvarmevaerk	01	301	NATURAL GAS	86196
1A1a	Electricity and heat production	010104	072	Hjoerring Varmeforsyning	01	301	NATURAL GAS	154080
1A1a	Electricity and heat production	010105	004	Kyndbyvaerket	41	204	GAS OIL	1479
1A1a	Electricity and heat production	010105	032	Helsingoer Kraftvarmevaerk	02	301	NATURAL GAS	9812
1A1a	Electricity and heat production	010203	036	Kolding Forbraendingsanlaeg	05	114	MUNICIP. WASTES	567630
1A1a	Electricity and heat production	010203	036	Kolding Forbraendingsanlaeg	05	204	GAS OIL	3694
1A1a	Electricity and heat production	010203	050	Fasan+Naestved Kraftvarmevaerk	01	114	MUNICIP. WASTES	1290377
1A1a	Electricity and heat production	010203	055	I/S Faelles Forbraending	01	114	MUNICIP. WASTES	330000
1A1a	Electricity and heat production	010203	068	Bofa I/S	01	114	MUNICIP. WASTES	219488
1A1a	Electricity and heat production	010203	086	Hammel Fjernvarme	01	114	MUNICIP. WASTES	320870
1A1a	Electricity and heat production	010203	086	Hammel Fjernvarme	01	215	FISH & RAPE OIL	6517
1A1a	Electricity and heat production	010203	088	Skagen Forbraendingen	01	114	MUNICIP. WASTES	125832
1A1b	Petroleum refining	010304	017	Shell Raffinaderi	05	308	REFINERY GAS	2299437
1A1b	Petroleum refining	010306	009	Statoil Raffinaderi	01	204	GAS OIL	7024

nfr_id_EA	nfr_name	snap_id	lps_id	lps_name	part_id	fuel	fuel_gr_abbr	lpsrat_val
1A1b	Petroleum refining	010306	009	Statoil Raffinaderi	01	308	REFINERY GAS	7052384
1A1b	Petroleum refining	010306	017	Shell Raffinaderi	01	203	RESIDUAL OIL	792504
1A1b	Petroleum refining	010306	017	Shell Raffinaderi	01	308	REFINERY GAS	4506111
1A1c	Other energy industries	010502	024	Nybro Gasbehandlingsanlaeg	01	301	NATURAL GAS	348025
1A2	Industry	030100	081	Haldor Topsoee	02	204	GAS OIL	1600
1A2	Industry	030100	081	Haldor Topsoee	02	301	NATURAL GAS	516600
1A2	Industry	030100	081	Haldor Topsoee	02	303	LPG	200
1A2	Industry	030102	023	Danisco Grindsted	01	102	COAL	547050
1A2	Industry	030102	023	Danisco Grindsted	01	203	RESIDUAL OIL	12718
1A2	Industry	030102	023	Danisco Grindsted	01	301	NATURAL GAS	8571
1A2	Industry	030102	033	DanSteel	01	301	NATURAL GAS	1407236
1A2	Industry	030102	034	Dalum Papir	01	111	WOOD	1062759
1A2	Industry	030102	034	Dalum Papir	01	204	GAS OIL	4161
1A2	Industry	030102	034	Dalum Papir	01	301	NATURAL GAS	156801
1A2	Industry	030102	082	Danisco Sugar Nakskov	02	102	COAL	616998
1A2	Industry	030102	082	Danisco Sugar Nakskov	02	203	RESIDUAL OIL	595766
1A2	Industry	030102	082	Danisco Sugar Nakskov	02	204	GAS OIL	3372
1A2	Industry	030102	082	Danisco Sugar Nakskov	02	309	BIOGAS	30314
1A2	Industry	030102	083	Danisco Sugar Nykoebing	02	102	COAL	208396
1A2	Industry	030102	083	Danisco Sugar Nykoebing	02	107	COKE OVEN COKE	37065
1A2	Industry	030102	083	Danisco Sugar Nykoebing	02	203	RESIDUAL OIL	808362
1A2	Industry	030104	071	Maricogen	01	301	NATURAL GAS	1315454
1A2	Industry	030311	045	Aalborg Portland	01	102	COAL	4030000
1A2	Industry	030311	045	Aalborg Portland	01	110	PETROLEUM COKE	9109000
1A2	Industry	030311	045	Aalborg Portland	01	114	MUNICIP. WASTES	1644000
1A2	Industry	030311	045	Aalborg Portland	01	203	RESIDUAL OIL	1056000
1A2	Industry	030315	078	Rexam Glass Holmegaard A/S	01	204	GAS OIL	338
1A2	Industry	030315	078	Rexam Glass Holmegaard A/S	01	301	NATURAL GAS	833656
1A2	Industry	030318	075	Rockwool A/S Hedehusene	01	301	NATURAL GAS	46800
1A2	Industry	030318	076	Rockwool A/S Vamdrup	01	107	COKE OVEN COKE	470880
1A2	Industry	030318	076	Rockwool A/S Vamdrup	01	301	NATURAL GAS	313920
1A2	Industry	030318	077	Rockwool A/S Doense	01	107	COKE OVEN COKE	406080
1A2	Industry	030318	077	Rockwool A/S Doense	01	301	NATURAL GAS	270720
1A4a	Commercial/ Institutional	020103	049	Rensningsanlaegget Lynetten	01	114	MUNICIP. WASTES	48720
1A4a	Commercial/ Institutional	020103	049	Rensningsanlaegget Lynetten	01	204	GAS OIL	15853
1A4a	Commercial/ Institutional	020103	049	Rensningsanlaegget Lynetten	01	309	BIOGAS	101606

Table 3A-48 Large point sources, plant specific emissions (IPCC 1A1, 1A2 and 1A4)[1)].

LPS_id	LPS name	LPS part	Sector (IPCC)	Sector (SNAP)	SO_2	NO_x	NMVOC	CO
001	Amagervaerket	02	1A1a	010101	x	x		
001	Amagervaerket	03	1A1a	010101	x	x		
002	Svanemoellevaerket	05	1A1a	010101	x	x		
002	Svanemoellevaerket	07	1A1a	010104	X	x		
003	H.C.Oerstedsvaerket	03	1A1a	010101	x	x		
003	H.C.Oerstedsvaerket	07	1A1a	010101	x	x		
003	H.C.Oerstedsvaerket	08	1A1a	010101	x	x		
004	Kyndbyvaerket	21	1A1a	010101	x	x		
004	Kyndbyvaerket	22	1A1a	010101	x	x		
004	Kyndbyvaerket	26	1A1a	010101	x	x		
004	Kyndbyvaerket	28	1A1a	010101	x	x		
004	Kyndbyvaerket	41	1A1a	010105				
004	Kyndbyvaerket	51	1A1a	010104	x	x		
004	Kyndbyvaerket	52	1A1a	010104	x	x		
005	Masnedoevaerket	12	1A1a	010102	x	x		
005	Masnedoevaerket	31	1A1a	010104	x	x		
007	Stigsnaesvaerket	01	1A1a	010101	x	x		
007	Stigsnaesvaerket	02	1A1a	010101	x	x		
008	Asnaesvaerket	02	1A1a	010101	x	x		
008	Asnaesvaerket	03	1A1a	010101	x	x		
008	Asnaesvaerket	04	1A1a	010101	x	x		
008	Asnaesvaerket	05	1A1a	010101	x	x		
009	Statoil Raffinaderi	01	1A1b	010306	x	x		
010	Avedoerevaerket	01	1A1a	010101	x	x		x
010	Avedoerevaerket	02	1A1a	010104	x	x		x
011	Fynsvaerket	03	1A1a	010101	x	x		
011	Fynsvaerket	07	1A1a	010101	x	x		
011	Fynsvaerket	08	1A1a	010102	x	x		x
012	Studstrupvaerket	03	1A1a	010101	x	x		
012	Studstrupvaerket	04	1A1a	010101	x	x		
014	Nordjyllandsvaerket	02	1A1a	010101	x	x		
014	Nordjyllandsvaerket	03	1A1a	010101	x	x		
017	Shell Raffinaderi	01	1A1b	010306	x	x		
017	Shell Raffinaderi	05	1A1b	010304	x	x		
018	Skaerbaekvaerket	01	1A1a	010101	x	x		
018	Skaerbaekvaerket	03	1A1a	010101	x	x		x
019	Enstedvaerket	03	1A1a	010101	x	x		
019	Enstedvaerket	04	1A1a	010101	x	x		
020	Esbjergvaerket	03	1A1a	010101	x	x		x
022	Oestkraft	05	1A1a	010102	x	x		

LPS_id	LPS name	LPS part	Sector (IPCC)	Sector (SNAP)	SO_2	NO_x	NMVOC	CO
022	Oestkraft	06	1A1a	010102	x	x		
023	Danisco Ingredients	01	1A2f	030102	x	x		
024	Dansk Naturgas Behandlingsanlaeg	01	1A1c	010502		x		
025	Horsens Kraftvarmevaerk	01	1A1a	010102	x	x		x
025	Horsens Kraftvarmevaerk	02	1A1a	010104		x		
026	Herningvaerket	01	1A1a	010102	x	x		x
027	Vestforbraendingen	01	1A1a	010102	x	x		
027	Vestforbraendingen	02	1A1a	010102	x	x		
028	Amagerforbraendingen	01	1A1a	010102	x	x	x	x
029	Randersvaerket	01	1A1a	010102	x	x		
030	Grenaavaerket	01	1A1a	010102	x	x		x
031	Hilleroedvaerket	01	1A1a	010104	x	x		
032	Helsingoervaerket	01	1A1a	010104	x	x		
032	Helsingoervaerket	02	1A1a	010105	x	x		
033	Staalvalsevaerket	01	1A2f	030102		x		
034	Stora Dalum	01	1A2f	030102		x		
035	Assens Sukkerfabrik	01	1A2f	030102	x			
036	Kolding Kraftvarmevaerk	01	1A1a	010103	x		x	x
036	Kolding Kraftvarmevaerk	03	1A1a	010103	x	x	x	x
037	Maabjergvaerket	02	1A1a	010102	x	x		x
038	Soenderborg Kraftvarmevaerk	01	1A1a	010102	x	x		x
038	Soenderborg Kraftvarmevaerk	02	1A1a	010104		x		
039	Kara Affaldsforbraendingsanlaeg	01	1A1a	010102	x			x
040	Viborg Kraftvarmevaerk	01	1A1a	010104	x	x		
042	Nordforbraendingen	01	1A1a	010102	x	x		x
045	Aalborg Portland	01/03	1A2f	030311	x	x		x
046	Aarhus Nord	01	1A1a	010102	x	x	x	
047	Reno Nord	01	1A1a	010103	x	x		x
048	Silkeborg Kraftvarmevaerk	01	1A1a	010104	x	x		
049	Rensningsanlægget Lynetten	01	1A4a	020103	x			
050	I/S Fasan	01	1A1a	010203	x	x		x
051	AVV Forbrændingsanlæg	01	1A1a	010103	x			x
052	I/S REFA Kraftvarmeværk	01	1A1a	010103				
053	Svendborg Kraftvarmeværk	01	1A1a	010102	x	x	x	x
054	Kommunekemi	01	1A1a	010102	x			x
054	Kommunekemi	02	1A1a	010102	x			x
054	Kommunekemi	03	1A1a	010102	x			x
058	I/S Reno Syd	01	1A1a	010103	x			x
059	I/S Kraftvarmeværk Thisted	01	1A1a	010103	x			x
060	Knudmoseværket	01	1A1a	010103	x			x
061	Kavo I/S Energien	01	1A1a	010103	x		x	x
061	Kavo I/S Energien	02	1A1a	010103	x	x		
065	Haderslev Kraftvarmeværk	01	1A1a	010103	x	x		x
066	Frederiskhavn Affaldskraftvarmeværk	01	1A1a	010103	x	x		x
067	Vejen Kraftvarmeværk	01	1A1a	010103	x	x		x
068	Bofa I/S	01	1A1a	010203	x			x
069	DTU	01	1A1a	010104	x	x		
070	Næstved Kraftvarmeværk	01	1A1a	010104		x		x
071	Maricogen	01	1A2f	030104	x	x		
072	Hjørring KVV	01	1A1a	010104	x	x		
076	Rockwool A/S Vamdrup	01	1A2f	030318	x		x	x
077	Rockwool A/S Doense	01	1A2f	030318	x		x	x
078	Rexam Glass Holmegaard A/S	01	1A2f	030315		x		x
080	Saint-Gobain Isover A/S	01	1A2f	030316				
081	Haldor Topsøe	02	1A2f	0301				
082	Danisco Sugar Nakskov	02	1A2f	030102				
083	Danisco Sugar Nykøbing	02	1A2f	030102				
085	L90 Affaldsforbrænding	01	1A1a	010102	x	x		x
086	Hammel Fjernvarme	01	1A1a	010203	x	x		x
087	Koege Kraftvarmevaerk	01	1A1a	010102	x	x	x	x
088	Skagen Forbraending	01	1A1a	010203	x		x	x
	Total				10493	36413	21	12373

1) Emission of the pollutants marked with "x" is plant specific. Emission of other pollutants is estimated based on emission factors. The total shown *in this table*-only includes plant specific data.

2) Based on particle size distribution.

Appendix 3A-8 Adjustment of CO_2 emission

Table 3A-49 Adjustment of CO_2 emission (ref. Danish Energy Authority 2008).

Degree Days		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Actual Degree Days	Degree days	2857	3284	3022	3434	3148	3297	3837	3236	3217	3056
Normal Degree Days	Degree days	3379	3380	3 359	3 365	3 366	3 378	3 395	3 389	3 375	3 339
Net electricity import	TJ	25373	-7099	13486	4266	-17424	-2858	-55444	-26107	-15552	-8327
Actual CO_2 emission	1 000 000 tonnes	52, 7	62, 8	56, 7	58, 9	62, 7	59, 6	73,0	63, 2	59, 4	56, 5
Adjusted CO_2 emission	1,000,000 tonnes	60,8	61,5	60,8	59,7	59,6	59,1	58,5	57,7	56,2	55,4

Continued

Degree Days		2000	2001	2002	2003	2004	2005	2006	2007
Actual Degree Days	Degree days	2902	3279	3011	3150	3113	3068	2908	2807
Normal Degree Days	Degree days	3 304	3 289	3 273	3 271	3 261	3 224	3 188	3136
Net electricity import	TJ	2394	-2071	-7453	-30760	-10340	4932	-24971	-3420
Actual CO_2 emission	1 000 000 tonnes	52, 5	53, 9	53, 1	58, 2	52, 8	49, 4	57, 3	52, 6
Adjusted CO_2 emission	1,000,000 tonnes	54,2	53,6	52,2	51,7	50,9	51,0	52,4	52,7

Appendix 3A-9 Uncertainty estimates 2007

Table 3A-50 Uncertainty estimation, GHG.

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data Gg CO_2 eq	Input data Gg CO_2 eq	Input data %	Input data %	%	%	%	%	%	%	%
Stationary Combustion, Coal	CO_2	24077	18302	1	5	5,099	2,681	-0,097	0,481	-0,485	0,680	0,835
Stationary Combustion, BKB	CO_2	11	0	3	5	5,831	0,000	0,000	0,000	-0,001	0,000	0,001
Stationary Combustion, Coke	CO_2	138	121	3	5	5,831	0,020	0,000	0,003	-0,001	0,014	0,014
Stationary Combustion, Petroleum coke	CO_2	410	970	3	5	5,831	0,163	0,016	0,025	0,078	0,108	0,133
Stationary Combustion, Plastic waste	CO_2	349	728	5	5	7,071	0,148	0,011	0,019	0,054	0,135	0,146
Stationary Combustion, Residual oil	CO_2	2505	1655	2	2	2,828	0,135	-0,017	0,043	-0,033	0,123	0,127
Stationary Combustion, Gas oil	CO_2	4547	1614	4	5	6,403	0,297	-0,067	0,042	-0,334	0,240	0,411
Stationary Combustion, Kerosene	CO_2	366	9	4	5	6,403	0,002	-0,009	0,000	-0,043	0,001	0,043
Stationary Combustion, Natural gas	CO_2	4320	9702	3	1	3,162	0,881	0,151	0,255	0,151	1,082	1,092
Stationary Combustion, LPG	CO_2	169	90	4	5	6,403	0,017	-0,002	0,002	-0,008	0,013	0,016
Stationary Combustion, Refinery gas	CO_2	806	906	3	5	5,831	0,152	0,004	0,024	0,022	0,101	0,103
Stationary combustion plants, gas engines	CH_4	7	215	2,2	40	40,060	0,248	0,005	0,006	0,220	0,018	0,221
Stationary combustion plants, other	CH_4	115	217	2,2	100	100,024	0,623	0,003	0,006	0,293	0,018	0,294
Stationary combustion plants	N_2O	240	277	2,2	1000	1000,002	7,954	0,001	0,007	1,498	0,023	1,498
Total		38060	34806				71,867					4,507
Total uncertainties			Overall uncertainty in the year (%):				8,477				Trend uncertainty (%):	2,123

Table 3A-51 Uncertainty estimation, CO_2.

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data Gg CO_2	Input data Gg CO_2	Input data %	Input data %	%	%	%	%	%	%	%
Stationary Combustion, Coal	CO_2	24077	18302	1	5	5,099	2,681	-0,097	0,481	-0,485	0,680	0,835
Stationary Combustion, BKB	CO_2	11	0	3	5	5,831	0,000	0,000	0,000	-0,001	0,000	0,001
Stationary Combustion, Coke	CO_2	138	121	3	5	5,831	0,020	0,000	0,003	-0,001	0,014	0,014
Stationary Combustion, Petroleum coke	CO_2	410	970	3	5	5,831	0,163	0,016	0,025	0,078	0,108	0,133
Stationary Combustion, Plastic waste	CO_2	349	728	5	5	7,071	0,148	0,011	0,019	0,054	0,135	0,146
Stationary Combustion, Residual oil	CO_2	2505	1655	2	2	2,828	0,135	-0,017	0,043	-0,033	0,123	0,127
Stationary Combustion, Gas oil	CO_2	4547	1614	4	5	6,403	0,297	-0,067	0,042	-0,334	0,240	0,411
Stationary Combustion, Kerosene	CO_2	366	9	4	5	6,403	0,002	-0,009	0,000	-0,043	0,001	0,043
Stationary Combustion, Natural gas	CO_2	4320	9702	3	1	3,162	0,881	0,151	0,255	0,151	1,082	1,092
Stationary Combustion, LPG	CO_2	169	90	4	5	6,403	0,017	-0,002	0,002	-0,008	0,013	0,016
Stationary Combustion, Refinery gas	CO_2	806	906	3	5	5,831	0,152	0,004	0,024	0,022	0,101	0,103
Total	CO_2	37698	34097				8,486					2,135
Total uncertainties		Overall uncertainty in the year (%):					2,913	Trend uncertainty (%):				1,461

Table 3A-52 Uncertainty estimation, CH_4.

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg CH_4	Mg CH_4	%	%	%	%	%	%	%	%	%
Stationary combustion plants, gas engines	CH_4	312	10253	2,2	40	40,060	19,968	1,581	1,774	63,235	5,519	63,475
Stationary combustion plants, other	CH_4	5468	10318	2,2	100	100,024	50,168	-1,567	1,785	-156,691	5,553	156,789
Total	CH_4	5780	20571				2915,533					28611,969
Total uncertainties		Overall uncertainty in the year (%):					**53,996**		Trend uncertainty (%):			**169,151**

Table 3A-53 Uncertainty estimation, N_2O.

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg N_2O	Gg N_2O	%	%	%	%	%	%	%	%	%
Stationary combustion plants	N_2O	0,775	0,893	2,200	1000	1000,002	1000,002	0,000	1,152	0,000	3,583	3,583
Total	N_2O	0,775	0,893				1000005					12,839
Total uncertainties		Overall uncertainty in the year (%):					**1000,002**		Trend uncertainty (%):			**3,583**

Table 3A-54 Uncertainty estimation, SO_2.

SNAP	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg SO_2	Mg SO_2	%	%	%	%	%	%	%	%	%
01	SO_2	129601	9074	2	10	10,198	4,492	-0,049	0,058	-0,493	0,163	0,519
02	SO_2	11491	4372	2	20	20,100	4,265	0,018	0,028	0,364	0,078	0,372
03	SO_2	16708	7157	2	10	10,198	3,543	0,031	0,045	0,315	0,128	0,340
Total	SO_2	157800	20604				50,913					0,524
Total uncertainties				Overall uncertainty in the year (%):				**7,135**			Trend uncertainty (%):	**0,724**

Table 3A-55 Uncertainty estimation, NO_x.

SNAP	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg NO_x	Mg NO_x	%	%	%	%	%	%	%	%	%
01	NO_x	94738	42482	2	20	20,100	13,750	-0,073	0,3681	-1,459	1,041	1,792
02	NO_x	7518	8481	2	50	50,040	6,834	0,038	0,0735	1,920	0,208	1,932
03	NO_x	13167	11136	2	20	20,100	3,605	0,035	0,0965	0,701	0,273	0,753
Total	NO_x	115423	62100				248,764					7,510
Total uncertainties				Overall uncertainty in the year (%):				**15,772**			Trend uncertainty (%):	**2,740**

Table 3A-56 Uncertainty estimation, NMVOC.

SNAP	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg NMVOC	Mg NMVOC	%	%	%	%	%	%	%	%	%
01	NMVOC	1075	2743	2	50	50,040	5,204	0,039	0,2177	1,956	0,616	2,051
02	NMVOC	10901	23067	2	50	50,040	43,753	0,019	1,8303	0,973	5,177	5,267
03	NMVOC	627	571	2	50	50,040	1,083	-0,059	0,0453	-2,937	0,128	2,940
Total	NMVOC	12603	26382				1942,589					40,596
Total uncertainties				Overall uncertainty in the year (%):				**44,075**		Trend uncertainty (%):		**6,372**

Table 3A-57 Uncertainty estimation, CO.

SNAP	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg CO	Mg CO	%	%	%	%	%	%	%	%	%
01	CO	8262	9291	2	20	20,100	1,095	-0,006	0,066	-0,110	0,188	0,218
02	CO	115829	147602	2	50	50,040	43,328	0,046	1,055	2,315	2,983	3,775
03	CO	15877	13574	2	20	20,100	1,601	-0,041	0,097	-0,822	0,274	0,867
Total	CO	139967	170467				1881,075					15,053
Total uncertainties				Overall uncertainty in the year (%):				**43,371**		Trend uncertainty (%):		**3,880**

Appendix 3A-10 Reference approach

TABLE 1.A(b) SECTORAL BACKGROUND DATA FOR ENERGY Inventory 2007
CO_2 from Fuel Combustion Activities - Reference Approach (IPCC Worksheet 1-1) Submission 2009 v1.1
(Sheet 1 of 1) DENMARK

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/ GCV (1)	Apparent consumption (TJ)	Carbon emission factor (t C/TJ)	Carbon content (Gg C)	Carbon stored (Gg C)	Net carbon emissions (Gg C)	Fraction of carbon oxidized	Actual CO_2 emissions (Gg CO_2)
Liquid Fossil	Primary Fuels	Crude Oil	TJ	652.563,17	87.380,82	404.314,81		1.742,10	333.887,08	1,00	NCV	333.887,08	20,00	6.677,74	NA	6.677,74	1,00	24.485,05
		Orimulsion	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA	22,00	NA	NA	NA	1,00	NA
		Natural Gas Liquids	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA	17,20	NA	NA	NA	1,00	NA
	Secondary Fuels	Gasoline	TJ		42.317,85	49.111,93	0,75	-919,09	-5.875,74	1,00	NCV	-5.875,74	18,90	-111,05	NA	-111,05	1,00	-407,19
		Jet Kerosene	TJ		32.113,13	22.171,05	36.789,23	-5.989,95	-20.857,20	1,00	NCV	-20.857,20	19,50	-406,72	NA	-406,72	1,00	-1.491,29
		Other Kerosene	TJ		NA	NA	NA	NA	NA	1,00	NCV	NA	19,60	NA	NA	NA	1,00	NA
		Shale Oil	TJ		NA	NA		NA	NA	1,00	NCV	NA	20,00	NA	NA	NA	1,00	NA
		Gas / Diesel Oil	TJ		90.761,89	49.745,65	10.946,73	-1.230,74	31.300,25	1,00	NCV	31.300,25	20,20	632,26	NA	632,26	1,00	2.318,30
		Residual Fuel Oil	TJ		60.603,22	68.480,37	35.243,14	-6.569,45	-36.550,85	1,00	NCV	-36.550,85	21,10	-771,22	NA	-771,22	1,00	-2.827,82
		Liquefied Petroleum Gas (LPG)	TJ		260,59	4.736,39		29,49	-4.505,29	1,00	NCV	-4.505,29	17,20	-77,49	NA	-77,49	1,00	-284,13
		Ethane	TJ		NA	NA		NA	NA	2,00	NCV	NA	16,80	NA	NA	NA	1,00	NA
		Naphtha	TJ		NA	1.891,16		-98,03	-1.793,13	1,00	NCV	-1.793,13	20,00	-35,86	NA	-35,86	1,00	-131,50
		Bitumen	TJ		10.526,07	223,04		371,69	9.931,33	1,00	NCV	9.931,33	22,00	218,49	221,15	-2,66	1,00	-9,75
		Lubricants	TJ		2.678,96	64,48	101,86	-3,27	2.515,89	1,00	NCV	2.515,89	20,00	50,32	25,74	24,58	1,00	90,11
		Petroleum Coke	TJ		10.886,03	409,14		684,02	9.792,88	1,00	NCV	9.792,88	27,50	269,30	NA	269,30	1,00	987,45
		Refinery Feedstocks	TJ		926,76	4.849,35		505,10	-4.427,69	1,00	NCV	-4.427,69	20,00	-88,55	NA	-88,55	1,00	-324,70
		Other Oil	TJ		NA	NA		NA	NA	1,00	NCV	NA	20,00	NA	NA	NA	1,00	NA
Other Liquid Fossil												608,39		12,17	9,13	3,04		11,15
White Spirit				NA	684,69	76,30	NA	NA	608,39	1,00	NCV	608,39	20,00	12,17	9,13	3,04	1,00	11,15
Liquid Fossil Totals												314.025,91		6.369,39	256,02	6.113,37		22.415,69
Solid Fossil	Primary Fuels	Anthracite (2)	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA	26,80	NA	NA	NA	1,00	NA
		Coking Coal	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA	25,80	NA	NA	NA	1,00	NA
		Other Bituminous Coal	TJ	NA	199.059,26	4.656,96	NA	661,15	193.741,14	1,00	NCV	193.741,14	25,80	4.998,52	NA	4.998,52	1,00	18.327,91
		Sub-bituminous Coal	TJ	NA	NA	NA	NA	NA	NA	1,00	NCV	NA	26,20	NA	NA	NA	1,00	NA
		Lignite	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA	27,60	NA	NA	NA	1,00	NA
		Oil Shale	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA	29,10	NA	NA	NA	1,00	NA
		Peat	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA	28,90	NA	NA	NA	1,00	NA
	Secondary Fuels	BKB (3) and Patent Fuel	TJ		2,64	3,90		NA	-1,26	1,00	NCV	-1,26	25,80	-0,03	NA	-0,03	1,00	-0,12
		Coke Oven/Gas Coke	TJ		1.036,69	NA		-82,71	1.119,41	1,00	NCV	1.119,41	29,50	33,02	NA	33,02	1,00	121,08
Other Solid Fossil												9.041,04		196,52	NA	196,52		720,57
Plastic part of municipal waste				9.041,04	NA	NA	NA	NA	9.041,04	1,00	NCV	9.041,04	21,74	196,52	NA	196,52	1,00	720,57
Solid Fossil Totals												203.900,33		5.228,03	NA	5.228,03		19.169,45
Gaseous Fossil		Natural Gas (Dry)	TJ	346.146,14	NA	169.540,07		6.554,51	170.051,56	1,00	NCV	170.051,56	15,30	2.601,79	NA	2.601,79	1,00	9.539,89
Other Gaseous Fossil												NA		NA	NA	NA		NA
Gaseous Fossil Totals												170.051,56		2.601,79	NA	2.601,79		9.539,89
Total												687.977,80		14.199,21	256,02	13.943,19		51.125,03
Biomass total												112.777,60		3.344,26	NA	3.344,26		12.262,29
		Solid Biomass	TJ	90.097,99	18.765,61	NA		NA	108.863,60	1,00	NCV	108.863,60	29,90	3.255,02	NA	3.255,02	1,00	11.935,08
		Liquid Biomass	TJ	3.684,80	NA	3.684,80		NA	NA	1,00	NCV	NA	20,00	NA	NA	NA	1,00	NA
		Gas Biomass	TJ	3.914,00	NA	NA		NA	3.914,00	1,00	NCV	3.914,00	22,80	89,24	NA	89,24	1,00	327,21

FUEL TYPES	REFERENCE APPROACH			SECTORAL APPROACH [1]		DIFFERENCE [2]	
	Apparent energy consumption [3] (PJ)	Apparent energy consumption (excluding non-energy use and feedstocks) [4] (PJ)	CO_2 emissions (Gg)	Energy consumption (PJ)	CO_2 emissions (Gg)	Energy consumption (%)	CO_2 emissions (%)
Liquid Fuels (excluding international bunkers)	314,03	300,97	22.415,69	302,68	22.287,55	-0,56	0,57
Solid Fuels (excluding international bunkers) [5]	203,90	194,86	19.169,45	195,27	18.425,76	-0,21	4,04
Gaseous Fuels	170,05	170,05	9.539,89	170,87	9.702,27	-0,48	-1,67
Other [5]	NA,NO	NO	NA,NO	IE,NA,NO	711,48		-100,00
Total [5]	***687,98***	***665,88***	***51.125,03***	***668,82***	***51.127,06***	***-0,44***	***0,00***

[1] "Sectoral approach" is used to indicate the approach (if different from the Reference approach) used by the Party to estimate CO_2 emissions from fuel combustion as reported in table 1.A(a), sheets 1-4.

[2] Difference in CO_2 emissions estimated by the Reference approach (RA) and the Sectoral approach (SA) (difference = 100% x ((RA-SA)/SA)). For calculating the difference in energy consumption between the two approaches, data as reported in the column "Apparent energy consumption (excluding non-energy use and feedstocks)" are used for the Reference approach.

[3] Apparent energy consumption data shown in this column are as in table 1.A(b).

[4] For the purposes of comparing apparent energy consumption from the Reference approach with energy consumption from the Sectoral approach, Parties should, in this column, subtract from the apparent energy consumption (Reference approach) the energy content corresponding to the fuel quantities used as feedstocks and/or for non-energy purposes, in accordance with the accounting of energy use in the Sectoral approach

[5] Emissions from biomass are not included.

Note: The Reporting Instructions of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories require that estimates of CO_2 emissions from fuel combustion, derived using a detailed Sectoral approach, be compared to those from the Reference approach (Worksheet 1-1 of the IPCC Guidelines, Volume 2, Workbook). This comparison is to assist in verifying the Sectoral data.

Documentation Box:

Parties should provide detailed explanations on the fuel combustion sub-sector, including information related to the comparison of CO_2 emissions calculated using the Sectoral approach with those calculated using the Reference approach, in the corresponding part of Chapter 3: Energy (CRF sub-sector 1.A) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

If the CO_2 emission estimates from the two approaches differ by more than 2 per cent, Parties should briefly explain the cause of this difference in this documentation box and provide a reference to relevant section of the NIR where this difference is explained in more detail.

1.AC Difference - Reference and Sectoral Approach:Non-energy use of fuels is not included in the Danish National Approach. Fuel consumption for non-energy is subtracted in Reference Approach to ma
CO2 emission from plastic part of municipal wastes is included in the Danish National Approach.
CO2 emission from the plastic part of municipal wastes is added in Reference Approach to make results comparable. (Other fuels of sources 1A1, 1A2 and 1A4)

Table 3A-58 Fuel category correspondence list for the reference approach.

Reference approach		Danish energy statistics
Biomass	Gas Biomass	Biogas, other
Biomass	Gas Biomass	Biogas, landfill
Biomass	Gas Biomass	Biogas, sewage sludge
Biomass	Liquid Biomass	Liquid biofuels
Biomass	Solid Biomass	Fish oil
Biomass	Solid Biomass	Waste combustion, plastic
Biomass	Solid Biomass	Waste combustion, other
Biomass	Solid Biomass	Firewood
Biomass	Solid Biomass	Straw
Biomass	Solid Biomass	Wood Chips
Biomass	Solid Biomass	Firewood
Biomass	Solid Biomass	Wood Pellets
Liquid fossil	Bitumen	Bitumen
Liquid fossil	Crude oil	Crude Oil
Liquid fossil	Crude oil	Waste Oil
Liquid fossil	Ethane	-
Liquid fossil	Gas/diesel oil	Gas/Diesel Oil
Liquid fossil	Gasoline	Aviation Gasoline
Liquid fossil	Gasoline	Motor Gasoline
Liquid fossil	Jet Kerosene	JP1
Liquid fossil	Jet Kerosene	JP4
Liquid fossil	LPG	LPG
Liquid fossil	Lubricants	Lubricants
Liquid fossil	Naphtha	White Spirit
Liquid fossil	Naphtha	Naphtha (LVN)
Gaseous fossil	Natural gas	Natural Gas
Liquid fossil	Natural gas liquids	-
Liquid fossil	Orimulsion	Orimulsion
Liquid fossil	Other kerosene	Other Kerosene
Liquid fossil	Petroleum coke	Petroleum Coke
Liquid fossil	Refinery feedstocks	Refinery Feedstocks
Liquid fossil	Residual fuel oil	Fuel Oil
Liquid fossil	Shale oil	-
Solid fossil	Anthracite	-
Solid fossil	BKB & Patent fuel	Brown Coal Briquettes
Solid fossil	Coke oven/gas coke	Coke
Solid fossil	Coking Coal	-
Solid fossil	Lignite	-
Solid fossil	Oil Shale	-
Solid fossil	Other Bit. Coal	Other Hard Coal
Solid fossil	Other Bit. Coal	Electricity Plant Coal
Solid fossil	Peat	-
Solid fossil	Sub-bit. coal	-

Appendix 3A-11 Emission inventory 2007 based on SNAP sectors

Table 3A-59 Emission inventory 2007 based on SNAP sectors.

SNAP 2)	SO_2 Mg	NO_x Mg	NMVOC Mg	CH_4 Mg	CO Mg	CO_2 1) Gg	N_2O Mg
Total 01	9074	42482	2743	9183	9291	32062	483
010100	0	3	0	0	0	2	0
010101	6789	20634	322	376	2236	18834	178
010102	724	4503	51	43	613	4180	45
010103	134	1318	19	56	308	1384	17
010104	275	2553	64	61	772	2502	73
010105	33	3206	1734	8030	2264	1047	22
010201	1	2	0	0	1	2	0
010202	64	103	34	24	187	114	4
010203	618	1158	440	323	2399	1371	49
010204	0	3	0	0	0	1	0
010205	3	126	34	189	75	30	0
010304	2	723	3	3	27	248	10
010306	421	1031	0	0	198	722	25
010502	0	33	1	2	10	20	0
010504	8	7033	39	42	174	1597	62
010505	2	54	2	34	27	8	0
Total 02	4372	8481	23067	10493	147602	8800	269
020100	172	552	637	270	629	896	20
020103	2	12	1	1	5	16	0
020104	0	3	0	0	0	1	0
020105	8	352	94	523	211	83	1
020200	2509	6467	20825	8010	138516	7043	225
020202	0	1	0	0	0	1	0
020204	0	186	132	583	144	71	2
020300	1661	536	1250	450	7863	588	18
020302	12	5	0	0	3	3	0
020303	0	4	0	0	0	2	0
020304	7	364	128	655	230	96	2
Total 03	7157	11136	571	927	13574	5308	144
030100	3865	2715	323	372	2049	2880	68
030102	1126	506	80	69	357	446	13
030103	4	20	7	7	40	25	1
030104	1	438	6	7	27	250	10
030105	2	108	50	240	73	33	1
030303	-	-	-	-	-	-	-
030307	-	-	-	-	-	-	-
030308	-	-	-	-	-	-	-
030310	-	-	-	-	-	-	-
030311	1622	7080	92	210	1676	1497	48
030312	-	-	-	-	-	-	-
030315	0	158	2	5	30	47	1
030316	-	-	-	-	-	-	-
030318	538	110	12	17	9322	131	3

1) Including CO_2 emission from biomass

2) SNAP sector codes are shown in appendix 3

Appendix 3A-12 Description of the Danish energy statistics

This description of the Danish energy statistics has been prepared by Denmark's National Environmental Research Institute (NERI) in cooperation with the Danish Energy Authority (DEA) as background information to the Danish National Inventory Report (NIR).

The Danish energy statistics system

DEA is responsible for the Danish energy balance. Main contributors to the energy statistics outside DEA are Statistics Denmark and Danish Energy Association (before Association of Danish Energy Companies). The statistics is performed using an integrated statistical system building on an Access database and Excel spreadsheets.

The DEA follows the recommendations of the International Energy Agency as well as Eurostat.

The national energy statistics is updated annually and all revisions are immediately included in the published statistics, which can be found on http://ens.dk/sw16508.asp. It is an easy task to check for breaks in a series because the statistics is 100 % time-series oriented.

The national energy statistics does not include Greenland and Faroe Islands.

For historical reasons, DEA receive monthly information from the Danish oil companies regarding Danish deliveries of oil products to Greenland and Faroe Islands. But the monthly (MOS) and annual (AOS) reporting of oil statistics to Eurostat and IEA exclude Greenland and Faroe Islands. For all other energy products the Danish figures are also excluding Greenland and Faroe Islands.

Reporting to the Danish Energy Authority

The Danish Energy Authority receives monthly statistics for the following fuel groups:

- Crude oil and oil products
  - Monthly data from 46 oil companies, the main purpose is monitoring oil stocks according to the oil preparedness system
- Natural gas
  - Fuel/flare from platforms in the North Sea
  - Natural gas balance from the regulator Energinet.dk (National monopoly)
- Coal and coke
  - Power plants (94 %)
  - Industry companies (4 %)
  - Coal and coke traders (2 %)
- Electricity
  - Monthly reporting by e-mail from the regulator Energinet.dk (National monopoly)
  - The statistics covers:
    - Production by type of producer
    - Own use of electricity
    - Import and export by country

    - Domestic supply (consumption + distribution loss)
- Town gas (quarterly) from two town gas producers

The large central power plants also report monthly consumption of biomass.

Annual data includes renewable energy including waste. The DEA conducts a biannual survey on wood pellets and wood fuel. Statistics Denmark conducts biannual surveys on the energy consumption in the service and industrial sectors. Statistics Denmark prepares annual surveys on forest (wood fuel) & straw.

Other annual data sources include:

- DEA
  - Survey on production of electricity and heat and fuels used
  - Survey on end use of oil
  - Survey on end use of natural gas
  - Survey on end use of coal and coke
- National Environmental Research Institute (NERI), Aarhus University
  - Energy consumption for domestic air transport
- Danish Energy Association (Association of Danish Energy companies)
  - Survey on electricity consumption
- Ministry of Taxation
  - Border trade
- Centre for Biomass Technology
  - Annual estimates of final consumption of straw and wood chips

Annual revisions

In general, DEA follows the same procedures as in the Danish national account. This means that normally only figures for the last two years are revised.

Aggregating the energy statistics on SNAP level

As part of the data delivery agreement between the DEA and NERI, the DEA supplies a version of the official energy statistics aggregated on SNAP level to be used in the emission calculation. In cooperation between DEA and NERI a fuel correspondence table has been developed mapping the fuels used by the DEA in the official energy statistics with the fuel codes used in the Danish national emission database. Similarly the sectors used in the official energy statistics have been mapped to SNAP categories, used in the Danish emission database. The fuel correspondence table between fuel categories used by the DEA, NERI and IPCC is presented in annex 3A of the Danish NIR.

The mapping between the energy statistics and the SNAP and fuel codes used by NERI can be seen in the Table 3A-60 below.

Table 3A-60 Correspondence between the Danish national energy statistics and the snap nomenclature.

Unit: TJ		Enduse		Transformation 1980-1993	
	Snap	Fuel (in Danish)	Fuel-code	Snap	Fuel-code
Foreign Trade					
- Border Trade					
- - Motor Gasoline					
- - Gas-/Diesel Oil					
- - Petroleum Coke	0202	Petrokoks	110A		
Vessels in Foreign Trade					
- International Marine Bunkers					
- - Gas-/Diesel Oil	080404	Gas & Diesel oil	204B		
- - Fuel Oil	080404	Fuel oil & Spildolie	203W		
- - Lubricants					
Energy Sector					
Extraction and Gasification					
- Extraction					
- - Natural Gas	010504	Natural gas	301A		
- Gasification					
- - Biogas, Landfill	091006	Biogas	309A		
- - Biogas, Other	091006	Biogas	309A		
Refineries					
- Own Use					
- - Refinery Gas	010306	Raffinaderigas	308A		
- - LPG	010306	LPG	303A		
- - Gas-/Diesel Oil	010306	Gas & Diesel oil	204A		
- - Fuel Oil	010306	Fuel oil & Spildolie	203A		
Transformation Sector					
Large-scale Power Units					
- Fuels Used for Power Production					
- - Gas-/Diesel Oil				0101	204A
- - Fuel Oil				0101	203A
- - Electricity Plant Coal				0101	102A
- - Straw				0101	117A
Large-Scale CHP Units					
- Fuels Used for Power Production					
- - Refinery Gas				0103	308A
- - LPG				0101	303A
- - Naphtha (LVN)				0101	210A
- - Gas-/Diesel Oil				0101	204A
- - Fuel Oil				0101	203A
- - Petroleum Coke				0101	110A
- - Orimulsion				0101	225A
- - Natural Gas				0101	301A
- - Electricity Plant Coal				0101	102A
- - Straw				0101	117A
- - Wood Chips				0101	111A
- - Wood Pellets				0101	111A
- - Wood Waste				0101	111A
- - Biogas, Landfill				0101	309A
- - Biogas, Others				0101	309A
- - Waste, Non-renewable				0101	114A
- - Wastes, Renewable				0101	114A
- Fuels Used for Heat Production					
- - Refinery Gas				0103	308A

Continued					
Unit: TJ		Enduse		Transformation 1980-1993	
	Snap	Fuel (in Danish)	Fuel-code	Snap	Fuel-code
- - LPG				0101	303A
- - Naphtha (LVN)				0101	210A
- - Gas-/Diesel Oil				0101	204A
- - Fuel Oil				0101	203A
- - Petroleum Coke				0101	110A
- - Orimulsion				0101	225A
- - Natural Gas				0101	301A
- - Electricity Plant Coal				0101	102A
- - Straw				0101	117A
- - Wood Chips				0101	111A
- - Wood Pellets				0101	111A
- - Wood Waste				0101	111A
- - Biogas, Landfill				0101	309A
- - Biogas, Other				0101	309A
- - Waste, Non-renewable				0101	114A
- - Wastes, Renewable				0101	114A
Small-Scale CHP Units					
- Fuels Used for Power Production					
- - Gas-/Diesel Oil				0101	204A
- - Fuel Oil				0101	203A
- - Natural Gas				0101	301A
- - Hard Coal				0101	102A
- - Straw				0101	117A
- - Wood Chips				0101	111A
- - Wood Pellets				0101	111A
- - Wood Waste				0101	111A
- - Biogas, Landfill				0101	309A
- - Biogas, Other				0101	309A
- - Waste, Non-renewable				0101	114A
- - Wastes, Renewable				0101	114A
- Fuels Used for Heat Production					
- - Gas-/Diesel Oil				0101	204A
- - Fuel Oil				0101	203A
- - Natural Gas				0101	301A
- - Coal				0101	102A
- - Straw				0101	117A
- - Wood Chips				0101	111A
- - Wood Pellets				0101	111A
- - Wood Waste				0101	111A
- - Biogas, Landfill				0101	309A
- - Biogas, Other				0101	309A
- - Waste, Non-renewable				0101	114A
- - Wastes, Renewable				0101	114A
District Heating Units					
- Fuels Used for Heat Production					
- - Refinery Gas				0103	308A
- - LPG				0102	303A
- - Gas-/Diesel Oil				0102	204A
- - Fuel Oil				0102	203A
- - Waste Oil				0102	203A
- - Petroleum Coke				0102	110A

Continued					
Unit: TJ		Enduse		Transformation 1980-1993	
	Snap	Fuel (in Danish)	Fuel-code	Snap	Fuel-code
- - Natural Gas				0102	301A
- - Electricity Plant Coal				0102	102A
- - Coal				0102	102A
- - Straw				0102	117A
- - Wood Chips				0102	111A
- - Wood Pellets				0102	111A
- - Wood Waste				0102	111A
- - Biogas, Landfill				0102	309A
- - Biogas, Sludge				0102	309A
- - Biogas, Other				0102	309A
- - Waste, Non-renewable				0102	114A
- - Wastes, Renewable				0102	114A
- - Fish Oil				0102	215A
Autoproducers, Electricity Only					
- Fuels Used for Power Production					
- - Natural Gas				0301	301A
- - Biogas, Landfill				0301	309A
- - Biogas, Sewage Sludge				0301	309A
- - Biogas, Other				0301	309A
Autoproducers, CHP Units					
- Fuels Used for Power Production					
- - Refinery Gas				0103	308A
- - Gas-/Diesel Oil				0301	204A
- - Fuel Oil				0301	203A
- - Waste Oil				0301	203A
- - Natural Gas				0301	301A
- - Coal				0301	102A
- - Straw				0301	117A
- - Wood Chips				0301	111A
- - Wood Pellets				0301	111A
- - Wood Waste				0301	111A
- - Biogas, Landfill				0301	309A
- - Biogas, Sludge				0301	309A
- - Biogas, Other				0301	309A
- - Fish Oil				0301	215A
- - Waste, Non-renewable				0301	114A
- - Wastes, Renewable				0301	114A
- Fuels Used for Heat Production					
- - Refinery Gas				0103	308A
- - Gas-/Diesel Oil				0301	204A
- - Fuel Oil				0301	203A
- - Waste Oil				0301	203A
- - Natural Gas				0301	301A
- - Coal				0301	102A
- - Wood Chips				0301	111A
- - Wood Waste				0301	111A
- - Biogas, Landfill				0301	309A
- - Biogas, Sludge				0301	309A
- - Biogas, Other				0301	309A
- - Waste, Non-renewable				0301	114A
- - Wastes, Renewable				0301	114A

Continued					
Unit: TJ		Enduse		Transformation 1980-1993	
	Snap	Fuel (in Danish)	Fuel-code	Snap	Fuel-code
Autoproducers, Heat Only					
- Fuels Used for Heat Production					
- - Gas-/Diesel Oil				0301	204A
- - Fuel Oil				0301	203A
- - Waste Oil				0301	203A
- - Natural Gas				0301	301A
- - Straw				0301	117A
- - Wood Chips				0301	111A
- - Wood Chips				0301	111A
- - Wood Waste				0301	111A
- - Biogas, Landfill				0301	309A
- - Biogas, Sludge				0301	309A
- - Biogas, Other				0301	309A
- - Waste, Non-renewable				0102	114A
- - Wastes, Renewable				0102	114A
Town Gas Units	030106	Natural gas	301A		
- Fuels Used for Production of District Heating	030106	Kul (-83) / Gasolie (84-)	102A / 204A		
Transport					
Military Transport					
- Aviation Gasoline	0801	Flyvebenzin	209A		
- Motor Gasoline	0801	Benzin og LVN	2080		
- JP4	0801	JP1 og JP4	207A		
- JP1	0801	JP1 og JP4	207A		
- Gas-/Diesel Oil	0801	Gas & Diesel oil	2050		
Road					
- LPG	07	LPG	3030		
- Motor Gasoline	07	Benzin og LVN	2080		
- Other Kerosene	0202	Petroleum	206A		
- Gas-/Diesel Oil	07	Gas & Diesel oil	2050		
- Fuel Oil	07	Fuel oil & Spildolie	203V		
Rail					
- Motor Gasoline	0802	Benzin og LVN	2080		
- Other Kerosene	0802	Petroleum	206A		
- Gas-/Diesel Oil	0802	Gas & Diesel oil	2050		
- Electricity					
Domestic Sea Transport					
- LPG	080402	LPG	3030		
- Other Kerosene	080402	Petroleum	206A		
- Gas-/Diesel Oil	080402	Gas & Diesel oil	204B		
- Fuel Oil	080402	Fuel oil & Spildolie	203V		
Air Transport, Domestic					
- LPG	080501/080503	LPG	3030		
- Aviation Gasoline	080501/080503	Flyvebenzin	209A		
- Motor Gasoline	080501/080503	Benzin og LVN	2080		
- Other Kerosene	0201	Petroleum	206A		
- JP1	080501/080503	JP1 og JP4	207A		
Air Transport, International					
- Aviation Gasoline	080502/080504	Flyvebenzin	209A		
- JP1	080502/080504	JP1 og JP4	207A		

Continued					
Unit: TJ		Enduse		Transformation 1980-1993	
	Snap	Fuel (in Danish)	Fuel-code	Snap	Fuel-code
Agriculture and Forestry					
- LPG	0806-09	LPG	303A		
- Motor Gasoline	0806-09	Benzin og LVN	2080		
- Other Kerosene	0203	Petroleum	206A		
- Gas-/Diesel Oil	0806-09	Gas & Dieselolie	204B		
- Fuel Oil	0203	Fuelolie & Spildolie	203A		
- Petroleum Coke	0203	Petrokoks	110A		
- Natural Gas	0203	Naturgas	301A		
- Coal	0203	Kul	102A		
- Brown Coal Briquettes	0203	Brunkul	106A		
- Straw	0203	Halm	117A		
- Wood Chips	0203	Træ	111A		
- Wood Waste	0203	Træ	111A		
- Biogas, Other	0203	Biogas	309A		
Horticulture					
- LPG	0806-09	LPG	3030		
- Motor Gasoline	0806-09	Benzin og LVN	2080		
- Gas-/Diesel Oil	0806-09	Gas & Dieselolie	204B		
- Fuel Oil	0203	Fuelolie & Spildolie	203A		
- Petroleum Coke	0203	Petrokoks	110A		
- Natural Gas	0203	Naturgas	301A		
- Coal	0203	Kul	102A		
- Wood Waste	0203	Træ	111A		
Fishing					
- LPG	080403	LPG	3030		
- Motor Gasoline	080403	Benzin og LVN	2080		
- Other Kerosene	080403	Petroleum	206A		
- Gas-/Diesel Oil	080403	Gas & Dieselolie	204B		
- Fuel Oil	080403	Fuelolie & Spildolie	203V		
Manufacturing Industry					
- Refinery Gas	0301	Raffinaderigas	308A		
- LPG	0806-09	LPG	3030		
- Naphtha (LVN)	0806-09	Benzin og LVN	2080		
- Motor Gasoline	0806-09	Benzin og LVN	2080		
- Other Kerosene	0301	Petroleum	206A		
- Gas-/Diesel Oil	0806-09	Gas & Dieselolie	204B		
- Fuel Oil	0301	Fuelolie & Spildolie	203A		
- Waste Oil	0301	Fuelolie & Spildolie	203A		
- Petroleum Coke	0301	Petrokoks	110A		
- Natural Gas	0301	Naturgas	301A		
- Coal	0301	Kul	102A		
- Coke	0301	Koks	107A		
- Brown Coal Briquettes	0301	Brunkul	106A		
- Wood Pellets	0301	Træ	111A		
- Wood Waste	0301	Træ	111A		
- Biogas, Landfill	0301	Biogas	309A		
- Biogas, Other	0301	Biogas	309A		
- Wastes, Non-renewable	0301	Affald	114A		
- Wastes, Renewable	0301	Affald	114A		
- Town Gas	0301	Naturgas	301A		

Continued					
Unit: TJ		Enduse		Transformation 1980-1993	
	Snap	Fuel (in Danish)	Fuel-code	Snap	Fuel-code
Construction					
- LPG	0301	LPG	303A		
- Motor Gasoline	0806-09	Benzin og LVN	2080		
- Other Kerosene	0301	Petroleum	206A		
- Gas-/Diesel Oil	0806-09	Gas & Dieselolie	204B		
- Fuel Oil	0301	Fuelolie & Spildolie	203A		
- Natural Gas	0301	Naturgas	301A		
Wholesale					
- LPG	0201	LPG	303A		
- Motor Gasoline	0201	Petroleum	206A		
- Other Kerosene	0201	Gas & Dieselolie	204A		
- Gas-/Diesel Oil	0201	Fuelolie & Spildolie	203A		
- Petroleum Coke	0201	Petrokoks	110A		
- Natural Gas	0201	Naturgas	301A		
- Wood Waste	0201	Træ	111A		
Retail Trade					
- LPG	0201	LPG	303A		
- Other Kerosene	0201	Petroleum	206A		
- Gas-/Diesel Oil	0201	Gas & Dieselolie	204A		
- Fuel Oil	0201	Fuelolie & Spildolie	203A		
- Petroleum Coke	0201	Petrokoks	110A		
- Natural Gas	0201	Naturgas	301A		
Private Service					
- LPG	0201	LPG	303A		
- Other Kerosene	0201	Petroleum	206A		
- Gas-/Diesel Oil	0201	Gas & Dieselolie	204A		
- Fuel Oil	0201	Fuelolie & Spildolie	203A		
- Waste Oil	0201	Fuelolie & Spildolie	203A		
- Petroleum Coke	0201	Petrokoks	110A		
- Natural Gas	0201	Naturgas	301A		
- Wood Chips	0201	Træ	111A		
- Wood Waste	0201	Træ	111A		
- Biogas, Landfill	0201	Biogas	309A		
- Biogas, Sludge	0201	Biogas	309A		
- Biogas, Other	0201	Biogas	309A		
- Wastes, Non-renewable	0201	Affald	114A		
- Wastes, Renewable	0201	Affald	114A		
- Town Gas	0201	Naturgas	301A		
Public Service					
- LPG	0201	LPG	303A		
- Other Kerosene	0201	Petroleum	206A		
- Gas-/Diesel Oil	0201	Gas & Dieselolie	204A		
- Fuel Oil	0201	Fuelolie & Spildolie	203A		
- Petroleum Coke	0201	Petrokoks	110A		
- Natural Gas	0201	Naturgas	301A		
- Coal	0201	Kul	102A		
- Brown Coal Briquettes	0201	Brunkul	106A		
- Wood Chips	0201	Træ	111A		
- Wood Pellets	0201	Træ	111A		
- Town Gas	0201	Naturgas	301A		

Continued					
Unit: TJ		Enduse		Transformation 1980-1993	
	Snap	Fuel (in Danish)	Fuel-code	Snap	Fuel-code
Single Family Houses					
- LPG	0202	LPG	303A		
- Motor Gasoline	0806-09	Benzin og LVN	2080		
- Other Kerosene	0202	Petroleum	206A		
- Gas-/Diesel Oil	0202	Gas & Dieselolie	204A		
- Fuel Oil	0202	Fuelolie & Spildolie	203A		
- Petroleum Coke	0202	Petrokoks	110A		
- Natural Gas	0202	Naturgas	301A		
- Coal	0202	Kul	102A		
- Coke	0202	koks	107A		
- Brown Coal Briquettes	0202	Brunkul	106A		
- Straw	0202	Halm	117A		
- Firewood	0202	Træ	111A		
- Wood Chips	0202	Træ	111A		
- Wood Pellets	0202	Træ	111A		
- Town Gas	0202	Naturgas	301A		
Multi-family Houses					
- LPG	0202	LPG	303A		
- Other Kerosene	0202	Petroleum	206A		
- Gas-/Diesel Oil	0202	Gas & Dieselolie	204A		
- Fuel Oil	0202	Fuelolie & Spildolie	203A		
- Petroleum Coke	0202	Petrokoks	110A		
- Natural Gas	0202	Naturgas	301A		
- Coal	0202	Kul	102A		
- Coke	0202	Koks	107A		
- Brown Coal Briquettes	0202	Brunkul	106A		
- Town Gas	0202	Naturgas	301A		

Appendix 3A-13 Key source analysis

Table 3A-61 GHG key source analysis, Level 2007.

IPCC Category Code	IPCC Category	Fuel	GHG	Latest Year Estimate Ex,t [in CO_2-equiv. units]	Absolute Value of Latest Year Estimate	Level Assess-ment Lx,t	Cumulative Total of Column H	
1A1	Energy Sector	COAL	CO_2	17341	17341	0,498	50 %	Key Source, Level
1A1	Energy Sector	NATURAL GAS	CO_2	5194	5194	0,149	65 %	Key Source, Level
1A4	Other Sectors	NATURAL GAS	CO_2	2391	2391	0,069	72 %	Key Source, Level
1A2	Industry	NATURAL GAS	CO_2	2117	2117	0,061	78 %	Key Source, Level
1A4	Other Sectors	GAS OIL	CO_2	1506	1506	0,043	82 %	Key Source, Level
1A1	Energy Sector	RESIDUAL OIL	CO_2	919	919	0,026	85 %	Key Source, Level
1A1	Energy Sector	REFINERY GAS	CO_2	906	906	0,026	87 %	Key Source, Level
1A2	Industry	PETROLEUM COKE	CO_2	850	850	0,024	90 %	Key Source, Level
1A2	Industry	COAL	CO_2	768	768	0,022	92 %	Key Source, Level
1A1	Energy Sector	PLASTIC WASTE	CO_2	665	665	0,019	94 %	Key Source, Level
1A2	Industry	RESIDUAL OIL	CO_2	663	663	0,019	96 %	Key Source, Level
1A1, 1A2, 1A4	Natural gas fuelled engines	GAS	CH_4	198	198	0,006	96 %	
1A4	Other Sectors	COAL	CO_2	196	196	0,006	97 %	
1A4	Other Sectors	BIOMASS	CH_4	177	177	0,005	97 %	
1A2	Industry	COKE OVEN COKE	CO_2	121	121	0,003	98 %	
1A4	Other Sectors	PETROLEUM COKE	CO_2	120	120	0,003	98 %	
1A1	Energy Sector	GAS OIL	CO_2	107	107	0,003	98 %	
1A4	Other Sectors	RESIDUAL OIL	CO_2	72	72	0,002	99 %	
1A4	Other Sectors	LPG	CO_2	58	58	0,002	99 %	
1A4	Other Sectors	BIOMASS	N_2O	53	53	0,002	99 %	
1A1	Energy Sector	GAS	N_2O	50	50	0,001	99 %	
1A1	Energy Sector	SOLID	N_2O	46	46	0,001	99 %	
1A2	Industry	PLASTIC WASTE	CO_2	45	45	0,001	99 %	
1A2	Industry	LPG	CO_2	32	32	0,001	99 %	
1A1	Energy Sector	BIOMASS	N_2O	20	20	0,001	99 %	
1A1	Energy Sector	LIQUID	N_2O	18	18	0,001	100 %	
1A1, 1A2, 1A4	Biogas fuelled engines	BIOMASS	CH_4	17	17	0,000	100 %	
1A1	Energy Sector	OTHER 1	N_2O	17	17	0,000	100 %	
1A4	Other Sectors	LIQUID	N_2O	15	15	0,000	100 %	
1A2	Industry	LIQUID	N_2O	14	14	0,000	100 %	
1A4	Other Sectors	GAS	N_2O	13	13	0,000	100 %	
1A2	Industry	GAS	N_2O	13	13	0,000	100 %	
1A2	Industry	SOLID	N_2O	9	9	0,000	100 %	
1A4	Other Sectors	KEROSENE	CO_2	8	8	0,000	100 %	
1A2	Industry	BIOMASS	N_2O	7	7	0,000	100 %	
1A1	Energy Sector	BIOMASS	CH_4	7	7	0,000	100 %	
1A1	Energy Sector	SOLID	CH_4	6	6	0,000	100 %	
1A1	Energy Sector	GAS	CH_4	5	5	0,000	100 %	
1A4	Other Sectors	GAS	CH_4	5	5	0,000	100 %	
1A2	Industry	GAS	CH_4	4	4	0,000	100 %	
1A2	Industry	BIOMASS	CH_4	4	4	0,000	100 %	
1A2	Industry	LIQUID	CH_4	3	3	0,000	100 %	
1A2	Industry	SOLID	CH_4	3	3	0,000	100 %	
1A2	Industry	OTHER 1	N_2O	2	2	0,000	100 %	
1A4	Other Sectors	SOLID	N_2O	2	2	0,000	100 %	
1A4	Other Sectors	LIQUID	CH_4	1	1	0,000	100 %	
1A2	Industry	KEROSENE	CO_2	1	1	0,000	100 %	
1A2	Industry	GAS OIL	CO_2	1	1	0,000	100 %	
1A4	Other Sectors	PLASTIC WASTE	CO_2	1	1	0,000	100 %	
1A1	Energy Sector	LIQUID	CH_4	1	1	0,000	100 %	
1A1	Energy Sector	OTHER 1	CH_4	1	1	0,000	100 %	
1A4	Other Sectors	SOLID	CH_4	1	1	0,000	100 %	
1A2	Industry	OTHER 1	CH_4	0	0	0,000	100 %	
1A4	Other Sectors	COKE OVEN COKE	CO_2	0	0	0,000	100 %	
1A4	Other Sectors	OTHER 1	N_2O	0	0	0,000	100 %	
1A4	Other Sectors	OTHER 1	CH_4	0	0	0,000	100 %	

Table 3A-62 GHG key source analysis, Level 1990.

IPCC Category Code	IPCC Category	Fuel	GHG	1990 Estimate Ex,t [in CO_2-equiv. units]	Absolute Value of 1990 Estimate	Level Assess-ment Lx,t	Cumulative Total of Column H	
1A1	Energy Sector	COAL	CO_2	22462	22462	0,590	59 %	Key Source, Level 1990
1A4	Other Sectors	GAS OIL	CO_2	4341	4341	0,114	70 %	Key Source, Level 1990
1A1	Energy Sector	NATURAL GAS	CO_2	1540	1540	0,040	74 %	Key Source, Level 1990
1A4	Other Sectors	NATURAL GAS	CO_2	1486	1486	0,039	78 %	Key Source, Level 1990
1A2	Industry	RESIDUAL OIL	CO_2	1427	1427	0,037	82 %	Key Source, Level 1990
1A2	Industry	COAL	CO_2	1318	1318	0,035	86 %	Key Source, Level 1990
1A2	Industry	NATURAL GAS	CO_2	1294	1294	0,034	89 %	Key Source, Level 1990
1A1	Energy Sector	RESIDUAL OIL	CO_2	882	882	0,023	91 %	Key Source, Level 1990
1A1	Energy Sector	REFINERY GAS	CO_2	795	795	0,021	93 %	Key Source, Level 1990
1A4	Other Sectors	KEROSENE	CO_2	361	361	0,009	94 %	Key Source, Level 1990
1A1	Energy Sector	PLASTIC WASTE	CO_2	328	328	0,009	95 %	Key Source, Level 1990
1A4	Other Sectors	COAL	CO_2	298	298	0,008	96 %	
1A2	Industry	PETROLEUM COKE	CO_2	258	258	0,007	97 %	
1A4	Other Sectors	RESIDUAL OIL	CO_2	196	196	0,005	97 %	
1A1	Energy Sector	GAS OIL	CO_2	166	166	0,004	98 %	
1A4	Other Sectors	PETROLEUM COKE	CO_2	153	153	0,004	98 %	
1A2	Industry	COKE OVEN COKE	CO_2	126	126	0,003	98 %	
1A2	Industry	LPG	CO_2	102	102	0,003	99 %	
1A4	Other Sectors	BIOMASS	CH_4	74	74	0,002	99 %	
1A4	Other Sectors	LPG	CO_2	66	66	0,002	99 %	
1A1	Energy Sector	SOLID	N_2O	63	63	0,002	99 %	
1A4	Other Sectors	LIQUID	N_2O	43	43	0,001	99 %	
1A2	Industry	GAS OIL	CO_2	40	40	0,001	99 %	
1A4	Other Sectors	BIOMASS	N_2O	22	22	0,001	99 %	
1A4	Other Sectors	PLASTIC WASTE	CO_2	21	21	0,001	99 %	
1A1	Energy Sector	OTHER 1	N_2O	17	17	0,000	100 %	
1A1	Energy Sector	LIQUID	N_2O	17	17	0,000	100 %	
1A2	Industry	LIQUID	N_2O	15	15	0,000	100 %	
1A2	Industry	SOLID	N_2O	14	14	0,000	100 %	
1A1	Energy Sector	GAS	N_2O	13	13	0,000	100 %	
1A4	Other Sectors	COKE OVEN COKE	CO_2	12	12	0,000	100 %	
1A2	Industry	REFINERY GAS	CO_2	11	11	0,000	100 %	
1A4	Other Sectors	BROWN COAL BRI.	CO_2	11	11	0,000	100 %	
1A1	Energy Sector	SOLID	CH_4	9	9	0,000	100 %	
1A1	Energy Sector	BIOMASS	N_2O	9	9	0,000	100 %	
1A4	Other Sectors	GAS	N_2O	8	8	0,000	100 %	
1A2	Industry	GAS	N_2O	7	7	0,000	100 %	
1A2	Industry	BIOMASS	N_2O	7	7	0,000	100 %	
1A2	Industry	KEROSENE	CO_2	5	5	0,000	100 %	
1A2	Industry	SOLID	CH_4	5	5	0,000	100 %	
1A1, 1A2, 1A4	Natural gas fuelled engines	GAS	CH_4	5	5	0,000	100 %	
1A1	Energy Sector	BIOMASS	CH_4	5	5	0,000	100 %	
1A2	Industry	BIOMASS	CH_4	4	4	0,000	100 %	
1A4	Other Sectors	LIQUID	CH_4	3	3	0,000	100 %	
1A4	Other Sectors	GAS	CH_4	3	3	0,000	100 %	
1A4	Other Sectors	SOLID	N_2O	3	3	0,000	100 %	
1A2	Industry	GAS	CH_4	3	3	0,000	100 %	
1A1	Energy Sector	GAS	CH_4	2	2	0,000	100 %	
1A2	Industry	LIQUID	CH_4	2	2	0,000	100 %	
1A1, 1A2, 1A4	Biogas fuelled engines	BIOMASS	CH_4	2	2	0,000	100 %	
1A1	Energy Sector	OTHER 1	CH_4	2	2	0,000	100 %	
1A1	Energy Sector	LIQUID	CH_4	1	1	0,000	100 %	
1A4	Other Sectors	OTHER 1	N_2O	1	1	0,000	100 %	
1A4	Other Sectors	SOLID	CH_4	1	1	0,000	100 %	
1A2	Industry	PLASTIC WASTE	CO_2	1	1	0,000	100 %	
1A1	Energy Sector	LPG	CO_2	1	1	0,000	100 %	
1A2	Industry	BROWN COAL BRI.	CO_2	0	0	0,000	100 %	
1A4	Other Sectors	OTHER 1	CH_4	0	0	0,000	100 %	
1A2	Industry	OTHER 1	N_2O	0	0	0,000	100 %	
1A2	Industry	OTHER 1	CH_4	0	0	0,000	100 %	

Table 3A-63 GHG key source analysis, Trend.

IPCC Category Code	IPCC Category	Fuel	GHG	Base Year Estimate, Ex,0	Latest Year Estimate Ex,t	Trend Assessment Tx,t	% Contribution to Trend	Cumulative Total of Column H	
1A1	Energy Sector	NATURAL GAS	CO_2	1540	5194	0,0995	25 %	25 %	Key Source, Trend
1A1	Energy Sector	COAL	CO_2	22462	17341	0,0839	21 %	46 %	Key Source, Trend
1A4	Other Sectors	GAS OIL	CO_2	4341	1506	0,0647	16 %	63 %	Key Source, Trend
1A4	Other Sectors	NATURAL GAS	CO_2	1486	2391	0,0271	7 %	70 %	Key Source, Trend
1A2	Industry	NATURAL GAS	CO_2	1294	2117	0,0245	6 %	76 %	Key Source, Trend
1A2	Industry	RESIDUAL OIL	CO_2	1427	663	0,0169	4 %	80 %	Key Source, Trend
1A2	Industry	PETROLEUM COKE	CO_2	258	850	0,0161	4 %	84 %	Key Source, Trend
1A2	Industry	COAL	CO_2	1318	768	0,0115	3 %	87 %	Key Source, Trend
1A1	Energy Sector	PLASTIC WASTE	CO_2	328	665	0,0096	2 %	90 %	Key Source, Trend
1A4	Other Sectors	KEROSENE	CO_2	361	8	0,0085	2 %	92 %	Key Source, Trend
1A1, 1A2, 1A4	Natural gas fuelled engines	GAS	CH_4	5	198	0,0051	1 %	93 %	Key Source, Trend
1A1	Energy Sector	REFINERY GAS	CO_2	795	906	0,0047	1 %	94 %	Key Source, Trend
1A1	Energy Sector	RESIDUAL OIL	CO_2	882	919	0,0030	1 %	95 %	Key Source, Trend
1A4	Other Sectors	BIOMASS	CH_4	74	177	0,0029	1 %	96 %	
1A4	Other Sectors	RESIDUAL OIL	CO_2	196	72	0,0028	1 %	97 %	
1A4	Other Sectors	COAL	CO_2	298	196	0,0020	1 %	97 %	
1A2	Industry	LPG	CO_2	102	32	0,0016	0 %	97 %	
1A1	Energy Sector	GAS OIL	CO_2	166	107	0,0012	0 %	98 %	
1A2	Industry	PLASTIC WASTE	CO_2	1	45	0,0012	0 %	98 %	
1A1	Energy Sector	GAS	N_2O	13	50	0,0010	0 %	98 %	
1A2	Industry	GAS OIL	CO_2	40	1	0,0009	0 %	99 %	
1A4	Other Sectors	BIOMASS	N_2O	22	53	0,0009	0 %	99 %	
1A4	Other Sectors	LIQUID	N_2O	43	15	0,0006	0 %	99 %	
1A4	Other Sectors	PETROLEUM COKE	CO_2	153	120	0,0005	0 %	99 %	
1A4	Other Sectors	PLASTIC WASTE	CO_2	21	1	0,0005	0 %	99 %	
1A1, 1A2, 1A4	Biogas fuelled engines	BIOMASS	CH_4	2	17	0,0004	0 %	99 %	
1A1	Energy Sector	SOLID	N_2O	63	46	0,0003	0 %	99 %	
1A1	Energy Sector	BIOMASS	N_2O	9	20	0,0003	0 %	99 %	
1A4	Other Sectors	COKE OVEN COKE	CO_2	12	0	0,0003	0 %	100 %	
1A2	Industry	REFINERY GAS	CO_2	11	0	0,0003	0 %	100 %	
1A4	Other Sectors	BROWN COAL BRI.	CO_2	11	0	0,0003	0 %	100 %	
1A2	Industry	GAS	N_2O	7	13	0,0002	0 %	100 %	
1A4	Other Sectors	GAS	N_2O	8	13	0,0002	0 %	100 %	
1A2	Industry	COKE OVEN COKE	CO_2	126	121	0,0001	0 %	100 %	
1A2	Industry	SOLID	N_2O	14	9	0,0001	0 %	100 %	
1A2	Industry	KEROSENE	CO_2	5	1	0,0001	0 %	100 %	
1A1	Energy Sector	GAS	CH_4	2	5	0,0001	0 %	100 %	
1A1	Energy Sector	LIQUID	N_2O	17	18	0,0001	0 %	100 %	
1A1	Energy Sector	BIOMASS	CH_4	5	7	0,0001	0 %	100 %	
1A1	Energy Sector	SOLID	CH_4	9	6	0,0001	0 %	100 %	
1A2	Industry	OTHER 1	N_2O	0	2	0,0001	0 %	100 %	
1A4	Other Sectors	GAS	CH_4	3	5	0,0001	0 %	100 %	
1A4	Other Sectors	LPG	CO_2	66	58	0,0000	0 %	100 %	
1A4	Other Sectors	LIQUID	CH_4	3	1	0,0000	0 %	100 %	
1A2	Industry	GAS	CH_4	3	4	0,0000	0 %	100 %	
1A2	Industry	LIQUID	CH_4	2	3	0,0000	0 %	100 %	
1A2	Industry	SOLID	CH_4	5	3	0,0000	0 %	100 %	
1A4	Other Sectors	OTHER 1	N_2O	1	0	0,0000	0 %	100 %	
1A4	Other Sectors	SOLID	N_2O	3	2	0,0000	0 %	100 %	
1A1	Energy Sector	OTHER 1	N_2O	17	17	0,0000	0 %	100 %	
1A1	Energy Sector	OTHER 1	CH_4	2	1	0,0000	0 %	100 %	
1A1	Energy Sector	LPG	CO_2	1	0	0,0000	0 %	100 %	
1A1	Energy Sector	LIQUID	CH_4	1	1	0,0000	0 %	100 %	
1A2	Industry	BROWN COAL BRI.	CO_2	0	0	0,0000	0 %	100 %	
1A4	Other Sectors	SOLID	CH_4	1	1	0,0000	0 %	100 %	
1A2	Industry	BIOMASS	N_2O	7	7	0,0000	0 %	100 %	
1A2	Industry	OTHER 1	CH_4	0	0	0,0000	0 %	100 %	
1A4	Other Sectors	OTHER 1	CH_4	0	0	0,0000	0 %	100 %	
1A2	Industry	BIOMASS	CH_4	4	4	0,0000	0 %	100 %	
1A2	Industry	LIQUID	N_2O	15	14	0,0000	0 %	100 %	

Annex 3B Transport

List of content

Annex 2B-1 Fleet data 1985-2006 for road transport (No. vehicles)

Sector	Subsector	Tech 2	FYear	LYear	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	80570	46208	44014	42804	36466	39959	37597	37130	3434	2761	2103	1744
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	333715	187911	161642	139010	119424	80741	67991	53302	44338	31104	22511	17980
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	104223	86056	79240	72588	65797	49614	42976	34748	25889	17458	10806	7298
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	345946	301692	295677	288944	280769	262502	250449	233656	215509	183239	147178	118979
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990		282011	280181	278685	278152	275859	272989	269953	275188	264791	254032	235890
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996			39608	73527	101489	139813	169133	205235	210861	208281	206803	204184
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000									38465	74495	108508	135030
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005												
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010												
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	61592	35940	34233	33292	28362	31079	29242	28879	2671	2148	1635	1356
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	218180	127631	109640	94188	80844	54600	45991	36078	30465	21520	15647	12537
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	60836	55062	50674	46402	42040	31712	27445	22173	16509	11141	6870	4642
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	210574	174545	170749	166595	161591	150612	143385	133412	122642	103931	83270	67222
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990		190297	188949	187872	187524	186044	184194	182297	186155	179510	172582	160800
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996			35647	75763	119562	201007	288096	375253	383870	378063	375137	370803
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000									95358	196046	274022	326268
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005												
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010												
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	5923	3423	3260	3171	2701	2960	2785	2750	254	205	156	129
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	18532	10781	9234	7914	6781	4567	3849	3022	2619	1881	1366	1110
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	8730	4392	4043	3702	3354	2531	2191	1770	1318	888	549	371
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	31066	24667	24157	23595	22912	21429	20432	19053	17571	14934	12016	9722
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990		25679	25524	25389	25338	25120	24844	24546	24977	23975	22975	21251
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996			3961	8129	12434	20068	27915	35770	36617	36081	35808	35388
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000									12432	27315	44923	61899
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005												
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010												
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	75828	79714	75794	72294	68535	62144	58848	55004	48251	43893	43004	42604
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996			4042	8018	11872	18305	24557	31177	31314	31730	35118	39314
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000									7046	14640	23084	31541
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005												
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010												
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	3451	3703	3556	3425	3281	3040	2906	2747	2461	2266	2237	2228
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996			213	437	668	1078	1499	1921	1928	1952	2161	2420
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000									655	1478	2711	4232

Continued

Passenger Cars	Diesel >2,0 l	Euro III	2001	2005												
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010												
Passenger Cars	LPG	Conventional	0	1990	287	286	286	288	289	289	301	311	172	97	44	32
Passenger Cars	2-Stroke	Conventional	0	9999	4823	5417	4804	4308	3747	3029	2443	1824	1248	761	400	300
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	33049	42333	43215	44179	45486	47261	44601	41519	37209	34454	31489	28488
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998							4259	8524	12645	17212	16632	15979
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001											4705	9299
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006												
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011												
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	121431	155543	158781	162324	167129	173650	163877	152553	142109	131572	122992	115695
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998							15648	31318	48292	65727	64964	64894
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001											18376	37766
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006												
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011												
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	251	250	255	260	268	279	288	295	261	274	253	257
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	5140	5108	5214	5330	5369	5087	4775	4418	3891	3585	2986	2329
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996					120	616	1121	1488	1421	1415	1251	1042
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001								132	655	1213	1598	1682
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006												114
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	10350	10286	10500	10734	10811	10243	9615	8897	7590	6413	5443	4921
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996					241	1240	2257	2997	2772	2531	2281	2201
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001								265	1278	2171	2914	3556
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006												242
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	13115	13034	13306	13602	13700	12981	12184	11274	10431	9548	8709	7677
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996					305	1571	2860	3798	3810	3768	3649	3434
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001								336	1757	3232	4662	5547
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006												377
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	11517	11446	11684	11944	12030	11398	10699	9900	9086	8469	7931	7123
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996					268	1379	2511	3335	3318	3342	3323	3186
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001								295	1530	2866	4246	5147
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006												350

Continued

Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014												
Buses	Urban Buses	Conventional	0	1993	4712	4753	4561	4522	4490	4083	3635	3261	2946	2792	2542	2319
Buses	Urban Buses	Euro I	1994	1996						390	746	1084	1060	972	913	852
Buses	Urban Buses	Euro II	1997	2001									390	729	1053	1345
Buses	Urban Buses	Euro III	2002	2006												
Buses	Urban Buses	Euro IV	2007	2009												
Buses	Coaches	Conventional	0	1993	3298	3327	2868	3007	3086	2927	4507	4156	3662	3369	3007	2724
Buses	Coaches	Euro I	1994	1996						280	925	1381	1318	1173	1080	1001
Buses	Coaches	Euro II	1997	2001									485	879	1246	1579
Buses	Coaches	Euro III	2002	2006												
Buses	Coaches	Euro IV	2007	2009												
Mopeds	<50 cm³	Conventional	0	1999	151000	120000	118000	113000	109000	105000	114167	123333	132500	141667	150833	143607
Mopeds	<50 cm³	Euro I	2000	2003												16393
Mopeds	<50 cm³	Euro II	2004	9999												
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	6209	6617	6804	6904	7111	7406	7672	8214	8980	9598	10385	11054
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	7037	7499	7712	7824	8059	8394	8695	9310	10177	10878	11769	11670
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003												858
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006												
Motorcycles	4-stroke <250 cm³	Euro III	2007	9999												
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	19352	20622	21207	21516	22162	23083	23911	25602	27986	29914	32365	32093
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003												2360
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006												
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	8796	9374	9639	9780	10074	10492	10869	11637	12721	13597	14712	14588
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003												1073
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006												

Continued

Sector	Subsector	Tech 2	FYear	LYear	2001	2002	2003	2004	2005	2006	2007
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	1614	1475	1392	1313	1313	1313	1313
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	15837	14155	13149	12404	12335	12279	12102
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	5510	4178	3128	2433	2882	2869	2828
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	97964	79041	60723	45824	25489	14555	8865
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	219216	194543	171430	142490	133653	117770	97775
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	201708	197423	192152	185488	183896	185747	175728
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	132812	130153	128898	126400	133689	129230	130820
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005	21858	47428	70311	99658	126777	128423	137270
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010						31558	54861
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	1255	1147	1083	1021	1021	1021	1021
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	11077	9923	9230	8707	8852	8964	8986
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	3500	2659	1987	1545	1858	1892	1908
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	55300	44572	34238	25810	14529	8564	5515
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	149915	133745	118448	99092	86463	72814	58779
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	367136	359959	351645	340424	286124	227403	169862
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	320971	314678	311808	305621	334798	342059	322170
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005	49700	105323	147067	195430	250309	274132	321955
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010						52995	96186
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	120	109	103	97	97	97	97
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	986	885	825	778	807	836	856
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	280	212	159	123	147	148	147
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	8009	6459	4964	3744	2045	1103	592
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	19699	17377	15265	12607	12107	10565	8778
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	35024	34329	33516	32431	27636	23084	18339
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	60799	59506	58896	57815	48867	39683	32828
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005	15179	30712	45080	65819	82828	77816	76346
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010						22245	36980
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	42641	42100	40525	38619	38012	37146	40829
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	43578	48670	53462	59968	62042	63663	71580
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	34764	38842	43327	49262	61839	72606	93778
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005	5482	13338	21371	33648	49775	62020	95071
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010						13028	31275
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	2229	2187	2096	1978	2005	1958	2149
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	2683	2998	3295	3698	3647	3556	3795
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	4658	5196	5790	6592	6450	6112	6792
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005	1163	2682	4432	7505	10932	11986	15797

Continued										
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010					3426	7652
Passenger Cars	LPG	Conventional	0	1990	63	21	15	15	15	15	10
Passenger Cars	2-Stroke	Conventional	0	9999	200	150	100	50			
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	25423	21615	18838	14576	12300	9827	6041
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	15527	15049	13949	14793	14462	13766	10509
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	14017	13917	13805	14126	14061	13667	10693
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006		5140	10719	16724	23033	29145	23176
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011							5439
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	105397	92990	82927	66760	59477	51497	37477
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	64370	64743	61406	67753	69932	72140	65198
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	58112	59870	60771	64697	67990	71620	66341
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006		22112	47186	76596	111375	152728	143794
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011							33742
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	249	249	247	233	252	266	273
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	1910	1671	1351	1007	779	577	381
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	936	938	796	883	817	756	695
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	1720	1788	1608	1768	1677	1600	1508
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006	354	845	1279	1892	2350	2742	2655
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009					16	95	502
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014					5	34	189
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	4063	3014	2468	1544	1195	885	585
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	1992	1692	1454	1354	1253	1160	1065
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	3660	3226	2939	2711	2572	2454	2312
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006	754	1525	2336	2901	3604	4205	4072
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009					25	146	771
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014					8	52	289
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	6576	5309	4389	2930	2267	1678	1110
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	3224	2981	2585	2569	2377	2201	2021
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	5923	5683	5225	5144	4880	4656	4387
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006	1221	2686	4154	5505	6837	7978	7726
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009					48	277	1462
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014					16	98	549
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	6299	5272	4528	3092	2392	1771	1171
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	3088	2960	2667	2711	2508	2323	2133
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	5673	5643	5391	5428	5150	4914	4630
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006	1169	2667	4286	5809	7215	8419	8153
Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009					51	292	1543

Continued

Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014					17	103	579
Buses	Urban Buses	Conventional	0	1993	2159	1977	1859	1711	1551	1381	1210
Buses	Urban Buses	Euro I	1994	1996	792	752	713	663	643	614	581
Buses	Urban Buses	Euro II	1997	2001	1596	1525	1447	1345	1317	1273	1220
Buses	Urban Buses	Euro III	2002	2006		346	670	951	1275	1585	1534
Buses	Urban Buses	Euro IV	2007	2009							344
Buses	Coaches	Conventional	0	1993	2444	2165	1962	1773	1542	1328	1119
Buses	Coaches	Euro I	1994	1996	896	823	752	687	639	591	538
Buses	Coaches	Euro II	1997	2001	1807	1670	1527	1394	1309	1224	1128
Buses	Coaches	Euro III	2002	2006		379	706	986	1267	1524	1418
Buses	Coaches	Euro IV	2007	2009							318
Mopeds	<50 cm^3	Conventional	0	1999	136249	128209	120305	112262	98369	82388	66597
Mopeds	<50 cm^3	Euro I	2000	2003	28751	42791	48695	46069	45882	50386	53728
Mopeds	<50 cm^3	Euro II	2004	9999				10669	24749	36226	48674
Motorcycles	2-stroke >50 cm^3	Conventional	0	1999	11367	11582	11850	12326	13158	14241	15400
Motorcycles	4-stroke <250 cm^3	Conventional	0	1999	12487	12882	13380	14078	14943	16241	17652
Motorcycles	4-stroke <250 cm^3	Euro I	2000	2003	918	1348	1806	1816	2292	2766	3352
Motorcycles	4-stroke <250 cm^3	Euro II	2004	2006				604	1187	1879	1831
Motorcycles	4-stroke <250 cm^3	Euro III	2007	9999							4340
Motorcycles	4-stroke 250 - 750 cm^3	Conventional	0	1999	34338	35424	36794	38714	41092	44663	48542
Motorcycles	4-stroke 250 - 750 cm^3	Euro I	2000	2003	2525	3707	4967	4993	6302	7606	9218
Motorcycles	4-stroke 250 - 750 cm^3	Euro II	2004	2006				1661	3263	5169	5036
Motorcycles	4-stroke >750 cm^3	Conventional	0	1999	15608	16102	16725	17597	18678	20301	22064
Motorcycles	4-stroke >750 cm^3	Euro I	2000	2003	1148	1685	2258	2270	2865	3457	4190
Motorcycles	4-stroke >750 cm^3	Euro II	2004	2006				755	1483	2349	2289

Annex 2B-2: Mileage data 19852006 for road transport (km)

Sector	Subsector	Tech 2	FYear	LYear	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	9564	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	12115	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	16052	13358	12280	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	18800	16553	17094	17157	16720	16142	14571	12958	12050	11999	11794	11677
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990		20257	20778	21152	20734	20113	18818	17553	16474	14970	13688	12800
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996			24567	25667	25746	26068	24555	23306	22300	20949	19624	18422
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000									26232	25674	24561	23828
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005												
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010												
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	9564	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	12033	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	16044	13352	12269	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	18883	16515	17059	17121	16659	16068	14525	12940	12050	11999	11794	11677
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990		20402	20935	21291	20886	20231	18942	17667	16584	15142	13875	12961
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996			24567	25726	25975	26475	25308	24084	23002	21643	20226	18954
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000									26232	25700	24547	23722
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005												
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010												
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	9564	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	12052	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	16050	13361	12285	12005	12412	12729	12405	12060	12050	11999	11794	11677
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	18834	16582	17121	17200	16793	16180	14593	12966	12050	11999	11794	11677
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990		20101	20643	21047	20575	20005	18715	17452	16353	14779	13551	12691
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996			24567	25712	25924	26398	25184	23952	22880	21524	20119	18864
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000									26232	25727	24744	24087
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005												
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010												
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	25365	28694	28549	27996	27386	26630	25416	24032	22779	21643	21021	20153
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996			42600	42505	41806	41473	40106	38625	36268	33906	32434	30423
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000									41813	40714	39790	38511
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005												
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010												
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	26523	29795	29621	28991	28185	27216	25845	24311	22873	21537	20880	20004
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996			42600	42529	41894	41615	40354	38857	36471	34109	32607	30584

Continued

Passenger Cars	Diesel >2,0 l	Euro II	1997	2000									41813	40769	40104	39052
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005												
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010												
Passenger Cars	LPG	Conventional	0	1990	18832	16538	17080	17144	16698	16113	14553	12950	12050	11999	11794	11677
Passenger Cars	2-Stroke	Conventional	0	9999	18832	16538	17080	17144	16698	16113	14553	12950	12050	11999	11794	11677
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	20184	17544	18019	18706	18894	18937	18138	17727	17852	17884	17453	17612
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998							18138	17727	17852	17884	17453	17612
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001											17453	17612
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006												
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011												
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	30638	33157	33484	32340	32311	34213	32818	32837	32567	32043	31268	30445
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998							32818	32837	32567	32043	31268	30445
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001											31268	30445
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006												
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011												
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	38144	37941	38562	39503	37263	36784	36280	35574	32740	33082	33668	34672
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	35978	48034	48003	45749	42687	44518	43972	44143	36450	37156	39923	40817
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996					42687	44518	43972	44143	36450	37156	39923	40817
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001								44143	36450	37156	39923	40817
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006												40817
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	50128	58064	58026	55301	51600	53813	53153	53360	51118	49468	46549	44753
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996					51600	53813	53153	53360	51118	49468	46549	44753
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001								53360	51118	49468	46549	44753
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006												44753
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	69684	80715	80662	76875	71730	74806	73889	74176	76580	76690	79456	76388
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996					71730	74806	73889	74176	76580	76690	79456	76388
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001								74176	76580	76690	79456	76388
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006												76388
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014												
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	69684	80715	80662	76875	71730	74806	73889	74176	76580	76690	79456	76388
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996					71730	74806	73889	74176	76580	76690	79456	76388
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001								74176	76580	76690	79456	76388

Continued

Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006												76388
Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009												
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014												
Buses	Urban Buses	Conventional	0	1993	92802	112240	117691	113847	116744	127625	126231	126143	123791	120484	118268	115867
Buses	Urban Buses	Euro I	1994	1996						127625	126231	126143	123791	120484	118268	115867
Buses	Urban Buses	Euro II	1997	2001									123791	120484	118268	115867
Buses	Urban Buses	Euro III	2002	2006												
Buses	Urban Buses	Euro IV	2007	2009												
Buses	Coaches	Conventional	0	1993	58168	72331	84744	77381	79680	86020	62473	74025	74537	73139	72747	70668
Buses	Coaches	Euro I	1994	1996						86020	62473	74025	74537	73139	72747	70668
Buses	Coaches	Euro II	1997	2001									74537	73139	72747	70668
Buses	Coaches	Euro III	2002	2006												
Buses	Coaches	Euro IV	2007	2009												
Mopeds	<50 cm³	Conventional	0	1999	2334	2182	2282	2393	2449	2510	2470	2439	2481	2498	2125	1919
Mopeds	<50 cm³	Euro I	2000	2003												1919
Mopeds	<50 cm³	Euro II	2004	9999												
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	6702	6471	6493	6824	6987	7148	7131	7033	7076	7168	7072	7170
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	6702	6471	6493	6824	6987	7148	7131	7033	7076	7168	7072	7170
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003												7170
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006												
Motorcycles	4-stroke <250 cm³	Euro III	2007	9999												
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	6702	6471	6493	6824	6987	7148	7131	7033	7076	7168	7072	7170
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003												7170
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006												
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	6702	6471	6493	6824	6987	7148	7131	7033	7076	7168	7072	7170
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003												7170
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006												

Sector	Subsector	Tech 2	FYear	LYear	2001	2002	2003	2004	2005	2006	2007
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	11946	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	17417	16703	15385	14480	12894	11814	11063

Continued											
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	22154	21228	20262	19167	17555	16294	15431
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005	25033	24934	25811	23998	22096	20092	19062
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010						23380	22991
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	12030	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	17934	17241	16099	15270	13761	12432	11275
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	22066	21099	20154	19119	17565	16301	15454
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005	25033	24925	25554	23855	21973	20019	18984
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010						23380	22972
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	11499	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	11875	11628	11611	11646	11093	10740	10715
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	17845	17147	15980	15139	13657	12326	11226
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	22498	21546	20526	19375	17855	16503	15536
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005	25033	24906	25737	24025	22152	20194	19251
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010						23380	23012
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	19275	18818	18984	19491	19442	19442	19442
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	28953	27593	25909	25090	23523	22002	20261
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	36035	34206	33003	32021	30779	29504	28027
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005	40832	40341	39594	40005	38582	36281	34487
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010						42323	41693
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	19172	18818	18984	19491	19442	19442	19442
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	29108	27750	26127	25336	23934	22313	20369
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	36697	34869	33560	32425	31292	29875	28189
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005	40832	40307	39605	40208	38823	36556	34929
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010						42323	41753
Passenger Cars	LPG	Conventional	0	1990	11499	11628	11611	11646	11093	10280	9368
Passenger Cars	2-Stroke	Conventional	0	9999	11499	11628	11611	11646			
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	17712	17891	17762	17528	16747	16213	16176
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	17712	17891	17762	17528	16747	16213	16176
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	17712	17891	17762	17528	16747	16213	16176
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006		17891	17762	17528	16747	16213	16176

Continued

Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011							16176
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	29844	29977	31949	32475	32758	32736	34062
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	29844	29977	31949	32475	32758	32736	34062
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	29844	29977	31949	32475	32758	32736	34062
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006		29977	31949	32475	32758	32736	34062
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011							34062
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	40372	41106	41246	41114	38707	37474	37388
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	53045	53769	59450	58777	56169	56132	58405
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	53045	53769	59450	58777	56169	56132	58405
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	53045	53769	59450	58777	56169	56132	58405
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006	53045	53769	59450	58777	56169	56132	58405
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009					56169	56132	58405
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014					56169	56132	58405
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	25194	21993	24033	24842	23740	23724	24685
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	25194	21993	24033	24842	23740	23724	24685
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	25194	21993	24033	24842	23740	23724	24685
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006	25194	21993	24033	24842	23740	23724	24685
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009					23740	23724	24685
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014					23740	23724	24685
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009					86997	86939	90460
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014					86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006	82099	82221	87366	91037	86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009					86997	86939	90460
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014					86997	86939	90460
Buses	Urban Buses	Conventional	0	1993	111518	111179	118562	120358	116665	116588	121309
Buses	Urban Buses	Euro I	1994	1996	111518	111179	118562	120358	116665	116588	121309
Buses	Urban Buses	Euro II	1997	2001	111518	111179	118562	120358	116665	116588	121309
Buses	Urban Buses	Euro III	2002	2006		111179	118562	120358	116665	116588	121309
Buses	Urban Buses	Euro IV	2007	2009							121309
Buses	Coaches	Conventional	0	1993	70397	72357	77557	83872	81298	81244	84535

Continued

Buses	Coaches	Euro I	1994	1996	70397	72357	77557	83872	81298	81244	84535
Buses	Coaches	Euro II	1997	2001	70397	72357	77557	83872	81298	81244	84535
Buses	Coaches	Euro III	2002	2006		72357	77557	83872	81298	81244	84535
Buses	Coaches	Euro IV	2007	2009							84535
Mopeds	<50 cm^3	Conventional	0	1999	1526	1550	1547	1529	1460	1413	1410
Mopeds	<50 cm^3	Euro I	2000	2003	1526	1550	1547	1529	1460	1413	1410
Mopeds	<50 cm^3	Euro II	2004	9999				1529	1460	1413	1410
Motorcycles	2-stroke >50 cm^3	Conventional	0	1999	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke <250 cm^3	Conventional	0	1999	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke <250 cm^3	Euro I	2000	2003	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke <250 cm^3	Euro II	2004	2006				7387	7089	6864	6848
Motorcycles	4-stroke <250 cm^3	Euro III	2007	9999							6848
Motorcycles	4-stroke 250 - 750 cm^3	Conventional	0	1999	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke 250 - 750 cm^3	Euro I	2000	2003	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke 250 - 750 cm^3	Euro II	2004	2006				7387	7089	6864	6848
Motorcycles	4-stroke >750 cm^3	Conventional	0	1999	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke >750 cm^3	Euro I	2000	2003	7229	7387	7428	7387	7089	6864	6848
Motorcycles	4-stroke >750 cm^3	Euro II	2004	2006				7387	7089	6864	6848

Annex 2B-3: EU directive emission limits for road transportation vehicles

Private cars and light duty vehicles I (<1305 kg)

g pr km		EURO 1	EURO 2	EURO 3[1)]	EURO 4	EURO 5	EURO 6
Normal temp.							
CO	Gasoline	2.72	2.2	2.3	1.0	1.0	1.0
	Diesel	2.72	1.0	0.64	0.5	0.5	0.5
HC	Gasoline	-	-	0.20	0.10	0.1	0.1
NMHC	Gasoline	-	-	-	-	0.068	0.068
NO_x	Gasoline	-	-	0.15	0.08	0.06	0.06
	Diesel	-	-	0.5	0.25	0.18	0.08
HC+NO_x	Gasoline	0.97	0.5	-	-		-
	Diesel	0.97	0.7/0.9[2)]	0.56	0.30	0.23	0.17
Particulates	Diesel	0.14	0.08/0.10[2)]	0.05	0.025	0.005	0.005
Low temp.							
CO	Gasoline	-	-	-	15	15	15
HC	Gasoline	-	-	-	1.8	1.8	1.8
Evaporation							
HC[3)]	Gasoline	2.0	2.0	2.0	2.0	2.0	2.0

1) Changed test procedure at normal temperatures (40 s warm-up phase omitted) and for evaporation measurements

2) Less stringent emission limits for direct injection diesel engines

3) Unit: g pr test

Light duty vehicles II (1305-1760 kg)

g pr km		EURO 1	EURO 2	EURO 3[1)]	EURO 4	EURO 5	EURO 6
Normal temp.							
CO	Gasoline	5.17	4.0	4.17	1.81	1.81	1.81
	Diesel	5.17	1.25	0.80	0.63	0.63	0.63
HC	Gasoline	-	-	0.25	0.13	0.13	0.13
NMHC	Gasoline	-	-	-	-	0.9	0.9
NO_x	Gasoline	-	-	0.18	0.10	0.75	0.75
	Diesel	-	-	0.65	0.33	0.235	0.105
HC+NO_x	Gasoline	1.4	0.6	-	-	-	-
	Diesel	1.4	1.0/1.3[2)]	0.72	0.39	0.295	0.195
Particulates	Gasoline					0.005	0.005
	Diesel	0.19	0.12/0.14[2)]	0.07	0.04	0.005	0.005
Low temp.							
CO	Gasoline	-	-	-	24	24	24
HC	Gasoline	-	-		2.7	2.7	2.7
Evaporation							
HC[3)]	Gasoline	2.0	2.0	2.0	2.0	2.0	2.0

1) Changed test procedure at normal temperatures (40 s warm-up phase omitted) and for evaporation measurements

2) Less stringent emission limits for direct injection diesel engines

3) Unit: g pr test

Light duty vehicles III (>1760 kg)

g pr km		EURO 1	EURO 2	EURO 3[1)]	EURO 4	EURO 5	EURO 6
Normal temp.							
CO	Gasoline	6.9	5.0	5.22	2.27	2.27	2.27
	Diesel	6.9	1.5	0.95	0.74	0.74	0.74
HC	Gasoline	-	-	0.29	0.16	0.16	0.16
NMHC	Gasoline					0.108	0.108
NO_x	Gasoline	-	-	0.21	0.11	0.082	0.082
	Diesel	-	-	0.78	0.39	0.28	0.125
$HC+NO_x$	Gasoline	1.7	0.7	-	-	-	-
	Diesel	1.7	1.2/1.6[2)]	0.86	0.46	0.35	0.215
Particulates	Gasoline					0.005	0.005
	Diesel	0.25	0.17/0.20[2)]	0.10	0.06	0.005	0.005
Low temp.							
CO	Gasoline	-	-	-	30	30	30
HC	Gasoline	-	-	-	3.2	3.2	3.2
Evaporation							
HC[3)]	Gasoline	2.0	2.0	2.0	2.0	2.0	2.0

[1)] Changed test procedure at normal temperatures (40 s warm-up phase omitted) and for evaporation measurements

[2)] Less stringent emission limits for direct injection diesel engines

[3)] Unit: g pr test

Heavy duty diesel vehicles

(g pr kWh)		EURO 1	EURO 2	EURO 3	EURO 4	EURO 5	EEV[2)]
	Test[1)]	1993	1996	2001	2006	2009	2000
CO	ECE/ESC	4.5	4.0	2.1	1.5	1.5	1.5
	ETC	-	-	(5.45)	4.0	4.0	3.0
HC	ECE/ESC	1.1	1.1	0.66	0.46	0.46	0.25
	ETC	-	-	(0.78)	0.55	0.55	0.40
NO_x	ECE/ESC	8.0	7.0	5.0	3.5	2.0	2.0
	ETC	-	-	(5.0)	3.5	2.0	2.0
Particulates[3)]	ECE/ESC	0.36/0.61	0.15/0.25	0.10/0.13	0.02	0.02	0.02
	ETC	-	-	(0.16/0.21)	0.03	0.03	0.02
	ELR	-	-	0.8	0.5	0.5	0.15

[1)] Test procedure: Euro 1 og Euro 2: ECE (stationary)
Euro 3: ESC (stationary) + ELR (load response)
Euro 4, Euro 5 og EEV: ESC (stationary) + ETC (transient) + ELR (load response)

[2)] EEV: Emission limits for extra environmental friendly vehicles, used as a basis for economical incitaments (gas fueled vehicles).

[3)] For Euro 1, Euro 2 og Euro 3 less stringent emission limits apply for small engines:

Euro 1: <85 kW
Euro 2: <0,7 l
Euro 3: <0,75 l

Annex 2B-4: Basis emission factors (g pr km)

Sector	Subsector	Tech 2	FYear	LYear	FCu	FCr	FCh	COu	COr	COh	PMu	PMr	PMh	NOxu	NOxr	NOxh
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	67,499	55,000	62,743	27,505	19,333	15,520	0,063	0,044	0,041	1,849	2,062	2,023
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	58,240	44,460	48,600	18,966	14,480	18,620	0,063	0,044	0,041	1,849	2,062	2,023
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	53,248	45,170	51,200	15,859	8,200	8,260	0,063	0,044	0,041	1,619	2,102	2,909
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	53,248	45,170	51,200	16,752	8,793	7,620	0,042	0,029	0,029	1,680	2,253	3,276
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	51,420	43,440	47,700	9,087	4,956	4,292	0,030	0,020	0,020	1,691	2,089	2,662
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	47,399	41,954	46,055	1,765	1,372	1,765	0,003	0,002	0,002	0,273	0,281	0,458
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	46,486	39,509	44,016	0,659	0,575	0,749	0,003	0,002	0,002	0,154	0,154	0,181
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005	48,687	42,255	45,323	0,519	0,691	1,148	0,001	0,001	0,001	0,076	0,060	0,052
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010	50,038	44,193	48,285	0,195	0,287	0,529	0,001	0,001	0,001	0,054	0,030	0,019
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	79,277	67,000	76,386	27,505	19,333	15,520	0,063	0,044	0,041	2,164	2,683	3,130
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	67,779	51,090	60,300	18,966	14,480	18,620	0,063	0,044	0,041	2,164	2,683	3,130
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	61,731	50,686	59,680	15,859	8,200	8,260	0,063	0,044	0,041	1,831	2,377	3,283
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	61,731	50,686	59,680	16,752	8,793	7,620	0,042	0,029	0,029	1,917	2,580	3,472
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	61,652	49,112	52,052	9,087	4,956	4,292	0,030	0,020	0,020	2,122	2,757	3,524
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	57,521	48,522	51,518	1,765	1,372	1,765	0,003	0,002	0,002	0,273	0,281	0,458
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	56,324	47,687	48,786	0,659	0,575	0,749	0,003	0,002	0,002	0,154	0,154	0,181
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005	58,259	49,897	53,092	0,519	0,691	1,148	0,001	0,001	0,001	0,076	0,060	0,052
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010	60,486	52,793	55,293	0,195	0,287	0,529	0,001	0,001	0,001	0,054	0,030	0,019
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	96,536	80,000	88,267	27,505	19,333	15,520	0,063	0,044	0,041	2,860	4,090	5,500
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	73,798	57,090	66,300	18,966	14,480	18,620	0,063	0,044	0,041	2,860	4,090	5,500
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	75,270	63,260	70,700	15,859	8,200	8,260	0,063	0,044	0,041	2,066	2,675	3,680
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	75,270	63,260	70,700	16,752	8,793	7,620	0,042	0,029	0,029	2,806	3,441	4,604
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	71,055	58,080	69,900	9,087	4,956	4,292	0,030	0,020	0,020	2,293	2,750	3,687
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	74,616	61,902	65,020	1,765	1,372	1,765	0,003	0,002	0,002	0,273	0,281	0,458
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	76,837	65,226	66,732	0,659	0,575	0,749	0,003	0,002	0,002	0,154	0,154	0,181
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005	70,798	57,424	56,826	0,519	0,691	1,148	0,001	0,001	0,001	0,076	0,060	0,052
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010	86,099	67,877	65,859	0,195	0,287	0,529	0,001	0,001	0,001	0,054	0,030	0,019
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	57,529	41,209	50,089	0,651	0,472	0,384	0,199	0,132	0,170	0,520	0,433	0,528
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	47,836	42,807	48,388	0,419	0,215	0,208	0,057	0,062	0,107	0,603	0,562	0,663
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	50,442	44,117	48,779	0,343	0,110	0,035	0,047	0,039	0,050	0,651	0,555	0,665
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005	48,920	43,427	45,585	0,099	0,041	0,012	0,029	0,030	0,045	0,716	0,665	0,750
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010	48,920	43,427	45,585	0,083	0,034	0,021	0,029	0,024	0,026	0,539	0,424	0,576
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	57,529	41,209	50,089	0,651	0,472	0,384	0,199	0,132	0,170	0,824	0,723	0,861
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	65,267	58,299	64,360	0,419	0,215	0,208	0,057	0,062	0,107	0,603	0,562	0,663

Continued

Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	65,267	58,299	64,360	0,343	0,110	0,035	0,047	0,039	0,050	0,651	0,555	0,665
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005	65,267	58,299	64,360	0,099	0,041	0,012	0,029	0,030	0,045	0,716	0,665	0,750
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010	65,267	58,299	64,360	0,083	0,034	0,021	0,029	0,024	0,026	0,539	0,424	0,576
Passenger Cars	LPG	Conventional	0	1990	59,000	45,000	54,000	2,043	2,373	9,723	0,040	0,030	0,025	2,203	2,584	2,861
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	82,270	59,883	56,470	14,925	6,075	7,389	0,040	0,040	0,040	2,671	3,118	3,387
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	96,450	70,388	66,450	4,187	0,862	1,087	0,003	0,002	0,002	0,427	0,400	0,429
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	96,450	70,388	66,450	2,554	0,526	0,663	0,003	0,002	0,002	0,145	0,136	0,146
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006	96,450	70,388	66,450	2,177	0,448	0,565	0,001	0,001	0,001	0,090	0,084	0,090
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011	96,450	70,388	66,450	1,172	0,241	0,304	0,001	0,001	0,001	0,043	0,040	0,043
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	76,718	65,934	72,142	1,124	1,009	1,060	0,285	0,303	0,322	1,673	0,843	0,834
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	68,860	58,185	63,660	0,393	0,328	0,423	0,070	0,066	0,090	1,138	0,975	1,022
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	68,860	58,185	63,660	0,393	0,328	0,423	0,070	0,066	0,090	1,138	0,975	1,022
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006	68,860	58,185	63,660	0,322	0,269	0,347	0,047	0,044	0,061	0,740	0,634	0,664
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011	68,860	58,185	63,660	0,255	0,213	0,275	0,024	0,023	0,032	0,319	0,273	0,286
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	225,000	150,000	165,000	70,000	55,000	55,000	0,400	0,400	0,400	4,500	7,500	7,500
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	95,822	87,060	109,160	1,612	1,216	1,267	0,288	0,220	0,231	3,363	3,435	4,412
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	77,226	74,990	96,471	0,533	0,417	0,496	0,111	0,085	0,090	2,343	2,497	3,204
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	72,861	72,179	93,536	0,441	0,364	0,416	0,047	0,043	0,053	2,498	2,575	3,216
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006	77,798	76,111	97,038	0,528	0,372	0,375	0,051	0,037	0,037	1,955	1,896	2,330
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009	72,942	71,399	91,133	0,042	0,030	0,031	0,010	0,007	0,006	1,186	1,206	1,520
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014	74,123	72,286	92,030	0,042	0,030	0,031	0,010	0,007	0,006	0,678	0,689	0,868
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	186,796	147,006	169,108	2,513	1,722	1,825	0,396	0,272	0,287	8,575	7,259	8,446
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	157,382	126,707	149,418	1,190	0,822	0,874	0,235	0,160	0,170	5,118	4,333	5,002
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	151,150	122,421	145,510	0,969	0,726	0,808	0,099	0,078	0,100	5,465	4,544	5,171
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006	158,817	127,460	150,203	1,163	0,780	0,821	0,104	0,071	0,076	4,431	3,535	3,915
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009	148,977	119,369	139,890	0,085	0,058	0,059	0,020	0,013	0,013	2,649	2,173	2,456
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014	151,867	121,247	141,672	0,086	0,059	0,060	0,021	0,013	0,013	1,514	1,242	1,403
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	295,313	227,040	230,740	2,803	1,927	1,895	0,549	0,384	0,376	12,512	10,087	10,251
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	255,466	198,864	203,490	1,975	1,387	1,365	0,389	0,264	0,255	8,507	6,835	6,905
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	245,791	192,865	197,773	1,588	1,198	1,230	0,168	0,124	0,155	8,916	7,118	7,115
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006	255,628	198,692	202,461	1,886	1,298	1,279	0,168	0,114	0,111	7,153	5,549	5,512
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009	238,931	185,357	188,314	0,134	0,092	0,087	0,032	0,021	0,019	4,345	3,428	3,456
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014	243,448	188,256	190,962	0,136	0,093	0,088	0,032	0,021	0,019	2,483	1,959	1,975
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	392,838	311,460	297,380	3,143	2,293	2,190	0,683	0,506	0,478	16,482	13,628	12,693
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	346,235	276,687	264,125	2,662	2,009	1,913	0,524	0,373	0,347	11,621	9,581	8,935
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	336,196	270,809	257,607	2,161	1,731	1,720	0,237	0,175	0,223	12,060	9,895	9,161
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006	346,156	276,262	262,095	2,497	1,841	1,759	0,219	0,155	0,143	9,625	7,809	7,238

Continued

Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009	322,306	256,680	243,232	0,170	0,122	0,112	0,040	0,027	0,024	5,943	4,830	4,589
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014	328,104	260,582	246,667	0,172	0,124	0,113	0,041	0,027	0,024	3,396	2,760	2,622
Buses	Urban Buses	Conventional	0	1993	315,796	253,287	219,035	4,741	3,178	2,375	0,751	0,498	0,374	14,511	12,324	10,937
Buses	Urban Buses	Euro I	1994	1996	268,961	219,461	190,892	2,274	1,532	1,059	0,407	0,290	0,211	8,836	7,474	6,391
Buses	Urban Buses	Euro II	1997	2001	259,715	216,150	190,405	2,004	1,359	0,914	0,187	0,141	0,118	9,441	7,809	6,730
Buses	Urban Buses	Euro III	2002	2006	273,102	224,893	195,747	2,218	1,456	0,988	0,176	0,127	0,101	7,997	6,112	4,916
Buses	Urban Buses	Euro IV	2007	2009	257,454	211,375	184,295	0,181	0,112	0,081	0,037	0,024	0,018	4,704	3,850	3,045
Buses	Coaches	Conventional	0	1993	281,771	214,600	198,320	2,640	1,684	1,409	0,538	0,364	0,312	10,938	8,865	8,559
Buses	Coaches	Euro I	1994	1996	259,336	198,133	182,616	2,140	1,405	1,179	0,425	0,277	0,227	8,372	6,741	6,409
Buses	Coaches	Euro II	1997	2001	258,542	198,791	182,581	1,787	1,213	1,071	0,183	0,134	0,119	9,357	7,401	6,978
Buses	Coaches	Euro III	2002	2006	276,957	213,400	197,945	2,202	1,453	1,231	0,202	0,140	0,117	8,039	6,015	5,526
Buses	Coaches	Euro IV	2007	2009	262,234	201,251	186,759	0,171	0,112	0,093	0,040	0,026	0,022	4,796	3,677	3,407
Mopeds	<50 cm^3	Conventional	0	1999	25,000	25,000	0,000	13,800	13,800	0,000	0,188	0,188	0,000	0,020	0,020	0,000
Mopeds	<50 cm^3	Euro I	2000	2003	15,000	15,000	0,000	5,600	5,600	0,000	0,076	0,076	0,000	0,020	0,020	0,000
Mopeds	<50 cm^3	Euro II	2004	9999	12,080	12,080	0,000	1,300	1,300	0,000	0,038	0,038	0,000	0,260	0,260	0,000
Motorcycles	2-stroke >50 cm^3	Conventional	0	1999	30,368	32,375	36,950	23,380	25,490	27,500	0,200	0,200	0,200	0,032	0,088	0,133
Motorcycles	4-stroke <250 cm^3	Conventional	0	1999	23,340	26,690	35,600	22,380	26,300	38,600	0,020	0,020	0,020	0,130	0,242	0,362
Motorcycles	4-stroke <250 cm^3	Euro I	2000	2003	22,060	29,470	52,000	12,901	14,597	15,450	0,020	0,020	0,020	0,245	0,416	0,725
Motorcycles	4-stroke <250 cm^3	Euro II	2004	2006	22,060	29,470	52,000	6,472	5,947	9,309	0,005	0,005	0,005	0,195	0,265	0,531
Motorcycles	4-stroke <250 cm^3	Euro III	2007	9999	22,060	29,470	52,000	4,705	1,581	2,241	0,005	0,005	0,005	0,126	0,150	0,329
Motorcycles	4-stroke 250 - 750 cm^3	Conventional	0	1999	28,580	28,640	34,700	20,440	21,517	25,810	0,020	0,020	0,020	0,136	0,251	0,374
Motorcycles	4-stroke 250 - 750 cm^3	Euro I	2000	2003	28,964	29,336	41,300	9,538	13,315	19,810	0,020	0,020	0,020	0,292	0,477	0,757
Motorcycles	4-stroke 250 - 750 cm^3	Euro II	2004	2006	28,964	29,336	41,300	6,472	5,947	9,309	0,005	0,005	0,005	0,195	0,265	0,531
Motorcycles	4-stroke >750 cm^3	Conventional	0	1999	37,520	34,340	38,600	14,880	18,030	24,300	0,020	0,020	0,020	0,148	0,266	0,392
Motorcycles	4-stroke >750 cm^3	Euro I	2000	2003	44,952	36,378	40,800	7,884	6,831	10,800	0,020	0,020	0,020	0,210	0,522	1,092
Motorcycles	4-stroke >750 cm^3	Euro II	2004	2006	44,952	36,378	40,800	6,472	5,947	9,309	0,005	0,005	0,005	0,195	0,265	0,531

Sector	Subsector	Tech 2	FYear	LYear	CH4u	CH_4r	CH_4h	N_2Ou	N_2Or	N_2Oh	NH_3u	NH_3r	NH_3h	VOCu	VOCr	VOCh
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	2,354	1,597	1,247
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,862	1,256	1,121
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,480	0,895	0,698
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	0,026	0,016	0,014	0,024	0,009	0,005	0,070	0,132	0,074	0,177	0,121	0,111
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	0,017	0,013	0,011	0,012	0,005	0,003	0,163	0,149	0,084	0,071	0,047	0,042
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005	0,003	0,002	0,004	0,001	0,000	0,000	0,002	0,030	0,065	0,015	0,015	0,025
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010	0,002	0,002	0,000	0,002	0,000	0,000	0,002	0,029	0,065	0,012	0,014	0,017
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	2,354	1,597	1,247
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,862	1,256	1,121
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,480	0,895	0,698
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	0,026	0,016	0,014	0,024	0,009	0,005	0,070	0,132	0,074	0,177	0,121	0,111
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	0,017	0,013	0,011	0,012	0,005	0,003	0,163	0,149	0,084	0,071	0,047	0,042
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005	0,003	0,002	0,004	0,001	0,000	0,000	0,002	0,030	0,065	0,015	0,015	0,025
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010	0,002	0,002	0,000	0,002	0,000	0,000	0,002	0,029	0,065	0,012	0,014	0,017
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	2,354	1,597	1,247
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,862	1,256	1,121
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,849	1,061	0,950
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	0,092	0,029	0,026	0,010	0,007	0,007	0,002	0,002	0,002	1,480	0,895	0,698
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	0,026	0,016	0,014	0,024	0,009	0,005	0,070	0,132	0,074	0,177	0,121	0,111
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	0,017	0,013	0,011	0,012	0,005	0,003	0,163	0,149	0,084	0,071	0,047	0,042
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005	0,003	0,002	0,004	0,001	0,000	0,000	0,002	0,029	0,065	0,015	0,015	0,025
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010	0,002	0,002	0,000	0,002	0,000	0,000	0,002	0,029	0,065	0,012	0,014	0,017
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	0,028	0,012	0,008	0,000	0,000	0,000	0,001	0,001	0,001	0,145	0,086	0,062
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	0,011	0,009	0,003	0,002	0,004	0,004	0,001	0,001	0,001	0,053	0,031	0,026
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	0,007	0,003	0,002	0,004	0,006	0,006	0,001	0,001	0,001	0,034	0,021	0,015
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005	0,003	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,018	0,011	0,009
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010	0,000	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,038	0,017	0,012
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	0,028	0,012	0,008	0,000	0,000	0,000	0,001	0,001	0,001	0,145	0,086	0,062
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	0,011	0,009	0,003	0,002	0,004	0,004	0,001	0,001	0,001	0,080	0,046	0,034
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	0,007	0,003	0,002	0,004	0,006	0,006	0,001	0,001	0,001	0,098	0,058	0,038
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005	0,003	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,038	0,017	0,012
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010	0,000	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,011	0,006	0,006

Continued

Passenger Cars	LPG	Conventional	0	1990	0,080	0,035	0,025	0,000	0,000	0,000	0,000	0,000	0,000	1,082	0,667	0,490
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	0,150	0,040	0,025	0,010	0,007	0,007	0,002	0,002	0,002	1,877	0,729	0,446
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	0,026	0,016	0,014	0,034	0,020	0,010	0,070	0,132	0,074	0,220	0,109	0,078
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	0,017	0,013	0,011	0,023	0,013	0,008	0,163	0,149	0,084	0,053	0,026	0,019
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006	0,003	0,002	0,004	0,007	0,001	0,001	0,002	0,030	0,065	0,031	0,015	0,011
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011	0,002	0,002	0,000	0,001	0,000	0,000	0,002	0,030	0,065	0,013	0,007	0,005
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	0,028	0,012	0,008	0,000	0,000	0,000	0,001	0,001	0,001	0,131	0,106	0,101
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	0,011	0,009	0,003	0,002	0,004	0,004	0,001	0,001	0,001	0,131	0,106	0,101
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	0,007	0,003	0,002	0,004	0,006	0,006	0,001	0,001	0,001	0,131	0,106	0,101
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006	0,003	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,081	0,065	0,063
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011	0,000	0,000	0,000	0,009	0,004	0,004	0,001	0,001	0,001	0,030	0,024	0,023
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	0,140	0,110	0,070	0,006	0,006	0,006	0,002	0,002	0,002	7,000	5,500	3,500
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	0,085	0,023	0,020	0,030	0,030	0,030	0,003	0,003	0,003	1,432	0,865	0,648
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	0,085	0,023	0,020	0,030	0,030	0,030	0,003	0,003	0,003	0,285	0,185	0,154
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	0,054	0,020	0,019	0,030	0,030	0,030	0,003	0,003	0,003	0,184	0,118	0,096
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006	0,048	0,021	0,018	0,030	0,030	0,030	0,003	0,003	0,003	0,166	0,105	0,082
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009	0,003	0,002	0,001	0,030	0,030	0,030	0,003	0,003	0,003	0,007	0,004	0,003
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014	0,003	0,002	0,001	0,030	0,030	0,030	0,003	0,003	0,003	0,007	0,004	0,003
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	0,085	0,023	0,020	0,030	0,030	0,030	0,003	0,003	0,003	1,317	0,833	0,680
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	0,085	0,023	0,020	0,030	0,030	0,030	0,003	0,003	0,003	0,551	0,364	0,308
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	0,054	0,020	0,019	0,030	0,030	0,030	0,003	0,003	0,003	0,355	0,231	0,193
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006	0,048	0,021	0,018	0,030	0,030	0,030	0,003	0,003	0,003	0,315	0,204	0,173
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009	0,003	0,002	0,001	0,030	0,030	0,030	0,003	0,003	0,003	0,013	0,008	0,008
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014	0,003	0,002	0,001	0,030	0,030	0,030	0,003	0,003	0,003	0,014	0,008	0,008
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	1,094	0,690	0,561
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	0,768	0,503	0,419
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	0,112	0,070	0,065	0,030	0,030	0,030	0,003	0,003	0,003	0,492	0,319	0,261
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006	0,098	0,074	0,064	0,030	0,030	0,030	0,003	0,003	0,003	0,436	0,281	0,234
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009	0,005	0,006	0,004	0,030	0,030	0,030	0,003	0,003	0,003	0,021	0,013	0,012
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014	0,005	0,006	0,004	0,030	0,030	0,030	0,003	0,003	0,003	0,021	0,013	0,012
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	0,958	0,593	0,482
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	0,889	0,574	0,473
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	0,112	0,070	0,065	0,030	0,030	0,030	0,003	0,003	0,003	0,564	0,363	0,290
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006	0,098	0,074	0,064	0,030	0,030	0,030	0,003	0,003	0,003	0,493	0,315	0,260
Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009	0,005	0,006	0,004	0,030	0,030	0,030	0,003	0,003	0,003	0,025	0,016	0,014
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014	0,005	0,006	0,004	0,030	0,030	0,030	0,003	0,003	0,003	0,025	0,017	0,015
Buses	Urban Buses	Conventional	0	1993	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	1,830	1,116	0,865

Continued

Buses	Urban Buses	Euro I	1994	1996	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	0,754	0,488	0,395
Buses	Urban Buses	Euro II	1997	2001	0,114	0,052	0,046	0,030	0,030	0,030	0,003	0,003	0,003	0,491	0,318	0,262
Buses	Urban Buses	Euro III	2002	2006	0,103	0,047	0,041	0,030	0,030	0,030	0,003	0,003	0,003	0,437	0,283	0,231
Buses	Urban Buses	Euro IV	2007	2009	0,005	0,002	0,002	0,030	0,030	0,030	0,003	0,003	0,003	0,022	0,015	0,011
Buses	Coaches	Conventional	0	1993	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	1,008	0,577	0,422
Buses	Coaches	Euro I	1994	1996	0,175	0,080	0,070	0,030	0,030	0,030	0,003	0,003	0,003	0,936	0,563	0,441
Buses	Coaches	Euro II	1997	2001	0,114	0,052	0,046	0,030	0,030	0,030	0,003	0,003	0,003	0,623	0,380	0,290
Buses	Coaches	Euro III	2002	2006	0,103	0,047	0,041	0,030	0,030	0,030	0,003	0,003	0,003	0,575	0,354	0,289
Buses	Coaches	Euro IV	2007	2009	0,005	0,002	0,002	0,030	0,030	0,030	0,003	0,003	0,003	0,028	0,017	0,014
Mopeds	<50 cm^3	Conventional	0	1999	0,219	0,219	0,000	0,001	0,001	0,001	0,001	0,001	0,001	13,910	13,910	0,000
Mopeds	<50 cm^3	Euro I	2000	2003	0,044	0,044	0,000	0,001	0,001	0,001	0,001	0,001	0,001	2,730	2,730	0,000
Mopeds	<50 cm^3	Euro II	2004	9999	0,024	0,024	0,000	0,001	0,001	0,001	0,001	0,001	0,001	1,560	1,560	0,000
Motorcycles	2-stroke >50 cm^3	Conventional	0	1999	0,150	0,150	0,150	0,002	0,002	0,002	0,002	0,002	0,002	9,340	8,402	8,360
Motorcycles	4-stroke <250 cm^3	Conventional	0	1999	0,200	0,200	0,200	0,002	0,002	0,002	0,002	0,002	0,002	1,550	0,960	1,320
Motorcycles	4-stroke <250 cm^3	Euro I	2000	2003	0,142	0,144	0,132	0,002	0,002	0,002	0,002	0,002	0,002	1,103	0,870	0,870
Motorcycles	4-stroke <250 cm^3	Euro II	2004	2006	0,136	0,092	0,092	0,002	0,002	0,002	0,002	0,002	0,002	1,053	0,557	0,612
Motorcycles	4-stroke <250 cm^3	Euro III	2007	9999	0,082	0,032	0,028	0,002	0,002	0,002	0,002	0,002	0,002	0,628	0,193	0,179
Motorcycles	4-stroke 250 - 750 cm^3	Conventional	0	1999	0,200	0,200	0,200	0,002	0,002	0,002	0,002	0,002	0,002	1,350	0,944	1,010
Motorcycles	4-stroke 250 - 750 cm^3	Euro I	2000	2003	0,148	0,174	0,156	0,002	0,002	0,002	0,002	0,002	0,002	1,002	0,753	0,790
Motorcycles	4-stroke 250 - 750 cm^3	Euro II	2004	2006	0,156	0,120	0,122	0,002	0,002	0,002	0,002	0,002	0,002	1,053	0,557	0,612
Motorcycles	4-stroke >750 cm^3	Conventional	0	1999	0,200	0,200	0,200	0,002	0,002	0,002	0,002	0,002	0,002	2,520	1,610	1,190
Motorcycles	4-stroke >750 cm^3	Euro I	2000	2003	0,092	0,092	0,154	0,002	0,002	0,002	0,002	0,002	0,002	1,170	0,742	0,920
Motorcycles	4-stroke >750 cm^3	Euro II	2004	2006	0,084	0,062	0,102	0,002	0,002	0,002	0,002	0,002	0,002	1,053	0,557	0,612

Annex 2B-5: Reduction factors

Sector	Subsector	Tech 2	FYear	LYear	FCuR	FCrR	FChR	COuR	COrR	COhR	PMuR	PMrR	PMhR	NOxuR	NOxrR	NOxhR	VOCuR	VOCrR	VOChR
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	1,9	5,8	4,4	62,6	58,1	57,5	0,0	0,0	0,0	43,6	45,2	60,4	60,2	61,3	62,1
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005	-2,7	-0,7	1,6	70,6	49,6	34,9	60,2	54,6	37,4	72,2	78,5	88,7	91,7	87,5	77,0
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010	-5,6	-5,3	-4,8	89,0	79,1	70,1	60,2	54,6	37,4	80,1	89,2	95,9	93,3	88,7	84,5
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	2,1	1,7	5,3	62,6	58,1	57,5	0,0	0,0	0,0	43,6	45,2	60,4	60,2	61,3	62,1
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005	-1,3	-2,8	-3,1	70,6	49,6	34,9	60,2	54,6	37,4	72,2	78,5	88,7	91,7	87,5	77,0
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010	-5,2	-8,8	-7,3	89,0	79,1	70,1	60,2	54,6	37,4	80,1	89,2	95,9	93,3	88,7	84,5
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	-3,0	-5,4	-2,6	62,6	58,1	57,5	0,0	0,0	0,0	43,6	45,2	60,4	60,2	61,3	62,1
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005	5,1	7,2	12,6	70,6	49,6	34,9	60,2	54,6	37,4	72,2	78,5	88,7	91,7	87,5	77,0
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010	-15,4	-9,7	-1,3	89,0	79,1	70,1	60,2	54,6	37,4	80,1	89,2	95,9	93,3	88,7	84,5
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	-5,4	-3,1	-0,8	18,1	48,8	83,0	17,9	36,9	53,2	-7,9	1,2	-0,2	34,8	33,4	41,6
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005	-2,3	-1,4	5,8	76,4	81,1	94,3	48,5	51,9	58,3	-18,7	-18,5	-13,0	65,9	63,3	66,2
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010	-2,3	-1,4	5,8	80,1	84,2	89,7	49,0	60,6	75,8	10,6	24,5	13,2	27,6	44,3	51,9
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Continued

Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	0,0	0,0	0,0	18,1	48,8	83,0	17,9	36,9	53,2	-7,9	1,2	-0,2	-22,1	-25,4	-11,5
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005	0,0	0,0	0,0	76,4	81,1	94,3	48,5	51,9	58,3	-18,7	-18,5	-13,0	52,2	62,7	63,9
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010	0,0	0,0	0,0	80,1	84,2	89,7	49,0	60,6	75,8	10,6	24,5	13,2	86,4	86,1	83,2
Passenger Cars	LPG	Conventional	0	1990	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	0,0	0,0	0,0	39,0	39,0	39,0	0,0	0,0	0,0	66,0	66,0	66,0	76,0	76,0	76,0
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006	0,0	0,0	0,0	48,0	48,0	48,0	60,2	54,6	37,4	79,0	79,0	79,0	86,0	86,0	86,0
Light Duty Vehicles	Gasoline <3,5t	Euro IV	2007	2011	0,0	0,0	0,0	72,0	72,0	72,0	60,2	54,6	37,4	90,0	90,0	90,0	94,0	94,0	94,0
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006	0,0	0,0	0,0	18,0	18,0	18,0	33,0	33,0	33,0	35,0	35,0	35,0	38,0	38,0	38,0
Light Duty Vehicles	Diesel <3,5 t	Euro IV	2007	2011	0,0	0,0	0,0	35,0	35,0	35,0	65,0	65,0	65,0	72,0	72,0	72,0	77,0	77,0	77,0
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	19,4	13,9	11,6	67,0	65,7	60,8	61,5	61,4	61,1	30,3	27,3	27,4	80,1	78,6	76,2
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	24,0	17,1	14,3	72,6	70,1	67,1	83,6	80,5	77,2	25,7	25,0	27,1	87,2	86,4	85,1
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006	18,8	12,6	11,1	67,3	69,4	70,4	82,2	83,1	84,0	41,9	44,8	47,2	88,4	87,8	87,3
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro IV	2007	2009	23,9	18,0	16,5	97,4	97,5	97,6	96,6	97,0	97,2	64,7	64,9	65,6	99,4	99,4	99,4
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro V	2010	2014	22,6	17,0	15,7	97,4	97,5	97,6	96,6	96,9	97,2	79,9	79,9	80,3	99,4	99,4	99,4
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	15,7	13,8	11,6	52,6	52,2	52,1	40,7	40,9	40,8	40,3	40,3	40,8	58,2	56,3	54,7
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	19,1	16,7	14,0	61,4	57,8	55,7	75,0	71,3	65,3	36,3	37,4	38,8	73,1	72,3	71,6
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006	15,0	13,3	11,2	53,7	54,7	55,0	73,7	73,7	73,6	48,3	51,3	53,6	76,1	75,5	74,6
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro IV	2007	2009	20,2	18,8	17,3	96,6	96,6	96,7	94,9	95,2	95,4	69,1	70,1	70,9	98,8	98,8	98,8
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro V	2010	2014	18,7	17,5	16,2	96,6	96,6	96,7	94,8	95,1	95,3	82,3	82,9	83,4	98,8	98,8	98,7
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	13,5	12,4	11,8	29,5	28,0	28,0	29,2	31,4	32,1	32,0	32,2	32,6	29,8	27,2	25,4
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	16,8	15,1	14,3	43,4	37,9	35,1	69,4	67,6	58,9	28,7	29,4	30,6	55,0	53,7	53,6
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006	13,4	12,5	12,3	32,7	32,7	32,5	69,4	70,2	70,5	42,8	45,0	46,2	60,2	59,2	58,3
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro IV	2007	2009	19,1	18,4	18,4	95,2	95,2	95,4	94,2	94,6	94,9	65,3	66,0	66,3	98,0	98,0	97,9
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro V	2010	2014	17,6	17,1	17,2	95,1	95,2	95,4	94,1	94,6	94,9	80,2	80,6	80,7	97,9	97,9	97,9
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	11,9	11,2	11,2	15,3	12,4	12,6	23,2	26,4	27,5	29,5	29,7	29,6	7,3	3,2	2,0
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	14,4	13,1	13,4	31,3	24,5	21,4	65,2	65,4	53,4	26,8	27,4	27,8	41,2	38,8	40,0
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006	11,9	11,3	11,9	20,6	19,7	19,7	68,0	69,4	70,0	41,6	42,7	43,0	48,6	46,9	46,2

Continued

Heavy Duty Vehicles	Diesel >32t	Euro IV	2007	2009	18,0	17,6	18,2	94,6	94,7	94,9	94,1	94,7	95,0	63,9	64,6	63,8	97,4	97,4	97,3
Heavy Duty Vehicles	Diesel >32t	Euro V	2010	2014	16,5	16,3	17,1	94,5	94,6	94,9	94,0	94,6	94,9	79,4	79,7	79,3	97,3	97,3	97,3
Buses	Urban Buses	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Buses	Urban Buses	Euro I	1994	1996	14,8	13,4	12,8	52,0	51,8	55,4	45,7	41,8	43,7	39,1	39,4	41,6	58,8	56,3	54,4
Buses	Urban Buses	Euro II	1997	2001	17,8	14,7	13,1	57,7	57,2	61,5	75,0	71,7	68,5	34,9	36,6	38,5	73,2	71,5	69,7
Buses	Urban Buses	Euro III	2002	2006	13,5	11,2	10,6	53,2	54,2	58,4	76,6	74,5	72,9	44,9	50,4	55,1	76,1	74,6	73,3
Buses	Urban Buses	Euro IV	2007	2009	18,5	16,5	15,9	96,2	96,5	96,6	95,0	95,2	95,2	67,6	68,8	72,2	98,8	98,7	98,7
Buses	Coaches	Conventional	0	1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Buses	Coaches	Euro I	1994	1996	8,0	7,7	7,9	18,9	16,5	16,3	20,9	23,8	27,1	23,5	24,0	25,1	7,2	2,5	-4,4
Buses	Coaches	Euro II	1997	2001	8,2	7,4	7,9	32,3	28,0	24,0	66,0	63,1	61,7	14,5	16,5	18,5	38,2	34,1	31,3
Buses	Coaches	Euro III	2002	2006	1,7	0,6	0,2	16,6	13,7	12,6	62,3	61,6	62,4	26,5	32,1	35,4	43,0	38,7	31,7
Buses	Coaches	Euro IV	2007	2009	6,9	6,2	5,8	93,5	93,3	93,4	92,5	92,9	92,9	56,1	58,5	60,2	97,0	96,9	96,6
Mopeds	<50 cm^3	Conventional	0	1999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Mopeds	<50 cm^3	Euro I	2000	2003	40,0	40,0	0,0	59,4	59,4	0,0	59,8	59,8	0,0	0,0	0,0	0,0	80,4	80,4	0,0
Mopeds	<50 cm^3	Euro II	2004	9999	51,7	51,7	0,0	90,6	90,6	0,0	80,0	80,0	0,0	-1200,0	-1200,0	0,0	88,8	88,8	0,0
Motorcycles	2-stroke >50 cm^3	Conventional	0	1999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Motorcycles	4-stroke <250 cm^3	Conventional	0	1999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Motorcycles	4-stroke <250 cm^3	Euro I	2000	2003	5,5	-10,4	-46,1	42,4	44,5	60,0	0,0	0,0	0,0	-88,7	-72,0	-100,3	28,9	9,4	34,1
Motorcycles	4-stroke <250 cm^3	Euro II	2004	2006	5,5	-10,4	-46,1	71,1	77,4	75,9	75,0	75,0	75,0	-50,0	-9,5	-46,7	32,1	42,0	53,6
Motorcycles	4-stroke <250 cm^3	Euro III	2007	9999	5,5	-10,4	-46,1	79,0	94,0	94,2	75,0	75,0	75,0	3,1	38,0	9,1	59,5	79,9	86,4
Motorcycles	4-stroke 250 - 750 cm^3	Conventional	0	1999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Motorcycles	4-stroke 250 - 750 cm^3	Euro I	2000	2003	-1,3	-2,4	-19,0	53,3	38,1	23,2	0,0	0,0	0,0	-114,6	-90,2	-102,4	25,7	20,2	21,8
Motorcycles	4-stroke 250 - 750 cm^3	Euro II	2004	2006	-1,3	-2,4	-19,0	68,3	72,4	63,9	75,0	75,0	75,0	-43,4	-5,6	-42,0	22,0	41,0	39,4
Motorcycles	4-stroke >750 cm^3	Conventional	0	1999	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Motorcycles	4-stroke >750 cm^3	Euro I	2000	2003	-19,8	-5,9	-5,7	47,0	62,1	55,6	0,0	0,0	0,0	-41,9	-96,4	-178,6	53,6	53,9	22,7
Motorcycles	4-stroke >750 cm^3	Euro II	2004	2006	-19,8	-5,9	-5,7	56,5	67,0	61,7	75,0	75,0	75,0	-31,8	0,4	-35,5	58,2	65,4	48,6

Annex 2B-6: Fuel use factors (MJ/km) and emission factors (g/km)

Sector	Forecast Year	FCu (MJ)	FCr (MJ)	FCh (MJ)	CO_2u	CO_2r	CO_2h	CH_4u	CH_4r	CH_4h	N_2Ou	N_2Or	N_2Oh	SO_2u	SO_2r	SO_2h	NO_xu	NO_xr	NO_xh
Passenger Cars	1985	3,236	2,105	2,413	236	154	176	0,143	0,028	0,025	0,009	0,006	0,006	0,063	0,039	0,047	1,871	2,218	2,839
Passenger Cars	1986	3,203	2,095	2,395	234	153	175	0,143	0,028	0,024	0,009	0,006	0,006	0,041	0,026	0,031	1,863	2,217	2,848
Passenger Cars	1987	3,190	2,083	2,372	233	152	173	0,143	0,028	0,024	0,009	0,006	0,006	0,042	0,026	0,032	1,861	2,210	2,839
Passenger Cars	1988	3,119	2,071	2,347	228	151	172	0,141	0,028	0,024	0,009	0,006	0,006	0,042	0,027	0,032	1,838	2,199	2,831
Passenger Cars	1989	3,089	2,065	2,336	226	151	171	0,140	0,028	0,024	0,009	0,006	0,006	0,031	0,020	0,023	1,828	2,196	2,836
Passenger Cars	1990	3,076	2,063	2,328	225	151	170	0,140	0,028	0,024	0,009	0,006	0,006	0,030	0,019	0,023	1,833	2,207	2,856
Passenger Cars	1991	3,094	2,059	2,315	226	150	169	0,135	0,027	0,024	0,010	0,006	0,006	0,029	0,018	0,022	1,750	2,070	2,686
Passenger Cars	1992	3,087	2,057	2,305	226	150	168	0,130	0,026	0,023	0,010	0,006	0,006	0,020	0,013	0,015	1,666	1,942	2,528
Passenger Cars	1993	3,098	2,054	2,293	226	150	168	0,124	0,025	0,022	0,011	0,006	0,006	0,012	0,008	0,009	1,598	1,825	2,387
Passenger Cars	1994	3,076	2,057	2,283	225	150	167	0,113	0,024	0,021	0,012	0,007	0,005	0,012	0,008	0,009	1,469	1,631	2,149
Passenger Cars	1995	3,110	2,058	2,274	227	150	166	0,106	0,023	0,020	0,013	0,007	0,005	0,012	0,008	0,009	1,387	1,481	1,964
Passenger Cars	1996	3,151	2,059	2,265	230	150	166	0,099	0,022	0,019	0,013	0,007	0,005	0,012	0,008	0,009	1,315	1,341	1,790
Passenger Cars	1997	3,079	2,045	2,232	225	149	163	0,088	0,020	0,018	0,013	0,007	0,005	0,011	0,008	0,009	1,189	1,174	1,584
Passenger Cars	1998	3,076	2,048	2,220	225	150	162	0,080	0,019	0,017	0,013	0,007	0,005	0,011	0,008	0,009	1,089	1,031	1,398
Passenger Cars	1999	3,057	2,049	2,212	223	150	162	0,073	0,018	0,016	0,013	0,006	0,004	0,009	0,006	0,007	1,006	0,915	1,241
Passenger Cars	2000	3,043	2,052	2,208	222	150	161	0,067	0,017	0,015	0,013	0,006	0,004	0,007	0,005	0,005	0,947	0,831	1,127
Passenger Cars	2001	3,072	2,056	2,209	225	150	161	0,062	0,016	0,014	0,012	0,006	0,004	0,007	0,005	0,005	0,900	0,768	1,037
Passenger Cars	2002	3,044	2,060	2,209	223	151	162	0,056	0,014	0,012	0,012	0,006	0,004	0,007	0,005	0,005	0,836	0,697	0,936
Passenger Cars	2003	3,056	2,064	2,209	223	151	162	0,051	0,013	0,011	0,011	0,005	0,003	0,007	0,005	0,005	0,783	0,635	0,846
Passenger Cars	2004	3,009	2,066	2,208	220	151	162	0,045	0,012	0,010	0,010	0,005	0,003	0,007	0,005	0,005	0,725	0,576	0,759
Passenger Cars	2005	3,026	2,059	2,198	221	151	161	0,041	0,010	0,009	0,009	0,004	0,003	0,001	0,001	0,001	0,677	0,520	0,674
Passenger Cars	2006	3,008	2,065	2,200	220	151	161	0,036	0,009	0,008	0,009	0,004	0,003	0,001	0,001	0,001	0,617	0,464	0,593
Passenger Cars	2007	2,981	2,066	2,200	218	151	161	0,030	0,007	0,007	0,008	0,003	0,003	0,001	0,001	0,001	0,570	0,422	0,528
Light Duty Vehicles	1985	3,939	2,786	2,988	291	206	221	0,048	0,016	0,011	0,002	0,001	0,001	0,764	0,560	0,613	2,038	1,188	1,222
Light Duty Vehicles	1986	3,918	2,788	2,995	289	206	221	0,046	0,016	0,010	0,001	0,001	0,001	0,464	0,341	0,373	2,018	1,162	1,193
Light Duty Vehicles	1987	3,926	2,788	2,996	290	206	221	0,046	0,016	0,010	0,001	0,001	0,001	0,465	0,341	0,373	2,023	1,160	1,190
Light Duty Vehicles	1988	3,875	2,789	2,997	286	206	221	0,046	0,016	0,010	0,001	0,001	0,001	0,460	0,342	0,374	1,991	1,157	1,186
Light Duty Vehicles	1989	3,853	2,790	3,001	285	206	222	0,045	0,016	0,010	0,001	0,001	0,001	0,308	0,230	0,252	1,973	1,140	1,168
Light Duty Vehicles	1990	3,846	2,791	3,004	284	206	222	0,044	0,016	0,010	0,001	0,001	0,001	0,310	0,231	0,253	1,965	1,129	1,155
Light Duty Vehicles	1991	3,877	2,791	3,003	286	206	222	0,044	0,016	0,010	0,001	0,001	0,001	0,311	0,231	0,252	1,986	1,133	1,160
Light Duty Vehicles	1992	3,877	2,789	2,998	286	206	222	0,046	0,016	0,010	0,001	0,001	0,001	0,201	0,149	0,163	1,987	1,152	1,181
Light Duty Vehicles	1993	3,909	2,789	2,997	289	206	221	0,046	0,016	0,010	0,001	0,001	0,001	0,079	0,058	0,063	2,007	1,155	1,184
Light Duty Vehicles	1994	3,946	2,790	3,001	291	206	222	0,045	0,016	0,010	0,001	0,001	0,001	0,080	0,058	0,063	2,008	1,140	1,168
Light Duty Vehicles	1995	3,938	2,770	2,979	291	205	220	0,043	0,015	0,010	0,002	0,001	0,001	0,079	0,058	0,063	1,953	1,123	1,153

Continued

Light Duty Vehicles	1996	3,974	2,752	2,958	293	203	219	0,040	0,015	0,009	0,002	0,002	0,002	0,080	0,057	0,062	1,919	1,102	1,133
Light Duty Vehicles	1997	3,904	2,732	2,938	288	202	217	0,038	0,014	0,009	0,003	0,002	0,002	0,079	0,057	0,062	1,829	1,082	1,114
Light Duty Vehicles	1998	3,888	2,714	2,916	287	200	215	0,036	0,014	0,008	0,003	0,003	0,002	0,078	0,056	0,061	1,773	1,071	1,105
Light Duty Vehicles	1999	3,853	2,698	2,899	284	199	214	0,033	0,013	0,008	0,004	0,003	0,003	0,043	0,031	0,034	1,704	1,049	1,084
Light Duty Vehicles	2000	3,822	2,682	2,881	282	198	213	0,031	0,012	0,007	0,004	0,003	0,003	0,009	0,006	0,007	1,642	1,032	1,067
Light Duty Vehicles	2001	3,840	2,667	2,864	284	197	212	0,028	0,011	0,007	0,005	0,004	0,003	0,009	0,006	0,007	1,604	1,015	1,052
Light Duty Vehicles	2002	3,787	2,648	2,844	280	196	210	0,025	0,010	0,006	0,006	0,004	0,003	0,009	0,006	0,007	1,487	0,965	1,001
Light Duty Vehicles	2003	3,773	2,631	2,829	279	194	209	0,022	0,008	0,005	0,006	0,004	0,004	0,009	0,006	0,007	1,403	0,915	0,950
Light Duty Vehicles	2004	3,694	2,608	2,806	273	193	207	0,018	0,007	0,004	0,007	0,004	0,004	0,009	0,006	0,007	1,276	0,867	0,902
Light Duty Vehicles	2005	3,705	2,591	2,792	274	191	206	0,015	0,006	0,004	0,008	0,004	0,004	0,002	0,001	0,001	1,219	0,830	0,864
Light Duty Vehicles	2006	3,666	2,575	2,778	271	190	205	0,013	0,005	0,003	0,008	0,004	0,004	0,002	0,001	0,001	1,148	0,797	0,831
Light Duty Vehicles	2007	3,621	2,557	2,765	267	189	204	0,011	0,004	0,002	0,009	0,004	0,004	0,002	0,001	0,001	1,044	0,738	0,770
Heavy Duty Vehicles	1985	11,446	9,610	10,448	847	711	773	0,138	0,063	0,062	0,030	0,030	0,030	2,668	2,244	2,443	11,406	10,062	10,757
Heavy Duty Vehicles	1986	11,447	9,611	10,449	847	711	773	0,138	0,063	0,062	0,030	0,030	0,030	1,602	1,347	1,466	11,410	10,063	10,757
Heavy Duty Vehicles	1987	11,447	9,611	10,449	847	711	773	0,138	0,063	0,062	0,030	0,030	0,030	1,602	1,347	1,466	11,410	10,063	10,757
Heavy Duty Vehicles	1988	11,447	9,612	10,449	847	711	773	0,138	0,063	0,062	0,030	0,030	0,030	1,602	1,347	1,466	11,410	10,063	10,757
Heavy Duty Vehicles	1989	11,447	9,612	10,449	847	711	773	0,138	0,063	0,062	0,030	0,030	0,030	1,068	0,898	0,978	11,412	10,064	10,758
Heavy Duty Vehicles	1990	11,329	9,541	10,413	838	706	771	0,137	0,062	0,062	0,030	0,030	0,030	1,057	0,892	0,974	11,283	9,984	10,718
Heavy Duty Vehicles	1991	11,463	9,543	10,372	848	706	767	0,139	0,062	0,061	0,030	0,030	0,030	1,070	0,892	0,970	11,410	9,985	10,682
Heavy Duty Vehicles	1992	11,462	9,542	10,371	848	706	767	0,139	0,062	0,061	0,030	0,030	0,030	0,695	0,580	0,631	11,408	9,985	10,681
Heavy Duty Vehicles	1993	11,245	9,567	10,323	832	708	764	0,137	0,063	0,061	0,030	0,030	0,030	0,262	0,224	0,241	11,151	9,963	10,588
Heavy Duty Vehicles	1994	11,060	9,418	10,184	818	697	754	0,136	0,062	0,061	0,030	0,030	0,030	0,258	0,220	0,238	10,785	9,638	10,263
Heavy Duty Vehicles	1995	10,936	9,374	10,015	809	694	741	0,136	0,063	0,060	0,030	0,030	0,030	0,255	0,219	0,234	10,484	9,422	9,922
Heavy Duty Vehicles	1996	10,908	9,253	9,918	807	685	734	0,136	0,062	0,060	0,030	0,030	0,030	0,254	0,216	0,232	10,296	9,151	9,662
Heavy Duty Vehicles	1997	11,112	9,366	9,935	822	693	735	0,136	0,064	0,061	0,030	0,030	0,030	0,259	0,219	0,232	10,370	9,129	9,528
Heavy Duty Vehicles	1998	11,080	9,342	9,875	820	691	731	0,133	0,064	0,061	0,030	0,030	0,030	0,259	0,218	0,231	10,211	8,975	9,326
Heavy Duty Vehicles	1999	11,177	9,399	9,868	827	696	730	0,132	0,065	0,062	0,030	0,030	0,030	0,144	0,121	0,127	10,191	8,915	9,193
Heavy Duty Vehicles	2000	11,111	9,345	9,803	822	692	725	0,128	0,064	0,061	0,030	0,030	0,030	0,026	0,022	0,023	9,995	8,729	8,983
Heavy Duty Vehicles	2001	11,398	9,530	9,861	843	705	730	0,129	0,067	0,063	0,030	0,030	0,030	0,027	0,022	0,023	10,006	8,675	8,807
Heavy Duty Vehicles	2002	11,354	9,502	9,808	840	703	726	0,124	0,067	0,063	0,030	0,030	0,030	0,027	0,022	0,023	9,656	8,359	8,460
Heavy Duty Vehicles	2003	11,312	9,474	9,770	837	701	723	0,119	0,067	0,062	0,030	0,030	0,030	0,026	0,022	0,023	9,350	8,080	8,164
Heavy Duty Vehicles	2004	11,173	9,378	9,668	827	694	715	0,114	0,067	0,062	0,030	0,030	0,030	0,026	0,022	0,023	8,892	7,675	7,744
Heavy Duty Vehicles	2005	11,108	9,326	9,613	822	690	711	0,109	0,066	0,061	0,030	0,030	0,030	0,005	0,004	0,005	8,592	7,402	7,463
Heavy Duty Vehicles	2006	11,040	9,272	9,555	817	686	707	0,104	0,065	0,060	0,030	0,030	0,030	0,005	0,004	0,004	8,270	7,113	7,167
Heavy Duty Vehicles	2007	10,927	9,177	9,453	809	679	699	0,093	0,059	0,054	0,030	0,030	0,030	0,005	0,004	0,004	7,720	6,634	6,685
Buses	1985	13,144	10,264	8,850	973	760	655	0,175	0,080	0,070	0,030	0,030	0,030	3,078	2,404	2,073	13,673	11,169	9,586
Buses	1986	13,142	10,261	8,849	973	759	655	0,175	0,080	0,070	0,030	0,030	0,030	1,847	1,442	1,243	13,669	11,164	9,582

Continued

Buses	1987	13,148	10,269	8,853	973	760	655	0,175	0,080	0,070	0,030	0,030	0,030	1,847	1,443	1,244	13,683	11,181	9,595
Buses	1988	13,157	10,282	8,861	974	761	656	0,175	0,080	0,070	0,030	0,030	0,030	1,849	1,445	1,245	13,705	11,207	9,615
Buses	1989	13,153	10,276	8,858	973	760	655	0,175	0,080	0,070	0,030	0,030	0,030	1,232	0,963	0,830	13,695	11,195	9,606
Buses	1990	13,137	10,253	8,844	972	759	654	0,175	0,080	0,070	0,030	0,030	0,030	1,231	0,961	0,828	13,656	11,148	9,569
Buses	1991	13,133	10,262	8,843	972	759	654	0,175	0,080	0,070	0,030	0,030	0,030	1,230	0,961	0,828	13,646	11,165	9,567
Buses	1992	13,143	10,245	8,844	973	758	654	0,175	0,080	0,070	0,030	0,030	0,030	0,800	0,624	0,538	13,672	11,130	9,568
Buses	1993	13,114	10,263	8,848	970	759	655	0,175	0,080	0,070	0,030	0,030	0,030	0,307	0,240	0,207	13,599	11,167	9,580
Buses	1994	12,998	10,108	8,772	962	748	649	0,175	0,080	0,070	0,030	0,030	0,030	0,304	0,237	0,205	13,260	10,722	9,310
Buses	1995	12,794	9,930	8,658	947	735	641	0,175	0,080	0,070	0,030	0,030	0,030	0,300	0,233	0,203	12,710	10,244	8,947
Buses	1996	12,605	9,778	8,555	933	724	633	0,175	0,080	0,070	0,030	0,030	0,030	0,295	0,229	0,200	12,202	9,832	8,623
Buses	1997	12,445	9,683	8,486	921	717	628	0,170	0,078	0,068	0,030	0,030	0,030	0,291	0,227	0,199	11,889	9,585	8,429
Buses	1998	12,349	9,632	8,447	914	713	625	0,165	0,075	0,066	0,030	0,030	0,030	0,289	0,226	0,198	11,726	9,459	8,328
Buses	1999	12,234	9,566	8,398	905	708	621	0,161	0,073	0,064	0,030	0,030	0,030	0,158	0,123	0,108	11,511	9,289	8,194
Buses	2000	12,134	9,511	8,357	898	704	618	0,157	0,072	0,063	0,030	0,030	0,030	0,028	0,022	0,020	11,327	9,147	8,080
Buses	2001	12,054	9,465	8,324	892	700	616	0,153	0,070	0,061	0,030	0,030	0,030	0,028	0,022	0,019	11,184	9,033	7,991
Buses	2002	12,011	9,449	8,323	889	699	616	0,149	0,068	0,060	0,030	0,030	0,030	0,028	0,022	0,019	10,907	8,781	7,766
Buses	2003	11,991	9,451	8,332	887	699	617	0,146	0,067	0,058	0,030	0,030	0,030	0,028	0,022	0,020	10,698	8,589	7,587
Buses	2004	11,961	9,432	8,332	885	698	617	0,143	0,065	0,057	0,030	0,030	0,030	0,028	0,022	0,020	10,485	8,387	7,413
Buses	2005	11,921	9,423	8,331	882	697	617	0,139	0,064	0,056	0,030	0,030	0,030	0,006	0,004	0,004	10,245	8,175	7,218
Buses	2006	11,882	9,412	8,330	879	697	616	0,136	0,062	0,054	0,030	0,030	0,030	0,006	0,004	0,004	10,015	7,969	7,030
Buses	2007	11,800	9,365	8,295	873	693	614	0,125	0,057	0,050	0,030	0,030	0,030	0,006	0,004	0,004	9,566	7,613	6,709
Mopeds	1985	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1986	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1987	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1988	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1989	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1990	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1991	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1992	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1993	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1994	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1995	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1996	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1997	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1998	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	1999	1,095	1,095		80	80		0,219	0,219		0,001	0,001		0,003	0,003		0,020	0,020	
Mopeds	2000	1,050	1,050		77	77		0,201	0,201		0,001	0,001		0,002	0,002		0,020	0,020	

Continued																			
Mopeds	2001	1,019	1,019		74	74		0,188	0,188		0,001	0,001		0,002	0,002		0,020	0,020	
Mopeds	2002	0,985	0,985		72	72		0,175	0,175		0,001	0,001		0,002	0,002		0,020	0,020	
Mopeds	2003	0,969	0,969		71	71		0,169	0,169		0,001	0,001		0,002	0,002		0,020	0,020	
Mopeds	2004	0,940	0,940		69	69		0,159	0,159		0,001	0,001		0,002	0,002		0,035	0,035	
Mopeds	2005	0,893	0,893		65	65		0,143	0,143		0,001	0,001		0,000	0,000		0,055	0,055	
Mopeds	2006	0,842	0,842		61	61		0,125	0,125		0,001	0,001		0,000	0,000		0,071	0,071	
Mopeds	2007	0,793	0,793		58	58		0,107	0,107		0,001	0,001		0,000	0,000		0,089	0,089	
Motorcycles	1985	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1986	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1987	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1988	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1989	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1990	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1991	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1992	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1993	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1994	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1995	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1996	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1997	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1998	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	1999	1,308	1,318	1,578	95	96	115	0,193	0,193	0,193	0,002	0,002	0,002	0,003	0,003	0,004	0,122	0,228	0,340
Motorcycles	2000	1,312	1,321	1,597	96	96	117	0,189	0,189	0,190	0,002	0,002	0,002	0,003	0,003	0,004	0,129	0,241	0,366
Motorcycles	2001	1,312	1,321	1,597	96	96	117	0,189	0,190	0,190	0,002	0,002	0,002	0,003	0,003	0,004	0,130	0,242	0,368
Motorcycles	2002	1,314	1,321	1,604	96	96	117	0,188	0,189	0,189	0,002	0,002	0,002	0,003	0,003	0,004	0,133	0,248	0,379
Motorcycles	2003	1,316	1,322	1,611	96	97	118	0,186	0,188	0,188	0,002	0,002	0,002	0,003	0,003	0,004	0,136	0,254	0,390
Motorcycles	2004	1,317	1,323	1,618	96	97	118	0,185	0,185	0,186	0,002	0,002	0,002	0,003	0,003	0,004	0,138	0,253	0,393
Motorcycles	2005	1,320	1,325	1,630	96	97	119	0,183	0,182	0,183	0,002	0,002	0,002	0,001	0,001	0,001	0,141	0,257	0,404
Motorcycles	2006	1,321	1,325	1,638	96	97	119	0,181	0,180	0,181	0,002	0,002	0,002	0,001	0,001	0,001	0,144	0,260	0,413
Motorcycles	2007	1,311	1,325	1,662	95	96	121	0,178	0,175	0,176	0,002	0,002	0,002	0,001	0,001	0,001	0,145	0,259	0,415

Sector	Forecast Year	NMVOCu (exh)	NMVOCr (exh)	NMVOCh (exh)	NMVOCu (tot)	NMVOCr (tot)	NMVOCh (tot)	COu	COr	COh	NH_3u	NH_3r	NH_3h	TSPu	TSPr	TSPh
Passenger Cars	1985	3,143	1,062	0,936	5,045	1,456	1,012	37,285	10,257	10,681	0,002	0,002	0,002	0,079	0,045	0,047
Passenger Cars	1986	3,039	1,039	0,910	4,949	1,435	0,986	35,123	9,742	10,035	0,002	0,002	0,002	0,077	0,043	0,045
Passenger Cars	1987	2,995	1,013	0,879	4,879	1,404	0,954	33,562	9,142	9,335	0,002	0,002	0,002	0,077	0,042	0,045
Passenger Cars	1988	2,749	0,979	0,838	4,699	1,384	0,916	29,204	8,350	8,386	0,002	0,002	0,002	0,072	0,041	0,043
Passenger Cars	1989	2,646	0,959	0,815	4,616	1,368	0,894	27,434	7,938	7,844	0,002	0,002	0,002	0,071	0,040	0,043
Passenger Cars	1990	2,605	0,948	0,801	4,575	1,357	0,879	26,526	7,643	7,434	0,002	0,002	0,002	0,068	0,039	0,041
Passenger Cars	1991	2,601	0,884	0,746	4,447	1,249	0,818	26,591	7,128	6,907	0,005	0,011	0,007	0,064	0,036	0,038
Passenger Cars	1992	2,490	0,824	0,695	4,318	1,169	0,754	25,326	6,664	6,450	0,009	0,019	0,011	0,058	0,033	0,035
Passenger Cars	1993	2,478	0,767	0,647	4,110	1,074	0,699	25,146	6,214	6,035	0,012	0,027	0,016	0,055	0,030	0,033
Passenger Cars	1994	2,271	0,677	0,569	3,784	0,949	0,616	22,657	5,521	5,328	0,017	0,039	0,023	0,048	0,027	0,029
Passenger Cars	1995	2,235	0,607	0,510	3,643	0,847	0,547	22,105	5,027	4,906	0,020	0,049	0,028	0,044	0,024	0,027
Passenger Cars	1996	2,248	0,542	0,455	3,478	0,750	0,483	22,063	4,570	4,511	0,024	0,059	0,033	0,041	0,022	0,025
Passenger Cars	1997	1,889	0,453	0,382	2,966	0,635	0,406	17,933	3,773	3,853	0,034	0,072	0,040	0,034	0,018	0,021
Passenger Cars	1998	1,732	0,388	0,328	2,608	0,536	0,348	16,485	3,314	3,426	0,042	0,082	0,046	0,030	0,016	0,018
Passenger Cars	1999	1,517	0,333	0,282	2,276	0,462	0,299	14,324	2,921	3,070	0,049	0,090	0,051	0,028	0,015	0,017
Passenger Cars	2000	1,388	0,294	0,249	1,898	0,381	0,260	13,097	2,649	2,831	0,054	0,095	0,053	0,026	0,014	0,017
Passenger Cars	2001	1,339	0,264	0,224	1,779	0,339	0,234	12,853	2,465	2,693	0,051	0,091	0,054	0,027	0,013	0,017
Passenger Cars	2002	1,167	0,232	0,198	1,551	0,297	0,207	11,308	2,251	2,517	0,049	0,086	0,055	0,025	0,013	0,016
Passenger Cars	2003	1,084	0,204	0,174	1,411	0,259	0,182	10,696	2,046	2,336	0,046	0,081	0,055	0,025	0,013	0,016
Passenger Cars	2004	0,908	0,175	0,151	1,186	0,222	0,157	9,023	1,837	2,147	0,043	0,076	0,054	0,024	0,013	0,017
Passenger Cars	2005	0,860	0,147	0,127	1,109	0,189	0,133	8,885	1,606	1,921	0,039	0,071	0,053	0,026	0,013	0,017
Passenger Cars	2006	0,721	0,121	0,106	0,937	0,158	0,111	7,517	1,374	1,676	0,035	0,063	0,052	0,026	0,013	0,018
Passenger Cars	2007	0,590	0,097	0,085	0,758	0,125	0,089	6,284	1,139	1,417	0,029	0,054	0,048	0,028	0,014	0,019
Light Duty Vehicles	1985	0,695	0,184	0,143	0,965	0,236	0,154	6,539	1,779	2,022	0,001	0,001	0,001	0,465	0,263	0,279
Light Duty Vehicles	1986	0,648	0,177	0,139	0,900	0,226	0,150	6,069	1,721	1,950	0,001	0,001	0,001	0,460	0,266	0,282
Light Duty Vehicles	1987	0,653	0,177	0,139	0,901	0,225	0,149	6,102	1,717	1,944	0,001	0,001	0,001	0,467	0,267	0,282
Light Duty Vehicles	1988	0,608	0,176	0,138	0,864	0,225	0,149	5,706	1,708	1,934	0,001	0,001	0,001	0,433	0,267	0,283
Light Duty Vehicles	1989	0,574	0,171	0,136	0,820	0,219	0,146	5,375	1,672	1,888	0,001	0,001	0,001	0,423	0,269	0,285
Light Duty Vehicles	1990	0,556	0,168	0,134	0,793	0,214	0,144	5,201	1,647	1,857	0,001	0,001	0,001	0,422	0,270	0,286
Light Duty Vehicles	1991	0,584	0,170	0,135	0,820	0,215	0,145	5,447	1,656	1,869	0,001	0,001	0,001	0,443	0,270	0,286
Light Duty Vehicles	1992	0,601	0,174	0,138	0,862	0,224	0,148	5,642	1,698	1,921	0,001	0,001	0,001	0,431	0,267	0,284
Light Duty Vehicles	1993	0,629	0,175	0,138	0,882	0,223	0,148	5,889	1,705	1,929	0,001	0,001	0,001	0,451	0,267	0,283
Light Duty Vehicles	1994	0,625	0,171	0,136	0,903	0,216	0,145	5,842	1,672	1,889	0,001	0,001	0,001	0,461	0,269	0,285
Light Duty Vehicles	1995	0,613	0,166	0,133	0,868	0,206	0,141	5,735	1,576	1,787	0,002	0,003	0,002	0,440	0,250	0,267
Light Duty Vehicles	1996	0,624	0,159	0,129	0,850	0,194	0,136	5,799	1,472	1,675	0,002	0,004	0,003	0,441	0,233	0,251
Light Duty Vehicles	1997	0,563	0,152	0,125	0,772	0,185	0,131	5,245	1,370	1,566	0,003	0,005	0,003	0,383	0,216	0,234
Light Duty Vehicles	1998	0,551	0,148	0,123	0,736	0,176	0,128	5,168	1,292	1,485	0,003	0,007	0,004	0,354	0,199	0,217

Continued

Light Duty Vehicles	1999	0,509	0,141	0,119	0,678	0,167	0,124	4,736	1,196	1,380	0,004	0,008	0,005	0,323	0,185	0,203
Light Duty Vehicles	2000	0,478	0,136	0,116	0,595	0,154	0,119	4,446	1,114	1,292	0,005	0,009	0,006	0,293	0,170	0,189
Light Duty Vehicles	2001	0,478	0,131	0,113	0,580	0,147	0,116	4,404	1,034	1,207	0,006	0,010	0,006	0,284	0,156	0,175
Light Duty Vehicles	2002	0,418	0,121	0,106	0,504	0,135	0,108	3,855	0,920	1,080	0,006	0,010	0,007	0,244	0,139	0,158
Light Duty Vehicles	2003	0,381	0,112	0,099	0,448	0,122	0,101	3,426	0,809	0,954	0,006	0,009	0,007	0,227	0,126	0,144
Light Duty Vehicles	2004	0,316	0,102	0,092	0,365	0,110	0,094	2,801	0,684	0,816	0,005	0,009	0,007	0,180	0,106	0,125
Light Duty Vehicles	2005	0,302	0,095	0,087	0,340	0,101	0,088	2,576	0,599	0,720	0,005	0,008	0,007	0,173	0,095	0,113
Light Duty Vehicles	2006	0,269	0,089	0,083	0,298	0,094	0,084	2,190	0,526	0,637	0,004	0,007	0,006	0,153	0,084	0,103
Light Duty Vehicles	2007	0,228	0,080	0,076	0,246	0,083	0,076	1,713	0,449	0,550	0,003	0,006	0,005	0,132	0,073	0,091
Heavy Duty Vehicles	1985	1,054	0,662	0,491	1,054	0,662	0,491	3,054	2,162	2,090	0,003	0,003	0,003	0,511	0,386	0,400
Heavy Duty Vehicles	1986	1,051	0,660	0,491	1,051	0,660	0,491	3,021	2,143	2,081	0,003	0,003	0,003	0,511	0,386	0,400
Heavy Duty Vehicles	1987	1,051	0,660	0,491	1,051	0,660	0,491	3,019	2,141	2,080	0,003	0,003	0,003	0,511	0,386	0,400
Heavy Duty Vehicles	1988	1,051	0,659	0,491	1,051	0,659	0,491	3,014	2,139	2,078	0,003	0,003	0,003	0,511	0,386	0,400
Heavy Duty Vehicles	1989	1,049	0,658	0,490	1,049	0,658	0,490	2,995	2,127	2,072	0,003	0,003	0,003	0,511	0,386	0,400
Heavy Duty Vehicles	1990	1,054	0,661	0,491	1,054	0,661	0,491	2,979	2,120	2,069	0,003	0,003	0,003	0,508	0,384	0,399
Heavy Duty Vehicles	1991	1,047	0,661	0,494	1,047	0,661	0,494	2,984	2,123	2,073	0,003	0,003	0,003	0,512	0,384	0,398
Heavy Duty Vehicles	1992	1,049	0,662	0,494	1,049	0,662	0,494	3,007	2,137	2,081	0,003	0,003	0,003	0,512	0,384	0,398
Heavy Duty Vehicles	1993	1,050	0,655	0,492	1,050	0,655	0,492	2,993	2,126	2,073	0,003	0,003	0,003	0,503	0,382	0,394
Heavy Duty Vehicles	1994	1,009	0,636	0,481	1,009	0,636	0,481	2,896	2,068	2,025	0,003	0,003	0,003	0,487	0,370	0,382
Heavy Duty Vehicles	1995	0,968	0,614	0,473	0,968	0,614	0,473	2,821	2,022	1,986	0,003	0,003	0,003	0,474	0,362	0,370
Heavy Duty Vehicles	1996	0,921	0,593	0,458	0,921	0,593	0,458	2,735	1,970	1,941	0,003	0,003	0,003	0,460	0,348	0,358
Heavy Duty Vehicles	1997	0,852	0,552	0,429	0,852	0,552	0,429	2,622	1,900	1,878	0,003	0,003	0,003	0,441	0,333	0,343
Heavy Duty Vehicles	1998	0,799	0,520	0,405	0,799	0,520	0,405	2,549	1,858	1,837	0,003	0,003	0,003	0,416	0,314	0,326
Heavy Duty Vehicles	1999	0,748	0,489	0,382	0,748	0,489	0,382	2,468	1,812	1,794	0,003	0,003	0,003	0,396	0,299	0,313
Heavy Duty Vehicles	2000	0,708	0,464	0,363	0,708	0,464	0,363	2,425	1,784	1,766	0,003	0,003	0,003	0,372	0,282	0,297
Heavy Duty Vehicles	2001	0,662	0,435	0,340	0,662	0,435	0,340	2,443	1,792	1,754	0,003	0,003	0,003	0,358	0,270	0,283
Heavy Duty Vehicles	2002	0,615	0,404	0,317	0,615	0,404	0,317	2,399	1,761	1,721	0,003	0,003	0,003	0,330	0,249	0,262
Heavy Duty Vehicles	2003	0,575	0,378	0,298	0,575	0,378	0,298	2,343	1,724	1,688	0,003	0,003	0,003	0,307	0,231	0,243
Heavy Duty Vehicles	2004	0,517	0,342	0,272	0,517	0,342	0,272	2,237	1,658	1,631	0,003	0,003	0,003	0,274	0,206	0,218
Heavy Duty Vehicles	2005	0,486	0,321	0,255	0,486	0,321	0,255	2,210	1,635	1,605	0,003	0,003	0,003	0,254	0,191	0,202
Heavy Duty Vehicles	2006	0,451	0,298	0,238	0,451	0,298	0,238	2,148	1,588	1,558	0,003	0,003	0,003	0,233	0,175	0,185
Heavy Duty Vehicles	2007	0,395	0,261	0,208	0,395	0,261	0,208	1,948	1,438	1,408	0,003	0,003	0,003	0,204	0,153	0,162
Buses	1985	1,462	0,856	0,544	1,462	0,856	0,544	4,248	2,679	1,826	0,003	0,003	0,003	0,701	0,453	0,339
Buses	1986	1,461	0,855	0,543	1,461	0,855	0,543	4,245	2,677	1,825	0,003	0,003	0,003	0,700	0,453	0,339
Buses	1987	1,465	0,858	0,545	1,465	0,858	0,545	4,254	2,684	1,830	0,003	0,003	0,003	0,701	0,454	0,339
Buses	1988	1,470	0,862	0,549	1,470	0,862	0,549	4,266	2,695	1,838	0,003	0,003	0,003	0,702	0,455	0,339
Buses	1989	1,467	0,860	0,547	1,467	0,860	0,547	4,261	2,690	1,835	0,003	0,003	0,003	0,702	0,454	0,339

Continued

Buses	1990	1,458	0,853	0,541	1,458	0,853	0,541	4,237	2,670	1,820	0,003	0,003	0,003	0,700	0,452	0,338
Buses	1991	1,456	0,855	0,540	1,456	0,855	0,540	4,232	2,677	1,819	0,003	0,003	0,003	0,699	0,453	0,338
Buses	1992	1,462	0,850	0,540	1,462	0,850	0,540	4,247	2,662	1,819	0,003	0,003	0,003	0,701	0,452	0,338
Buses	1993	1,445	0,856	0,543	1,445	0,856	0,543	4,204	2,678	1,824	0,003	0,003	0,003	0,696	0,453	0,338
Buses	1994	1,393	0,804	0,527	1,393	0,804	0,527	4,083	2,531	1,766	0,003	0,003	0,003	0,676	0,435	0,328
Buses	1995	1,293	0,747	0,493	1,293	0,747	0,493	3,836	2,369	1,669	0,003	0,003	0,003	0,644	0,415	0,316
Buses	1996	1,204	0,701	0,465	1,204	0,701	0,465	3,611	2,235	1,587	0,003	0,003	0,003	0,615	0,398	0,305
Buses	1997	1,124	0,660	0,443	1,124	0,660	0,443	3,436	2,137	1,528	0,003	0,003	0,003	0,573	0,373	0,287
Buses	1998	1,073	0,634	0,428	1,073	0,634	0,428	3,332	2,080	1,492	0,003	0,003	0,003	0,544	0,355	0,274
Buses	1999	1,015	0,604	0,411	1,015	0,604	0,411	3,206	2,009	1,450	0,003	0,003	0,003	0,513	0,336	0,260
Buses	2000	0,963	0,578	0,397	0,963	0,578	0,397	3,098	1,949	1,413	0,003	0,003	0,003	0,485	0,319	0,248
Buses	2001	0,922	0,557	0,385	0,922	0,557	0,385	3,011	1,900	1,384	0,003	0,003	0,003	0,462	0,306	0,239
Buses	2002	0,873	0,531	0,371	0,873	0,531	0,371	2,932	1,856	1,359	0,003	0,003	0,003	0,437	0,290	0,227
Buses	2003	0,837	0,512	0,361	0,837	0,512	0,361	2,882	1,830	1,345	0,003	0,003	0,003	0,419	0,279	0,219
Buses	2004	0,800	0,492	0,349	0,800	0,492	0,349	2,822	1,794	1,327	0,003	0,003	0,003	0,400	0,267	0,210
Buses	2005	0,756	0,470	0,338	0,756	0,470	0,338	2,753	1,758	1,305	0,003	0,003	0,003	0,378	0,254	0,200
Buses	2006	0,713	0,448	0,326	0,713	0,448	0,326	2,686	1,721	1,284	0,003	0,003	0,003	0,357	0,241	0,191
Buses	2007	0,648	0,409	0,300	0,648	0,409	0,300	2,480	1,593	1,189	0,003	0,003	0,003	0,326	0,221	0,175
Mopeds	1985	13,691	13,691		14,001	14,001		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1986	13,691	13,691		14,008	14,008		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1987	13,691	13,691		14,006	14,006		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1988	13,691	13,691		14,027	14,027		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1989	13,691	13,691		14,041	14,041		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1990	13,691	13,691		14,034	14,034		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1991	13,691	13,691		14,019	14,019		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1992	13,691	13,691		14,022	14,022		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1993	13,691	13,691		14,001	14,001		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1994	13,691	13,691		14,013	14,013		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1995	13,691	13,691		14,014	14,014		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1996	13,691	13,691		14,001	14,001		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1997	13,691	13,691		14,017	14,017		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1998	13,691	13,691		14,002	14,002		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	1999	13,691	13,691		14,037	14,037		13,800	13,800		0,001	0,001		0,188	0,188	
Mopeds	2000	12,563	12,563		12,849	12,849		12,960	12,960		0,001	0,001		0,176	0,176	
Mopeds	2001	11,773	11,773		12,084	12,084		12,371	12,371		0,001	0,001		0,168	0,168	
Mopeds	2002	10,937	10,937		11,256	11,256		11,748	11,748		0,001	0,001		0,160	0,160	
Mopeds	2003	10,520	10,520		10,837	10,837		11,437	11,437		0,001	0,001		0,156	0,156	

Continued

Mopeds	2004	9,924	9,924		10,241	10,241		10,776	10,776		0,001	0,001		0,148	0,148	
Mopeds	2005	8,923	8,923		9,274	9,274		9,743	9,743		0,001	0,001		0,135	0,135	
Mopeds	2006	7,805	7,805		8,173	8,173		8,676	8,676		0,001	0,001		0,122	0,122	
Mopeds	2007	6,692	6,692		7,053	7,053		7,593	7,593		0,001	0,001		0,109	0,109	
Motorcycles	1985	2,639	2,014	2,011	3,494	2,239	2,039	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1986	2,639	2,014	2,011	3,502	2,242	2,039	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1987	2,639	2,014	2,011	3,497	2,240	2,039	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1988	2,639	2,014	2,011	3,533	2,250	2,040	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1989	2,639	2,014	2,011	3,554	2,255	2,041	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1990	2,639	2,014	2,011	3,547	2,253	2,041	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1991	2,639	2,014	2,011	3,409	2,276	2,046	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1992	2,639	2,014	2,011	3,538	2,239	2,044	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1993	2,639	2,014	2,011	3,367	2,267	2,048	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1994	2,639	2,014	2,011	3,490	2,242	2,046	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1995	2,639	2,014	2,011	3,544	2,254	2,037	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1996	2,639	2,014	2,011	3,459	2,234	2,045	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1997	2,639	2,014	2,011	3,496	2,244	2,047	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1998	2,639	2,014	2,011	3,467	2,236	2,045	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	1999	2,639	2,014	2,011	3,496	2,244	2,046	20,029	22,185	27,917	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	2000	2,607	1,998	1,998	3,283	2,179	2,026	19,468	21,623	27,259	0,002	0,002	0,002	0,047	0,047	0,047
Motorcycles	2001	2,568	1,961	1,961	3,233	2,139	1,989	19,445	21,600	27,257	0,002	0,002	0,002	0,046	0,046	0,046
Motorcycles	2002	2,517	1,918	1,919	3,195	2,099	1,947	19,204	21,360	27,001	0,002	0,002	0,002	0,045	0,045	0,045
Motorcycles	2003	2,466	1,875	1,878	3,139	2,055	1,906	18,978	21,134	26,761	0,002	0,002	0,002	0,044	0,044	0,044
Motorcycles	2004	2,414	1,826	1,830	3,097	2,009	1,858	18,614	20,684	26,249	0,002	0,002	0,002	0,043	0,043	0,043
Motorcycles	2005	2,354	1,774	1,780	3,084	1,969	1,810	18,150	20,155	25,645	0,002	0,002	0,002	0,042	0,042	0,042
Motorcycles	2006	2,299	1,725	1,733	3,052	1,926	1,764	17,761	19,704	25,135	0,002	0,002	0,002	0,040	0,040	0,040
Motorcycles	2007	2,231	1,666	1,674	2,972	1,864	1,704	17,321	19,122	24,407	0,002	0,002	0,002	0,039	0,039	0,039

Annex 2B-7: Fuel use (GJ) and emissions (tons) per vehicle category and as totals

Year	Sector	FC (PJ)	SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	NH_3	TSP
1985	Passenger Cars	64	1208	52255	70537	1843	525856	4647	177	47	1445
1986	Passenger Cars	64	809	53053	70376	1865	504298	4686	180	47	1428
1987	Passenger Cars	65	843	53628	70106	1888	485511	4723	182	48	1423
1988	Passenger Cars	66	871	54803	69860	1923	440335	4788	187	49	1398
1989	Passenger Cars	65	635	54414	68389	1903	412678	4736	185	49	1363
1990	Passenger Cars	68	650	57926	71825	2021	421936	5004	197	52	1392
1991	Passenger Cars	73	669	58348	72370	2045	435764	5315	218	230	1374
1992	Passenger Cars	76	498	58769	71376	2017	425231	5576	238	422	1320
1993	Passenger Cars	78	296	57113	69069	1983	425672	5724	253	604	1270
1994	Passenger Cars	81	303	53865	64626	1871	392516	5920	277	926	1148
1995	Passenger Cars	82	308	50704	59763	1732	369785	5991	287	1170	1057
1996	Passenger Cars	83	313	47345	55266	1611	356896	6055	296	1393	973
1997	Passenger Cars	85	318	43689	48921	1513	303939	6204	303	1820	836
1998	Passenger Cars	87	327	39819	43527	1419	282166	6333	302	2175	751
1999	Passenger Cars	87	273	36142	38192	1313	248692	6370	298	2432	705
2000	Passenger Cars	87	198	33102	31709	1219	226199	6332	291	2587	670
2001	Passenger Cars	86	196	30435	28938	1109	216040	6274	273	2457	655
2002	Passenger Cars	87	199	28248	25657	1014	195347	6350	260	2390	636
2003	Passenger Cars	88	201	26162	23299	934	184534	6417	244	2293	635
2004	Passenger Cars	88	202	24122	19912	842	160535	6451	232	2192	633
2005	Passenger Cars	87	40	21795	18036	756	151967	6396	212	2035	662
2006	Passenger Cars	88	40	19772	15378	661	130602	6450	195	1866	679
2007	Passenger Cars	94	43	19253	13238	592	116622	6869	191	1713	786
1985	Light Duty Vehicles	14	2852	6760	2304	126	16496	1064	5	5	1525
1986	Light Duty Vehicles	16	1942	7457	2425	136	17360	1190	5	6	1710
1987	Light Duty Vehicles	17	1996	7654	2488	140	17864	1222	6	6	1768
1988	Light Duty Vehicles	17	2059	7846	2497	144	17627	1257	6	6	1759
1989	Light Duty Vehicles	18	1436	8056	2479	146	17447	1303	6	6	1813
1990	Light Duty Vehicles	19	1570	8703	2615	157	18462	1416	6	7	1974
1991	Light Duty Vehicles	20	1624	9057	2773	163	19725	1468	6	7	2088
1992	Light Duty Vehicles	20	1042	9052	2852	164	20080	1459	7	7	2035
1993	Light Duty Vehicles	20	418	9386	2984	170	21329	1509	7	7	2147
1994	Light Duty Vehicles	22	456	9959	3099	174	21901	1634	7	8	2326
1995	Light Duty Vehicles	22	448	9665	2950	165	21029	1612	10	15	2175

Continued

1996	Light Duty Vehicles	22	457	9644	2873	157	20892	1642	13	22	2139
1997	Light Duty Vehicles	23	463	9561	2710	152	19540	1662	16	29	1967
1998	Light Duty Vehicles	23	468	9576	2645	149	19402	1689	20	37	1856
1999	Light Duty Vehicles	23	263	9464	2503	141	18158	1706	23	46	1737
2000	Light Duty Vehicles	24	55	9496	2304	135	17520	1745	27	55	1641
2001	Light Duty Vehicles	24	56	9535	2283	128	17411	1784	32	65	1585
2002	Light Duty Vehicles	25	59	9434	2128	119	16130	1859	37	68	1460
2003	Light Duty Vehicles	28	65	9903	2116	114	15857	2052	43	68	1489
2004	Light Duty Vehicles	30	71	10166	1967	105	14464	2232	51	73	1348
2005	Light Duty Vehicles	34	16	10860	2045	100	14638	2488	60	73	1395
2006	Light Duty Vehicles	37	17	11536	2039	94	14026	2751	70	73	1383
2007	Light Duty Vehicles	38	18	10797	1764	78	11521	2780	73	62	1224
1985	Heavy Duty Vehicles	32	7559	33483	2451	279	7894	2394	92	9	1381
1986	Heavy Duty Vehicles	36	5110	37712	2749	314	8820	2697	103	10	1554
1987	Heavy Duty Vehicles	36	5006	36951	2695	308	8644	2642	101	10	1523
1988	Heavy Duty Vehicles	35	4926	36371	2660	303	8517	2599	99	10	1501
1989	Heavy Duty Vehicles	37	3415	37815	2760	315	8816	2703	103	10	1560
1990	Heavy Duty Vehicles	38	3546	39243	2898	329	9197	2806	108	11	1625
1991	Heavy Duty Vehicles	39	3609	39942	2944	335	9351	2856	110	11	1652
1992	Heavy Duty Vehicles	37	2279	38795	2866	326	9130	2775	107	11	1606
1993	Heavy Duty Vehicles	36	853	37634	2780	318	8888	2700	104	10	1559
1994	Heavy Duty Vehicles	39	909	39441	2846	333	9223	2876	113	11	1622
1995	Heavy Duty Vehicles	40	923	39299	2791	342	9154	2923	116	12	1613
1996	Heavy Duty Vehicles	41	949	39650	2769	356	9185	3005	121	12	1616
1997	Heavy Duty Vehicles	41	962	39596	2595	356	8883	3044	122	12	1548
1998	Heavy Duty Vehicles	42	971	39458	2480	355	8765	3071	123	12	1484
1999	Heavy Duty Vehicles	43	550	40131	2391	361	8729	3162	127	13	1449
2000	Heavy Duty Vehicles	41	96	38169	2205	345	8300	3049	123	12	1328
2001	Heavy Duty Vehicles	42	98	37864	2071	348	8253	3091	124	12	1271
2002	Heavy Duty Vehicles	41	97	36363	1929	340	8051	3063	123	12	1176
2003	Heavy Duty Vehicles	44	103	37557	1941	356	8410	3253	131	13	1174
2004	Heavy Duty Vehicles	45	106	37249	1853	361	8423	3345	136	14	1108
2005	Heavy Duty Vehicles	44	21	35069	1701	345	8067	3239	132	13	1004
2006	Heavy Duty Vehicles	44	21	34538	1621	342	8010	3292	135	14	948
2007	Heavy Duty Vehicles	47	22	34205	1515	328	7695	3444	143	14	885
1985	2-wheelers	1	2	62	5704	131	11021	56	1	1	79
1986	2-wheelers	1	2	61	5168	122	10456	52	1	1	72

Continued											
1987	2-wheelers	1	2	59	4796	115	9928	50	1	1	67
1988	2-wheelers	1	2	59	4577	112	9772	49	1	1	64
1989	2-wheelers	1	1	58	4368	108	9472	47	1	1	61
1990	2-wheelers	1	2	62	4473	112	9946	49	1	1	63
1991	2-wheelers	1	2	61	4610	116	10157	51	1	1	64
1992	2-wheelers	1	2	67	4669	120	10664	53	1	1	66
1993	2-wheelers	1	2	67	4672	122	10901	54	1	1	66
1994	2-wheelers	1	2	74	4683	126	11393	56	1	1	66
1995	2-wheelers	1	2	80	4966	132	12034	59	1	1	70
1996	2-wheelers	1	2	81	5284	140	12615	62	1	1	75
1997	2-wheelers	1	2	89	5796	154	13844	68	1	1	82
1998	2-wheelers	1	2	96	6234	166	14962	73	1	1	88
1999	2-wheelers	1	2	101	5872	164	15182	74	1	1	83
2000	2-wheelers	1	2	115	5360	162	15288	76	1	1	79
2001	2-wheelers	1	2	122	4534	155	15229	75	1	1	69
2002	2-wheelers	1	2	135	4568	161	16032	80	1	1	70
2003	2-wheelers	1	3	147	4491	166	16622	83	2	2	70
2004	2-wheelers	1	3	162	4396	171	17135	87	2	2	68
2005	2-wheelers	1	1	180	4132	172	17315	90	2	2	64
2006	2-wheelers	1	1	202	3934	177	17997	96	2	2	62
2007	2-wheelers	1	1	230	3847	187	19247	105	2	2	62
1985	Total	111	11621	92560	80995	2378	561267	8160	275	62	4431
1986	Total	117	7862	98283	80718	2437	540934	8625	289	64	4764
1987	Total	118	7847	98293	80084	2450	521947	8636	289	64	4781
1988	Total	118	7857	99080	79594	2481	476252	8694	293	66	4722
1989	Total	120	5488	100343	77996	2472	448414	8789	295	66	4796
1990	Total	126	5767	105934	81811	2619	459541	9275	312	70	5053
1991	Total	132	5903	107409	82697	2658	474997	9690	335	248	5179
1992	Total	134	3820	106683	81762	2627	465105	9863	352	441	5026
1993	Total	136	1569	104201	79504	2592	466790	9987	365	623	5041
1994	Total	143	1669	103338	75253	2503	435033	10487	398	946	5161
1995	Total	144	1682	99747	70469	2371	412002	10585	414	1198	4914
1996	Total	147	1721	96719	66193	2264	399588	10764	430	1428	4803
1997	Total	149	1744	92934	60022	2176	346206	10978	443	1862	4432
1998	Total	152	1768	88949	54887	2090	325296	11166	447	2226	4179
1999	Total	154	1088	85839	48958	1980	290760	11312	450	2492	3974
2000	Total	153	352	80883	41578	1861	267306	11202	444	2657	3718

Continued

2001	Total	153	353	77956	37826	1739	256933	11223	429	2536	3579
2002	Total	155	357	74180	34282	1635	235560	11352	421	2472	3342
2003	Total	161	371	73769	31847	1571	225422	11806	420	2376	3367
2004	Total	165	381	71699	28129	1479	200557	12115	421	2281	3158
2005	Total	166	77	67903	25914	1373	191988	12214	406	2123	3125
2006	Total	171	79	66049	22972	1275	170635	12589	402	1954	3072
2007	Total	180	83	64485	20364	1185	155084	13198	409	1791	2957

Annex 2B-8: COPERT IV:DEA statistics fuel use ratios and mileage adjustment factors

Sales			1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fuel ratio	Gasoline	DEA:COPERT IV	1,04	1,00	0,97	0,95	0,92	0,97	1,01	1,06	1,09	1,11	1,10	1,08	1,10	1,11	1,09	1,09
	Diesel (fuel ratio)	DEA:COPERT IV	1,22	1,29	1,25	1,25	1,28	1,39	1,43	1,40	1,41	1,52	1,49	1,51	1,51	1,50	1,47	1,42
Mileage factor	Gasoline	DEA:COPERT IV	1,04	1,00	0,97	0,95	0,92	0,97	1,01	1,06	1,09	1,11	1,10	1,08	1,10	1,11	1,09	1,09
	Diesel (mileage factor)	DEA:COPERT IV	1,25	1,32	1,28	1,28	1,32	1,45	1,49	1,45	1,47	1,59	1,57	1,59	1,59	1,57	1,55	1,50
Consumption																		
Fuel ratio	Gasoline	DEA:COPERT IV	1,08	1,08	1,07	1,08	1,07	1,06	1,06	1,07	1,07	1,08	1,09	1,09	1,11	1,11	1,13	1,15
	Diesel (fuel ratio)	DEA:COPERT IV	1,13	1,16	1,13	1,13	1,17	1,27	1,36	1,34	1,35	1,40	1,37	1,38	1,38	1,36	1,34	1,32
Mileage factor	Gasoline	DEA:COPERT IV	1,08	1,08	1,07	1,08	1,07	1,06	1,06	1,07	1,07	1,08	1,09	1,09	1,11	1,11	1,13	1,15
	Diesel (mileage factor)	DEA:COPERT IV	1,15	1,19	1,15	1,15	1,19	1,31	1,41	1,39	1,40	1,46	1,42	1,44	1,44	1,42	1,40	1,38

Continued			2001	2002	2003	2004	2005	2006	2007
Fuel ratio	Gasoline	DEA:COPERT IV	1,09	1,11	1,11	1,10	1,05	1,01	1,01
	Diesel (fuel ratio)	DEA:COPERT IV	1,38	1,38	1,45	1,47	1,43	1,42	1,42
Mileage factor	Gasoline	DEA:COPERT IV	1,09	1,11	1,11	1,10	1,05	1,01	1,01
	Diesel (mileage factor)	DEA:COPERT IV	1,46	1,47	1,57	1,61	1,56	1,56	1,62
Consumption									
Fuel ratio	Gasoline	DEA:COPERT IV	1,13	1,14	1,13	1,12	1,07	1,02	1,01
	Diesel (fuel ratio)	DEA:COPERT IV	1,29	1,27	1,31	1,32	1,28	1,28	1,30
Mileage factor	Gasoline	DEA:COPERT IV	1,13	1,14	1,13	1,12	1,07	1,02	1,01
	Diesel (mileage factor)	DEA:COPERT IV	1,35	1,34	1,38	1,41	1,37	1,38	1,45

Annex 2B-9: Basis fuel use and emission factors, deterioration factors, transient factors and specific operational data for non road working machinery and equipment, and recreational craft

Basis factors for diesel fuelled non road machinery.

Engine size	Emission Level	NO_x	VOC	CO	N_2O	NH_3	TSP	Fuel
[P=kW]					[g pr kWh]			
P<19	<1981	12.0	5.0	7	0.035	0.002	2.8	300
P<19	1981-1990	11.5	3.8	6	0.035	0.002	2.3	285
P<19	1991-Stage I	11.2	2.5	5	0.035	0.002	1.6	270
P<19	Stage I	11.2	2.5	5	0.035	0.002	1.6	270
P<19	Stage II	11.2	2.5	5	0.035	0.002	1.6	270
P<19	Stage IIIA	11.2	2.5	5	0.035	0.002	1.6	270
P<19	Stage IIIB	11.2	2.5	5	0.035	0.002	1.6	270
P<19	Stage IV	11.2	2.5	5	0.035	0.002	1.6	270
19<=P<37	<1981	18.0	2.5	6.5	0.035	0.002	2	300
19<=P<37	1981-1990	18.0	2.2	5.5	0.035	0.002	1.4	281
19<=P<37	1991-Stage I	9.8	1.8	4.5	0.035	0.002	1.4	262
19<=P<37	Stage I	9.8	1.8	4.5	0.035	0.002	1.4	262
19<=P<37	Stage II	6.5	0.6	2.2	0.035	0.002	0.4	262
19<=P<37	Stage IIIA	6.2	0.6	2.2	0.035	0.002	0.4	262
19<=P<37	Stage IIIB	6.2	0.6	2.2	0.035	0.002	0.4	262
19<=P<37	Stage IV	6.2	0.6	2.2	0.035	0.002	0.4	262
37<=P<56	<1981	7.7	2.4	6	0.035	0.002	1.8	290
37<=P<56	1981-1990	8.6	2.0	5.3	0.035	0.002	1.2	275
37<=P<56	1991-Stage I	11.5	1.5	4.5	0.035	0.002	0.8	260
37<=P<56	Stage I	7.7	0.6	2.2	0.035	0.002	0.4	260
37<=P<56	Stage II	5.5	0.4	2.2	0.035	0.002	0.2	260
37<=P<56	Stage IIIA	3.9	0.4	2.2	0.035	0.002	0.2	260
37<=P<56	Stage IIIB	3.9	0.4	2.2	0.035	0.002	0.0225	260
37<=P<56	Stage IV	3.9	0.4	2.2	0.035	0.002	0.0225	260
56<=P<75	<1981	7.7	2.0	5	0.035	0.002	1.4	290
56<=P<75	1981-1990	8.6	1.6	4.3	0.035	0.002	1	275
56<=P<75	1991-Stage I	11.5	1.2	3.5	0.035	0.002	0.4	260
56<=P<75	Stage I	7.7	0.4	1.5	0.035	0.002	0.2	260
56<=P<75	Stage II	5.5	0.3	1.5	0.035	0.002	0.2	260
56<=P<75	Stage IIIA	4.0	0.3	1.5	0.035	0.002	0.2	260
56<=P<75	Stage IIIB	3.0	0.2	1.5	0.035	0.002	0.0225	260
56<=P<75	Stage IV	0.4	0.2	1.5	0.035	0.002	0.0225	260
75<=P<130	<1981	10.5	2.0	5	0.035	0.002	1.4	280
75<=P<130	1981-1990	11.8	1.6	4.3	0.035	0.002	1	268
75<=P<130	1991-Stage I	13.3	1.2	3.5	0.035	0.002	0.4	255
75<=P<130	Stage I	8.1	0.4	1.5	0.035	0.002	0.2	255
75<=P<130	Stage II	5.2	0.3	1.5	0.035	0.002	0.2	255
75<=P<130	Stage IIIA	3.4	0.3	1.5	0.035	0.002	0.2	255
75<=P<130	Stage IIIB	3.0	0.2	1.5	0.035	0.002	0.0225	255
75<=P<130	Stage IV	0.4	0.2	1.5	0.035	0.002	0.0225	255
130<=P<560	<1981	17.8	1.5	2.5	0.035	0.002	0.9	270
130<=P<560	1981-1990	12.4	1.0	2.5	0.035	0.002	0.8	260
130<=P<560	1991-Stage I	11.2	0.5	2.5	0.035	0.002	0.4	250
130<=P<560	Stage I	7.6	0.3	1.5	0.035	0.002	0.2	250
130<=P<560	Stage II	5.2	0.3	1.5	0.035	0.002	0.1	250
130<=P<560	Stage IIIA	3.4	0.3	1.5	0.035	0.002	0.1	250
130<=P<560	Stage IIIB	3.0	0.2	1.5	0.035	0.002	0.0225	250
130<=P<560	Stage IV	0.4	0.2	1.5	0.035	0.002	0.0225	250

Basis factors for 4-stroke gasoline non road machinery.

Engine	Size code	Size classe	Emission Level	NO_x	VOC	CO	N_2O	NH_3	TSP	Fuel
		[S=ccm]					[g pr kWh]			
4-stroke	SH2	20<=S<50	<1981	2.4	33	198	0.002	0.03	0.08	496
4-stroke	SH2	20<=S<50	1981-1990	3.5	27.5	165	0.002	0.03	0.08	474
4-stroke	SH2	20<=S<50	1991-Stage I	4.7	22	132	0.002	0.03	0.08	451
4-stroke	SH2	20<=S<50	Stage I	4.7	22	132	0.002	0.03	0.08	406
4-stroke	SH2	20<=S<50	Stage II	4.7	22	132	0.002	0.03	0.08	406
4-stroke	SH3	S>=50	<1981	2.4	33	198	0.002	0.03	0.08	496
4-stroke	SH3	S>=50	1981-1990	3.5	27.5	165	0.002	0.03	0.08	474
4-stroke	SH3	S>=50	1991-Stage I	4.7	22	132	0.002	0.03	0.08	451
4-stroke	SH3	S>=50	Stage I	4.7	22	132	0.002	0.03	0.08	406
4-stroke	SH3	S>=50	Stage II	4.7	22	132	0.002	0.03	0.08	406
4-stroke	SN1	S<66	<1981	1.2	26.9	822	0.002	0.03	0.08	603
4-stroke	SN1	S<66	1981-1990	1.8	22.5	685	0.002	0.03	0.08	603
4-stroke	SN1	S<66	1991-Stage I	2.4	18	548	0.002	0.03	0.08	603
4-stroke	SN1	S<66	Stage I	4.3	16.1	411	0.002	0.03	0.08	475
4-stroke	SN1	S<66	Stage II	4.3	16.1	411	0.002	0.03	0.08	475
4-stroke	SN2	66<=S<100	<1981	2.3	10.5	822	0.002	0.03	0.08	627
4-stroke	SN2	66<=S<100	1981-1990	3.5	8.7	685	0.002	0.03	0.08	599
4-stroke	SN2	66<=S<100	1991-Stage I	4.7	7	548	0.002	0.03	0.08	570
4-stroke	SN2	66<=S<100	Stage I	4.7	7	467	0.002	0.03	0.08	450
4-stroke	SN2	66<=S<100	Stage II	4.7	7	467	0.002	0.03	0.08	450
4-stroke	SN3	100<=S<225	<1981	2.6	19.1	525	0.002	0.03	0.08	601
4-stroke	SN3	100<=S<225	1981-1990	3.8	15.9	438	0.002	0.03	0.08	573
4-stroke	SN3	100<=S<225	1991-Stage I	5.1	12.7	350	0.002	0.03	0.08	546
4-stroke	SN3	100<=S<225	Stage I	5.1	11.6	350	0.002	0.03	0.08	546
4-stroke	SN3	100<=S<225	Stage II	5.1	9.4	350	0.002	0.03	0.08	546
4-stroke	SN4	S>=225	<1981	1.3	11.1	657	0.002	0.03	0.08	539
4-stroke	SN4	S>=225	1981-1990	2	9.3	548	0.002	0.03	0.08	514
4-stroke	SN4	S>=225	1991-Stage I	2.6	7.4	438	0.002	0.03	0.08	490
4-stroke	SN4	S>=225	Stage I	2.6	7.4	438	0.002	0.03	0.08	490
4-stroke	SN4	S>=225	Stage II	2.6	7.4	438	0.002	0.03	0.08	490

Basis factors for 2-stroke gasoline non road machinery.

Engine	Size code	Size classe [ccm]	Emission Level	NO_x	VOC	CO	N_2O [g pr kWh]	NH_3	TSP	Fuel
2-stroke	SH2	20<=S<50	<1981	1	305	695	0.002	0.01	7	882
2-stroke	SH2	20<=S<50	1981-1990	1	300	579	0.002	0.01	5.3	809
2-stroke	SH2	20<=S<50	1991-Stage I	1.1	203	463	0.002	0.01	3.5	735
2-stroke	SH2	20<=S<50	Stage I	1.5	188	379	0.002	0.01	3.5	720
2-stroke	SH2	20<=S<50	Stage II	1.5	44	379	0.002	0.01	3.5	500
2-stroke	SH3	S>=50	<1981	1.1	189	510	0.002	0.01	3.6	665
2-stroke	SH3	S>=50	1981-1990	1.1	158	425	0.002	0.01	2.7	609
2-stroke	SH3	S>=50	1991-Stage I	1.2	126	340	0.002	0.01	1.8	554
2-stroke	SH3	S>=50	Stage I	2	126	340	0.002	0.01	1.8	529
2-stroke	SH3	S>=50	Stage II	1.2	64	340	0.002	0.01	1.8	500
2-stroke	SN1	S<66	<1981	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN1	S<66	1981-1990	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN1	S<66	1991-Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN1	S<66	Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN1	S<66	Stage II	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN2	66<=S<100	<1981	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN2	66<=S<100	1981-1990	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN2	66<=S<100	1991-Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN2	66<=S<100	Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN2	66<=S<100	Stage II	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN3	100<=S<225	<1981	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN3	100<=S<225	1981-1990	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN3	100<=S<225	1991-Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN3	100<=S<225	Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN3	100<=S<225	Stage II	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN4	S>=225	<1981	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN4	S>=225	1981-1990	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN4	S>=225	1991-Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN4	S>=225	Stage I	0.5	155	418	0.002	0.01	2.6	652
2-stroke	SN4	S>=225	Stage II	0.5	155	418	0.002	0.01	2.6	652

Fuel use and emission factors LPG fork lifts.

NO_x	VOC	CO	NH_3	N_2O	TSP	FC
[g pr kWh]	[g pr kWh]	[g pr kWh]	[g pr kWh]	[g pr kWh]	[g pr kWh]	[g pr kWh]
19	2.2	1.5	0.003	0.05	0.07	311

Fuel use and emission factors for All Terrain Vehicles (ATV's).

ATV type	NO_x	VOC	CO	NH_3	N_2O	TSP	Fuel
	[g pr GJ]	[g pr GJ]	[g pr GJ]	[g pr GJ]	[g pr GJ]	[g pr GJ]	[kg pr hour]
Professional	108	1077	16306	2	2	32	1.125
Private	128	1527	22043	2	2	39	0.75

Fuel use and emission factors for recreational craft.

Fuel type	Vessel type	Engine	Engine type	Direktiv	Engine size	CO	VOC	N_2O	NH_3	NO_x	TSP	Fuel
					[kW]	[g pr kWh]						
Gasoline	Other boats (< 20 ft)	Out board	2-stroke	2003/44	8	202.5	45.9	0.01	0.002	2	10	791
Gasoline	Other boats (< 20 ft)	Out board	2-stroke	Konv.	8	427	257.0	0.01	0.002	2	10	791
Gasoline	Other boats (< 20 ft)	Out board	4-stroke	2003/44	8	202.5	24.0	0.03	0.002	7	0.08	426
Gasoline	Other boats (< 20 ft)	Out board	4-stroke	Konv.	8	520	24.0	0.03	0.002	7	0.08	426
Gasoline	Yawls and cabin boats	Out board	2-stroke	2003/44	20	162	36.5	0.01	0.002	3	10	791
Gasoline	Yawls and cabin boats	Out board	2-stroke	Konv.	20	374	172.0	0.01	0.002	3	10	791
Gasoline	Yawls and cabin boats	Out board	4-stroke	2003/44	20	162	14.0	0.03	0.002	10	0.08	426
Gasoline	Yawls and cabin boats	Out board	4-stroke	Konv.	20	390	14.0	0.03	0.002	10	0.08	426
Gasoline	Sailing boats (< 26 ft)	Out board	2-stroke	2003/44	10	189	43.0	0.01	0.002	2	10	791
Gasoline	Sailing boats (< 26 ft)	Out board	2-stroke	Konv.	10	427	257.0	0.01	0.002	2	10	791
Gasoline	Sailing boats (< 26 ft)	Out board	4-stroke	2003/44	10	189	24.0	0.03	0.002	7	0.08	426
Gasoline	Sailing boats (< 26 ft)	Out board	4-stroke	Konv.	10	520	24.0	0.03	0.002	7	0.08	426
Gasoline	Speed boats	In board	4-stroke	2003/44	90	141	10.0	0.03	0.002	12	0.08	426
Gasoline	Speed boats	In board	4-stroke	Konv.	90	346	10.0	0.03	0.002	12	0.08	426
Gasoline	Speed boats	Out board	2-stroke	2003/44	50	145.8	31.8	0.01	0.002	3	10	791
Gasoline	Speed boats	Out board	2-stroke	Konv.	50	374	172.0	0.01	0.002	3	10	791
Gasoline	Speed boats	Out board	4-stroke	2003/44	50	145.8	14.0	0.03	0.002	10	0.08	426
Gasoline	Speed boats	Out board	4-stroke	Konv.	50	390	14.0	0.03	0.002	10	0.08	426
Gasoline	Water scooters	Built in	2-stroke	2003/44	45	147	32.2	0.01	0.002	3	10	791
Gasoline	Water scooters	Built in	2-stroke	Konv.	45	374	172.0	0.01	0.002	3	10	791
Gasoline	Water scooters	Built in	4-stroke	2003/44	45	147	14.0	0.03	0.002	10	0.08	426
Gasoline	Water scooters	Built in	4-stroke	Konv.	45	390	14.0	0.03	0.002	10	0.08	426
Diesel	Motor boats (27-34 ft)	In board		2003/44	150	5	1.7	0.035	0.002	8.6	1	275
Diesel	Motor boats (27-34 ft)	In board		Konv.	150	5.3	2.0	0.035	0.002	8.6	1.2	275
Diesel	Motor boats (> 34 ft)	In board		2003/44	250	5	1.6	0.035	0.002	8.6	1	275
Diesel	Motor boats (> 34 ft)	In board		Konv.	250	5.3	2.0	0.035	0.002	8.6	1.2	275
Diesel	Motor boats (< 27 ft)	In board		2003/44	40	5	1.8	0.035	0.002	9.8	1	281
Diesel	Motor boats (< 27 ft)	In board		Konv.	40	5.5	2.2	0.035	0.002	18	1.4	281
Diesel	Motor sailors	In board		2003/44	30	5	1.9	0.035	0.002	9.8	1	281
Diesel	Motor sailors	In board		Konv.	30	5.5	2.2	0.035	0.002	18	1.4	281
Diesel	Sailing boats (> 26 ft)	In board		2003/44	30	5	1.9	0.035	0.002	9.8	1	281
Diesel	Sailing boats (> 26 ft)	In board		Konv.	30	5.5	2.2	0.035	0.002	18	1.4	281

CH_4 shares of VOC for **diesel, gasoline and LPG.**

Fuel type	CH_4 share of VOC
Diesel	0.016
Gasoline 4-stroke	0.1
Gasoline 2-stroke	0.009
LPG	0.05

Deterioration factors for **diesel machinery.**

Emission Level	NO_x	VOC	CO	TSP
<1981	0.024	0.047	0.185	0.473
1981-1990	0.024	0.047	0.185	0.473
1991-Stage I	0.024	0.047	0.185	0.473
Stage I	0.024	0.036	0.101	0.473
Stage II	0.009	0.034	0.101	0.473
Stage IIIA	0.008	0.027	0.151	0.473
Stage IIIB	0.008	0.027	0.151	0.473
Stage IV	0.008	0.027	0.151	0.473

Deterioration factors for **gasoline 2-stroke machinery.**

Engine	Size code	Size classe	Emission Level	NO_x	VOC	CO	TSP
2-stroke	SH2	20<=S<50	<1981	0	0.2	0.2	0
2-stroke	SH2	20<=S<50	1981-1990	0	0.2	0.2	0
2-stroke	SH2	20<=S<50	1991-Stage I	0	0.2	0.2	0
2-stroke	SH2	20<=S<50	Stage I	0	0.29	0.24	0
2-stroke	SH2	20<=S<50	Stage II	0	0.29	0.24	0
2-stroke	SH3	S>=50	<1981	-0.031	0.2	0.2	0
2-stroke	SH3	S>=50	1981-1990	-0.031	0.2	0.2	0
2-stroke	SH3	S>=50	1991-Stage I	-0.031	0.2	0.2	0
2-stroke	SH3	S>=50	Stage I	0	0.266	0.231	0
2-stroke	SH3	S>=50	Stage II	0	0.266	0.231	0
2-stroke	SN1	S<66	<1981	-0.6	0.201	0.9	1.1
2-stroke	SN1	S<66	1981-1990	-0.6	0.201	0.9	1.1
2-stroke	SN1	S<66	1991-Stage I	-0.6	0.201	0.9	1.1
2-stroke	SN1	S<66	Stage I	-0.33	0.266	1.109	5.103
2-stroke	SN1	S<66	Stage II	-0.33	0	1.109	5.103
2-stroke	SN2	66<=S<100	<1981	-0.6	0.201	0.9	1.1
2-stroke	SN2	66<=S<100	1981-1990	-0.6	0.201	0.9	1.1
2-stroke	SN2	66<=S<100	1991-Stage I	-0.6	0.201	0.9	1.1
2-stroke	SN2	66<=S<100	Stage I	-0.33	0.266	1.109	5.103
2-stroke	SN2	66<=S<100	Stage II	-0.33	0	1.109	5.103
2-stroke	SN3	100<=S<225	<1981	-0.6	0.201	0.9	1.1
2-stroke	SN3	100<=S<225	1981-1990	-0.6	0.201	0.9	1.1
2-stroke	SN3	100<=S<225	1991-Stage I	-0.6	0.201	0.9	1.1
2-stroke	SN3	100<=S<225	Stage I	-0.33	0.266	1.109	5.103
2-stroke	SN3	100<=S<225	Stage II	-0.33	0	1.109	5.103
2-stroke	SN4	S>=225	<1981	-0.6	0.201	0.9	1.1
2-stroke	SN4	S>=225	1981-1990	-0.6	0.201	0.9	1.1
2-stroke	SN4	S>=225	1991-Stage I	-0.6	0.201	0.9	1.1
2-stroke	SN4	S>=225	Stage I	-0.274	0	0.887	1.935
2-stroke	SN4	S>=225	Stage II	-0.274	0	0.887	1.935

Deterioration factors for **gasoline 4-stroke machinery.**

Engine	Size code	Size classe	Emission Level	NO_x	VOC	CO	TSP
4-stroke	SN1	S<66	<1981	-0.6	1.1	0.9	1.1
4-stroke	SN1	S<66	1981-1990	-0.6	1.1	0.9	1.1
4-stroke	SN1	S<66	1991-Stage I	-0.6	1.1	0.9	1.1
4-stroke	SN1	S<66	Stage I	-0.3	1.753	1.051	1.753
4-stroke	SN1	S<66	Stage II	-0.3	1.753	1.051	1.753
4-stroke	SN2	66<=S<100	<1981	-0.6	1.1	0.9	1.1
4-stroke	SN2	66<=S<100	1981-1990	-0.6	1.1	0.9	1.1
4-stroke	SN2	66<=S<100	1991-Stage I	-0.6	1.1	0.9	1.1
4-stroke	SN2	66<=S<100	Stage I	-0.3	1.753	1.051	1.753
4-stroke	SN2	66<=S<100	Stage II	-0.3	1.753	1.051	1.753
4-stroke	SN3	100<=S<225	<1981	-0.6	1.1	0.9	1.1
4-stroke	SN3	100<=S<225	1981-1990	-0.6	1.1	0.9	1.1
4-stroke	SN3	100<=S<225	1991-Stage I	-0.6	1.1	0.9	1.1
4-stroke	SN3	100<=S<225	Stage I	-0.3	1.753	1.051	1.753
4-stroke	SN3	100<=S<225	Stage II	-0.3	1.753	1.051	1.753
4-stroke	SN4	S>=225	<1981	-0.6	1.1	0.9	1.1
4-stroke	SN4	S>=225	1981-1990	-0.6	1.1	0.9	1.1
4-stroke	SN4	S>=225	1991-Stage I	-0.6	1.1	0.9	1.1
4-stroke	SN4	S>=225	Stage I	-0.599	1.095	1.307	1.095
4-stroke	SN4	S>=225	Stage II	-0.599	1.095	1.307	1.095
4-stroke	SH2	20<=S<50	<1981	0	0	0	0
4-stroke	SH2	20<=S<50	1981-1990	0	0	0	0
4-stroke	SH2	20<=S<50	1991-Stage I	0	0	0	0
4-stroke	SH2	20<=S<50	Stage I	0	0	0	0
4-stroke	SH2	20<=S<50	Stage II	0	0	0	0
4-stroke	SH3	S>=50	<1981	0	0	0	0
4-stroke	SH3	S>=50	1981-1990	0	0	0	0
4-stroke	SH3	S>=50	1991-Stage I	0	0	0	0
4-stroke	SH3	S>=50	Stage I	0	0	0	0
4-stroke	SH3	S>=50	Stage II	0	0	0	0

Transient factors for **diesel machinery.**

Emission Level	Load	NO_x	VOC	CO	TSP	Fuel
<1981	High	0.95	1.05	1.53	1.23	1.01
1981-1990	High	0.95	1.05	1.53	1.23	1.01
1991-Stage I	High	0.95	1.05	1.53	1.23	1.01
Stage I	High	0.95	1.05	1.53	1.23	1.01
Stage II	High	0.95	1.05	1.53	1.23	1.01
Stage IIIA	High	0.95	1.05	1.53	1.23	1.01
Stage IIIB	High	1	1	1	1	1
Stage IV	High	1	1	1	1	1
<1981	Low	1.1	2.29	2.57	1.97	1.18
1981-1990	Low	1.1	2.29	2.57	1.97	1.18
1991-Stage I	Low	1.1	2.29	2.57	1.97	1.18
Stage I	Low	1.1	2.29	2.57	1.97	1.18
Stage II	Low	1.1	2.29	2.57	1.97	1.18
Stage IIIA	Low	1.1	2.29	2.57	1.97	1.18
Stage IIIB	Low	1	1	1	1	1
Stage IV	Low	1	1	1	1	1

Annual working hours, load factors and lifetimes for **agricultural tractors.**

Tractor type	Annual working hours	Load factor	Lifetime (yrs)
Diesel	500 (0-7 years) 500-100 (7-16 years) 100 (>16 years)	0.5	30
Gasoline (certified)	100	0.4	37
Gasoline (non certified)	50	0.4	37

Annual working hours, load factors and lifetimes for **harvesters.**

Annual working hours	Load factor	Lifetime (yrs)
250-100 (linear decrease 0-24 years)	0.8	25

Annual working hours, load factors and lifetime for **machine pool machinery.**

Tractor type	Hours pr yr	Load factor	Lifetime (yrs)
Tractors	750	0.5	7
Harvesters	100	0.8	11
Self-propelled vehicles	500	0.75	6

Operational data for **other machinery types in agriculture.**

Machinery type	Fuel type	Load factor	Lifetime (yrs)	Hours	Size (kW)
ATV private	Gasoline	-	6	250	-
ATV professional	Gasoline	-	8	400	-
Bedding machines	Gasoline	0.3	10	50	3
Fodder trucks	Gasoline	0.4	10	200	8
Other (gasoline)	Gasoline	0.4	10	50	5
Scrapers	Gasoline	0.3	10	50	3
Self-propelled vehicles	Diesel	0.75	15	150	60
Sweepers	Gasoline	0.3	10	50	3

Annual working hours, load factors and lifetimes for **forestry machinery**

Machinery type	Hours	Load factors	Lifetime
Chippers	1200	0.5	6
Tractors (other)	100 (1990) 400 (2004)	0.5	15
Tractors (silvicultural)	800	0.5	6
Harvesters	1200	0.5	8
Forwarders	1200	0.5	8
Chain saws (forestry)	800	0.4	3

Annual working hours, load factors and lifetime for **fork lifts.**

Hours pr yr	Load factor	Lifetime (yrs)
1200 (>=50 kW and <=10 years old) 650 (>=50 kW and >10 years old) 650 (<50 kW)	0.27	20

Operational data for **construction machinery.**

Machinery type	Load factor	Lifetime	Hours	Size
Track type dozers	0.5	10	1100	140
Track type loaders	0.5	10	1100	100 (1990) 150 (2004)
Wheel loaders (0-5 tons)	0.5	10	1200	20
Wheel loaders (> 5,1 tons)	0.5	10	1200	120
Wheel type excavators	0.6	10	1200	100
Track type excavators (0-5 tons)	0.6	10	1100	20
Track type excavators (>5,1 tons)	0.6	10	1100	120
Excavators/Loaders	0.45	10	700	50
Dump trucks	0.4	10	900 (1990) 1200 (2004)	60 (1990) 180 (2004)
Mini loaders	0.5	14	700	30
Telescopic loaders	0.5	14	1000	35

Stock and operational data for **other machinery types in industry.**

Sector	Fuel type	Machinery type	Size (kW)	No	Load Factor	Hours
Construction machinery	Diesel	Tampers/Land rollers	30	2800	0.45	600
Construction machinery	Diesel	Generators (diesel)	45	5000	0.5	200
Construction machinery	Diesel	Kompressors (diesel)	45	5000	0.5	500
Construction machinery	Diesel	Pumps (diesel)	75	1000	0.5	5
Construction machinery	Diesel	Asphalt pavers	80	300	0.35	700
Construction machinery	Diesel	Motor graders	100	100	0.4	700
Construction machinery	Diesel	Refuse compressors	160	100	0.25	1300
Construction machinery	Gasoline	Generators (gasoline)	2.5	11000	0.4	80
Construction machinery	Gasoline	Pumps (gasoline)	4	10000	0.4	300
Construction machinery	Gasoline	Kompressors (gasoline)	4	500	0.35	15
Industry	Diesel	Refrigerating units (distribution)	8	3000	0.5	1250
Industry	Diesel	Refrigerating units (long distance)	15	3500	0.5	200
Industry	Diesel	Tractors (transport, industry)	50	3000	0.4	500
Airport GSE and other	Diesel	Airport GSE and other (light duty)	100	500	0.5	400
Airport GSE and other	Diesel	Airport GSE and other (medium duty)	125	350	0.5	300
Airport GSE and other	Diesel	Airport GSE and other (Heavy duty)	175	650	0.5	200
Building and construction	Diesel	Vibratory plates	6	3500	0.6	300
Building and construction	Diesel	Aereal lifts (diesel)	30	150	0.4	400
Building and construction	Diesel	Sweepers (diesel)	30	200	0.4	300
Building and construction	Diesel	High pressure cleaners (diesel)	30	50	0.8	500
Building and construction	Gasoline	Rammers	2.5	3000	0.4	80
Building and construction	Gasoline	Drills	3	100	0.4	10
Building and construction	Gasoline	Vibratory plates (gasoline)	4	2500	0.5	200
Building and construction	Gasoline	Cutters	4	800	0.5	50
Building and construction	Gasoline	Other (gasoline)	5	1000	0.5	40
Building and construction	Gasoline	High pressure cleaners (gasoline)	5	500	0.6	200
Building and construction	Gasoline	Sweepers (gasoline)	10	500	0.4	150
Building and construction	Gasoline	Slicers	10	100	0.7	150
Building and construction	Gasoline	Aereal lifts (gasoline)	20	50	0.4	400

Operational data for the most **important types of household and gardening machinery.**

Machinery type	Engine	Size (kW)	Hours	Load factor	Lifetime (yrs)
Chain saws (private)	2-stroke	2	5	0.3	10
Chain saws (professional)	2-stroke	3	270	0.4	3
Cultivators (private-large)	4-stroke	3.7	5	0.6	5
Cultivators (private-small)	4-stroke	1	5	0.6	15
Cultivators (professional)	4-stroke	7	360	0.6	8
Hedge cutters (private)	2-stroke	0.9	10	0.5	10
Hedge cutters (professional)	2-stroke	2	300	0.5	4
Lawn movers (private)	4-stroke	2.5 (2000) 3.5 (2004)	25	0.4	8
Lawn movers (professional)	4-stroke	2.5 (2000) 3.5 (2004)	250	0.4	4
Riders (private)	4-stroke	11	50	0.5	12
Riders (professional)	4-stroke	13	330	0.5	5
Shrub clearers (private)	2-stroke	1	15	0.6	10
Shrub clearers (professional)	2-stroke	2	300	0.6	4
Trimmers (private)	2-stroke	0.9	20	0.5	10
Trimmers (professional)	2-stroke	0.9	200	0.5	4

Stock and operational data for **other machines in household and gardening.**

Machinery type	Engine	No.	Size (kW)	Hours	Load factor	Lifetime (yrs)
Chippers	2-stroke	200	10	100	0.7	10
Garden shredders	2-stroke	500	3	20	0.7	10
Other (gasoline)	2-stroke	200	2	20	0.5	10
Suction machines	2-stroke	300	4	80	0.5	10
Wood cutters	4-stroke	100	4	15	0.5	10

Operational data for **recreational craft.**

Fuel type	Vessel type	Engine type	Stroke	Hours	Lifetime	Load factor
Gasoline	Other boats (<20 ft)	Out board engine	2-stroke	30	10	0.5
Gasoline	Other boats (<20 ft)	Out board engine	4-stroke	30	10	0.5
Gasoline	Yawls and cabin boats	Out board engine	2-stroke	50	10	0.5
Gasoline	Yawls and cabin boats	Out board engine	4-stroke	50	10	0.5
Gasoline	Sailing boats (<26ft)	Out board engine	2-stroke	5	10	0.5
Gasoline	Sailing boats (<26ft)	Out board engine	4-stroke	5	10	0.5
Gasoline	Speed boats	In board engine	4-stroke	75	10	0.5
Gasoline	Speed boats	Out board engine	2-stroke	50	10	0.5
Gasoline	Speed boats	Out board engine	4-stroke	50	10	0.5
Gasoline	Water scooters	Built in	2-stroke	10	10	0.5
Gasoline	Water scooters	Built in	4-stroke	10	10	0.5
Diesel	Motor boats (27-34 ft)	In board engine		150	15	0.5
Diesel	Motor boats (>34 ft)	In board engine		100	15	0.5
Diesel	Motor boats (<27 ft)	In board engine		75	15	0.5
Diesel	Motor sailors	In board engine		75	15	0.5
Diesel	Sailing boats (<26ft)	In board engine		25	15	0.5

Annex 2B-10: Stock data for non-road working machinery and equipment

Stock data for diesel tractors 1985-2007.

Size (kW)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
37	<1981	3882	3234	3106	2922	2861	2610	2605	2273	2193	1918	1796	1601	1449	1298	1148	993	833	664	504
37	1981-1990	635	879	889	883	915	887	945	883	918	869	888	871	876	882	892	900	906	903	914
37	1991-Stage I			25	107	153	201	278	354	445	496	554	568	572	576	582	587	592	590	597
37	Stage I													33	56	83	84	84	84	85
37	Stage II																23	53	162	324
45	<1981	25988	21650	20796	19563	19154	17475	17441	15219	14684	12840	12025	10715	9700	8690	7685	6646	5577	4447	3376
45	1981-1990	5740	8770	8867	8805	9128	8848	9419	8807	9151	8668	8856	8681	8731	8800	8894	8974	9037	9006	9116
45	1991-Stage I			203	202	209	203	216	202	210	199	203	199	200	202	204	206	207	207	209
49	1991-Stage I				154	281	485	602	618	702	749	765	750	754	760	768	775	780	778	787
52	1991-Stage I											247	358	360	363	367	370	373	372	376
52	Stage I													132	242	377	381	383	382	387
52	Stage II																68	147	241	347
56	1991-Stage I				201	338	428	747	943	1181	1280	1307	1281	1289	1299	1313	1325	1334	1329	1346
60	<1981	54651	45529	43732	41140	40278	36747	36676	32004	30879	27001	25287	22533	20397	18273	16162	13976	11729	9351	7099
60	1981-1990	11751	20542	20770	20624	21380	20725	22063	20628	21434	20304	20744	20333	20451	20612	20834	21019	21167	21096	21353
60	1991-Stage I			863	857	888	861	917	857	891	844	862	845	850	856	866	873	879	876	887
63	1991-Stage I				468	855	1325	2014	2384	2837	3011	3076	3015	3033	3057	3090	3117	3139	3128	3167
67	1991-Stage I											671	1343	1351	1361	1376	1388	1398	1393	1410
67	Stage I													533	835	1113	1123	1131	1127	1141
67	Stage II																375	729	1144	1524
71	1991-Stage I				411	715	1179	1949	2507	3344	3594	3672	3600	3620	3649	3688	3721	3747	3735	3780
78	<1981	14558	12128	11649	10959	10729	9789	9770	8525	8226	7192	6736	6002	5433	4868	4305	3723	3124	2491	1891
78	1981-1990	4592	11323	11448	11368	11785	11424	12162	11371	11815	11192	11434	11208	11273	11361	11484	11586	11668	11628	11770
78	1991-Stage I			1233	1503	1713	1945	2429	2561	2946	2994	3287	3436	3727	3756	3797	3830	3857	3844	3891
78	Stage I														325	329	332	334	333	337
78	Stage II															227	310	400	463	469
78	Stage IIIA																			63
86	1991-Stage I				108	193	333	589	880	1364	1532	1718	1876	2023	2039	2061	2079	2094	2087	2112
86	Stage I														134	136	137	138	137	139
86	Stage II															91	343	530	760	769
86	Stage IIIA																			226
93	1991-Stage I											149	245	325	327	331	334	336	335	339

Continued

93	Stage I														114	115	116	117	116	118
93	Stage II															107	186	313	512	518
93	Stage IIIA																			264
97	1991-Stage I				71	175	443	962	1556	2327	2638	2695	2642	2657	2678	2707	2731	2750	2741	2774
101	<1981	4659	3881	3728	3507	3433	3132	3126	2728	2632	2302	2156	1921	1739	1558	1378	1191	1000	797	605
101	1981-1990	1158	2377	2403	2387	2474	2398	2553	2387	2480	2350	2400	2353	2367	2385	2411	2432	2449	2441	2471
101	1991-Stage I			266	264	274	266	283	264	275	260	696	1116	1567	1579	1596	1611	1622	1616	1636
101	Stage I														232	234	236	238	237	240
101	Stage II															136	357	635	776	785
101	Stage IIIA																			188
112	1991-Stage I				63	114	166	252	422	690	790	978	1265	1626	1639	1656	1671	1683	1677	1698
112	Stage I														465	470	474	478	476	482
112	Stage II															337	732	1170	1763	1785
112	Stage IIIA																			378
127	1991-Stage I				12	36	81	193	279	408	457	590	707	847	854	863	871	877	874	884
127	Stage I														152	154	155	156	156	158
127	Stage II															78	268	453	591	599
127	Stage IIIA																			292
131	<1981	798	665	639	601	588	537	536	467	451	394	369	329	298	267	236	204	171	137	104
131	1981-1990	288	887	897	890	923	895	952	890	925	876	895	878	883	890	899	907	914	911	922
131	1991-Stage I			97	97	100	97	103	97	100	95	97	95	96	96	97	98	99	99	100
157	1981-1990		15	15	15	16	15	16	15	16	15	15	15	15	15	15	16	16	16	16
157	1991-Stage I			9	23	39	102	232	357	545	648	784	900	905	912	922	930	937	934	945
157	Stage I													89	89	90	91	92	91	92
157	Stage II														149	415	695	1089	1085	1098
157	Stage IIIA																		623	1453
186	1991-Stage I											23	53	54	54	55	55	56	55	56
186	Stage I													47	48	48	49	49	49	49
186	Stage II														68	207	320	481	480	486
186	Stage IIIA																		272	685

Stock data for gasoline tractors 1985-2005.

Size (kW)	Emission Level	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Certified	<1981	13176	12541	11906	11270	10635	10000	9053	8148	7285	6465	5687	4951	4258	3607	2998	2432	1908	1427	987	591	236
Non certified	<1981	26352	25082	23811	22541	21270	20000	19042	18041	16998	15913	14785	13616	12403	11149	9852	8512	7131	5707	4240	2732	1180

Stock data for harvesters 1985-2007.

Size Group	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
0<S<=50	<1981	26601	18915	17241	15607	14575	12673	10700	9491	6966	5446	3589	2873	1828	1236	718	251			
0<S<=50	1981-1990	519	591	594	601	635	636	633	683	641	686	672	715	748	754	777	826	840	703	580
50<S<=60	<1981	2703	2828	2847	2876	3040	3044	3029	3271	3068	2930	2235	1999	1549	1222	854	366			
50<S<=60	1981-1990	853	1333	1341	1355	1432	1434	1427	1541	1446	1548	1516	1612	1687	1702	1752	1863	1894	1675	1519
50<S<=60	1991-Stage I			8	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11
60<S<=70	<1981	1786	1869	1881	1901	2009	2012	2002	2162	2028	2171	2127	2073	1626	1299	934	451			
60<S<=70	1981-1990	1138	2348	2363	2388	2524	2527	2515	2716	2547	2727	2671	2841	2973	2999	3087	3282	3338	3018	2827
60<S<=70	1991-Stage I			8	16	18	21	22	24	23	24	24	25	26	27	27	29	30	29	29
70<S<=80	<1981	929	972	979	989	1045	1046	1041	1125	1055	1129	1106	1176	1231	1071	699	202			
70<S<=80	1981-1990	383	1493	1502	1518	1604	1606	1598	1726	1619	1733	1698	1806	1890	1906	1963	2086	2122	1953	1886
70<S<=80	1991-Stage I			72	77	83	86	87	96	91	98	96	102	107	108	111	118	120	118	119
70<S<=80	Stage I											1	1	1	1	1	1	1	1	1
80<S<=90	<1981	323	338	340	344	363	364	362	391	367	393	385	409	428	432	445	202			
80<S<=90	1981-1990	383	1466	1475	1491	1575	1577	1570	1695	1590	1702	1667	1773	1856	1872	1927	2049	2083	1916	1848
80<S<=90	1991-Stage I			61	158	181	200	200	217	207	222	217	231	242	244	251	267	272	265	270
80<S<=90	Stage I											1	1	1	1	1	1	1	1	1
90<S<=100	1981-1990	89	670	674	681	720	721	717	775	726	778	762	810	848	855	881	936	952	930	945
90<S<=100	1991-Stage I			180	257	320	329	351	382	367	393	385	410	429	433	445	473	481	471	478
90<S<=100	Stage I											1	1	1	1	1	1	1	1	1
100<S<=120	1981-1990		589	592	599	633	634	630	681	639	684	670	712	745	752	774	823	837	818	830
100<S<=120	1991-Stage I			129	253	316	375	440	567	586	673	660	702	734	740	762	811	824	805	818
100<S<=120	Stage I											2	2	2	2	2	3	3	3	3
120<S<=140	1981-1990		183	184	186	197	197	196	212	199	213	208	222	232	234	241	256	260	255	258
120<S<=140	1991-Stage I			70	148	189	215	319	484	626	804	860	918	964	972	1001	1064	1082	1057	1074
120<S<=140	Stage I											21	26	30	31	32	34	34	33	34
120<S<=140	Stage II																3	3	3	3
120<S<=140	Stage IIIA																		1	1
140<S<=160	1991-Stage I				8	36	69	112	271	354	554	632	715	784	791	814	866	880	860	874

Continued																		
140<S<=160	Stage II												22	38	50	57	56	56
140<S<=160	Stage IIIA																5	8
160<S<=180	1991-Stage I					26	69	200	374	440	533	594	599	617	655	666	651	661
160<S<=180	Stage II												44	76	95	107	105	106
160<S<=180	Stage IIIA																8	13
180<S<=200	1991-Stage I						20	67	117	193	249	296	299	308	327	333	325	330
180<S<=200	Stage II												66	99	120	132	129	131
180<S<=200	Stage IIIA																8	13
200<S<=220	1991-Stage I								45	92	142	185	186	192	204	207	203	206
200<S<=220	Stage II												44	76	95	107	105	106
200<S<=220	Stage IIIA																8	13
220<S<=240	1991-Stage I									3	48	149	150	154	164	167	163	166
220<S<=240	Stage II												78	124	170	220	215	218
220<S<=240	Stage IIIA																55	113
240<S<=260	1991-Stage I									3	71	140	141	145	154	157	153	156
240<S<=260	Stage II												78	137	207	295	289	293
240<S<=260	Stage IIIA																102	214
260<S<=280	1991-Stage I									14	61	129	130	134	142	145	141	143
260<S<=280	Stage II												78	137	207	295	289	293
260<S<=280	Stage IIIA																102	214
280<S<=300	1991-Stage I											33	33	34	36	37	36	36
280<S<=300	Stage II												78	137	207	295	289	293
280<S<=300	Stage IIIA																102	214
300<S<=320	Stage II													28	61	104	102	103
300<S<=320	Stage IIIA																51	107

Stock data for fork lifts 1985-2007.

FuelCode	Size (kW)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
205B	35	<1981	387	260	234	209	183	158	133	107	84	58	30								
205B	35	1981-1990	120	297	297	297	297	297	297	297	297	297	297	297	277	249	232	198	177	135	95
205B	35	1991-Stage I			26	49	65	93	131	168	218	247	275	304	304	304	304	304	304	304	304
205B	35	Stage II													23	53	75	89	117	152	152
205B	35	Stage IIIA																			41
205B	45	<1981	1612	1082	976	870	764	658	552	446	349	243	126								
205B	45	1981-1990	499	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233	1151	1036	964	820	734	559	394
205B	45	1991-Stage I			108	203	270	386	544	699	905	1063	1063	1063	1063	1063	1063	1063	1063	1063	1063
205B	45	Stage I											151	303	422	524	664	664	664	664	664
205B	45	Stage II																104	232	452	612
205B	50	<1981	2173	1459	1316	1174	1031	888	745	602	471	328	170								
205B	50	1981-1990	673	1662	1662	1662	1662	1662	1662	1662	1662	1662	1662	1662	1551	1396	1299	1105	989	753	531
205B	50	1991-Stage I			145	273	363	519	732	940	1217	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469
205B	50	Stage I											240	461	682	897	1135	1135	1135	1135	1135
205B	50	Stage II																187	447	818	1134
205B	75	<1981	497	334	301	269	236	203	170	138	108	75	39								
205B	75	1981-1990	154	382	382	382	382	382	382	382	382	382	382	382	357	321	299	255	228	174	123
205B	75	1991-Stage I			33	63	84	120	169	217	281	354	354	354	354	354	354	354	354	354	354
205B	75	Stage I											70	162	234	311	311	311	311	311	311
205B	75	Stage II															58	129	208	326	326
205B	75	Stage IIIA																			142
205B	120	<1981	111	74	67	60	52	45	38	31	24	17	9								
205B	120	1981-1990	34	85	85	85	85	85	85	85	85	85	85	85	80	72	67	57	51	39	28
205B	120	1991-Stage I			7	14	19	27	38	49	63	97	97	97	97	97	97	97	97	97	97
205B	120	Stage I											32	71	89	118	118	118	118	118	118
205B	120	Stage II															16	38	58	112	112
205B	120	Stage IIIA																			58
3030	33		5420	5215	5156	5068	4947	4863	4835	4792	4732	4765	4712	4718	4677	4655	4595	4494	4345	4220	4154
3030	40		4917	4730	4676	4596	4486	4410	4384	4344	4289	4295	4223	4218	4214	4244	4224	4166	4116	4048	4005
3030	50		2149	2067	2044	2008	1960	1926	1915	1897	1874	1926	1941	1897	1938	2003	2020	2018	2029	2061	2136
3030	78		97	93	92	91	89	88	88	87	86	90	92	88	95	98	99	104	104	114	123
3030	120											1	2	2	2	3	3	3	3	3	3

Stock data for construction machinery 1985-2007.

TechID	EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
23	Track type dozers	<1981	125																		
23	Track type dozers	1981-1990	125	250	221	193	166	139	114	89	66	43	21								
23	Track type dozers	1991-Stage I			25	48	71	93	114	134	153	172	189	206	201	177	154	132	128	125	116
23	Track type dozers	Stage II														20	38	56	86	100	116
23	Track type dozers	Stage IIIA																		25	58
24	Track type loaders	<1981	50																		
24	Track type loaders	1981-1990	50	100	89	79	68	58	48	38	28	19	9								
24	Track type loaders	1991-Stage I			10	20	29	39	48	57	66	75	83	91	91	81	71	62	61	71	68
24	Track type loaders	Stage II														9	18	26	40	56	68
24	Track type loaders	Stage IIIA																		14	34
25	Wheel loaders (0-5 tons)	1981-1990			186	331	434	496	517	496	434	331	186								
25	Wheel loaders (0-5 tons)	1991-Stage I			21	83	186	331	517	744	1013	1323	1674	2067	2046	1984	1881	1736	1444	1269	1045
25	Wheel loaders (0-5 tons)	Stage II													227	496	806	1158	1444	1903	2090
25	Wheel loaders (0-5 tons)	Stage IIIA																			348
26	Wheel loaders (> 5,1 tons)	<1981	1250																		
26	Wheel loaders (> 5,1 tons)	1981-1990	1250	2500	2228	1960	1698	1441	1188	941	698	460	228								
26	Wheel loaders (> 5,1 tons)	1991-Stage I			248	490	728	960	1188	1411	1629	1841	1822	1802	1559	1322	1089	861	677	485	273
26	Wheel loaders (> 5,1 tons)	Stage I											228	450	668	881	871	861	902	969	1092
26	Wheel loaders (> 5,1 tons)	Stage II															218	431	677	969	1092
26	Wheel loaders (> 5,1 tons)	Stage IIIA																			273
27	Wheel type excavators	<1981	500																		
27	Wheel type excavators	1981-1990	500	1000	862	732	611	498	394	298	211	132	62								
27	Wheel type excavators	1991-Stage I			96	183	262	332	394	447	491	528	493	459	372	293	223	162	118	74	35
27	Wheel type excavators	Stage I											62	115	160	196	179	162	157	148	142
27	Wheel type excavators	Stage II															45	81	118	148	142
27	Wheel type excavators	Stage IIIA																			35
28	Track type excavators (0-5 tons)	1981-1990			459	816	1071	1224	1275	1224	1071	816	459								
28	Track type excavators (0-5 tons)	1991-Stage I			51	204	459	816	1275	1837	2500	3265	4132	5101	5050	4897	4642	4285	3889	3599	3027
28	Track type excavators (0-5 tons)	Stage II													561	1224	1990	2857	3889	5399	6054
28	Track type excavators (0-5 tons)	Stage IIIA																			1009
29	Track type excavators (>5,1 tons)	<1981	1000																		
29	Track type excavators (>5,1 tons)	1981-1990	1000	2000	1798	1596	1394	1194	993	794	594	396	198								
29	Track type excavators (>5,1 tons)	1991-Stage I			200	399	598	796	993	1190	1387	1583	1581	1579	1380	1181	983	785	683	536	313
29	Track type excavators (>5,1 tons)	Stage I											198	395	591	787	786	785	910	1073	1251
29	Track type excavators (>5,1 tons)	Stage II															197	393	683	1073	1251

Continued

29	Track type excavators (>5,1 tons)	Stage IIIA																			313
30	Excavators/Loaders	<1981	2100																		
30	Excavators/Loaders	1981-1990	2100	4200	3807	3408	3003	2592	2175	1752	1323	888	447								
30	Excavators/Loaders	1991-Stage I			423	852	1287	1728	2175	2628	3087	3552	3575	3599	3170	2735	2295	1848	1370	938	481
30	Excavators/Loaders	Stage I											447	900	1359	1824	2295	2310	2283	2344	2403
30	Excavators/Loaders	Stage II																462	913	1406	1922
31	Dump trucks	<1981	250																		
31	Dump trucks	1981-1990	250	500	489	469	441	404	358	304	241	169	89								
31	Dump trucks	1991-Stage I			54	117	189	269	358	455	561	676	711	745	682	611	530	442	385	301	176
31	Dump trucks	Stage I											89	186	292	407	530	552	642	752	880
31	Dump trucks	Stage II																110	257	451	704
32	Mini loaders	<1981	1800	800	635	447	235														
32	Mini loaders	1981-1990	1000	2000	2118	2237	2355	2473	2332	2168	1980	1768	1532	1273	990	684	354				
32	Mini loaders	1991-Stage I			212	447	706	989	1296	1626	1980	2357	2758	3183	3301	3419	3537	3656	2756	2294	1077
32	Mini loaders	Stage II													330	684	1061	1462	1531	1720	923
32	Mini loaders	Stage IIIA																			154
33	Telescopic loaders	1981-1990							149	265	348	398	414	398	348	265	149				
33	Telescopic loaders	1991-Stage I							83	199	348	530	746	994	1160	1326	1491	1657	1740	1837	1846
33	Telescopic loaders	Stage II													116	265	447	663	966	1378	1582
33	Telescopic loaders	Stage IIIA																			264

Stock data for machine pools 1985-2006.

EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Tractors (machine pools)	<1981	1236																	
Tractors (machine pools)	1981-1990	3091	4100	3643	2808	2368	1786	1214	604										
Tractors (machine pools)	1991-Stage I			607	1123	1776	2382	3035	3624	4324	4210	4336	3956	4069	3323	2566	2066	1421	947
Tractors (machine pools)	Stage I														554	513	517	474	474
Tractors (machine pools)	Stage II															513	1033	1421	1895
Harvesters (machine pools)	<1981	969	139																
Harvesters (machine pools)	1981-1990	807	1385	1385	1197	927	794	712	512	421	282	162	78						
Harvesters (machine pools)	1991-Stage I			139	266	348	454	593	615	737	751	729	778	779	651	531	472	300	257
Harvesters (machine pools)	Stage II														65	118	177	171	171
Harvesters (machine pools)	Stage IIIA																		43
Self-propelled vehicles (machine pools)	1981-1990					72	61	38											
Self-propelled vehicles (machine pools)	1991-Stage I					72	122	190	263	278	277	295	289	314	237	203	153	99	50
Self-propelled vehicles (machine pools)	Stage II														47	102	153	199	199
Self-propelled vehicles (machine pools)	Stage IIIA																		50

Stock data for household and gardening 1985-2006.

EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lawn movers (private)	<1981	253125																	
Lawn movers (private)	1981-1990	421875	675000	590625	506250	421875	337500	253125	168750	84375									
Lawn movers (private)	1991-Stage I			84375	168750	253125	337500	421875	506250	590625	675000	675000	675000	675000	675000	675000	675000	595000	513750
Lawn movers (private)	Stage I																	85000	171250
Lawn movers (professional)	1981-1990	25000	25000	18750	12500	6250													
Lawn movers (professional)	1991-Stage I			6250	12500	18750	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	18750	12500
Lawn movers (professional)	Stage I																	6250	12500
Cultivators (private-large)	<1981	73333	36667	29333	22000	14667	7333												
Cultivators (private-large)	1981-1990	36667	73333	73333	73333	73333	73333	73333	66000	58667	51333	44000	36667	29333	22000	14667	7333		
Cultivators (private-large)	1991-Stage I			7333	14667	22000	29333	36667	44000	51333	58667	66000	73333	80667	88000	95333	102667	102667	95333
Cultivators (private-large)	Stage II																	7333	14667
Cultivators (private-small)	1981-1990	10000	10000	8000	6000	4000	2000												
Cultivators (private-small)	1991-Stage I			2000	4000	6000	8000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	8000	6000
Cultivators (private-small)	Stage II																	2000	4000
Cultivators (professional)	<1981	3750																	
Cultivators (professional)	1981-1990	6250	10000	8750	7500	6250	5000	3750	2500	1250									
Cultivators (professional)	1991-Stage I			1250	2500	3750	5000	6250	7500	8750	10000	10000	10000	10000	10000	10000	10000	8750	7500
Cultivators (professional)	Stage I																	1250	2500
Chain saws (private)	<1981	125000																	
Chain saws (private)	1981-1990	125000	250000	227250	204000	180250	156000	131250	106000	80250	54000	27250							
Chain saws (private)	1991-Stage I			25250	51000	77250	104000	131250	159000	187250	216000	245250	275000	280750	286500	292250	298000	268200	238400
Chain saws (private)	Stage I																	29800	59600
Chain saws (professional)	1981-1990	10000	10000	7333	4000														
Chain saws (professional)	1991-Stage I			3667	8000	13000	14000	15000	16000	17000	18000	19000	20000	27500	35000	42500	50000	33333	16667
Chain saws (professional)	Stage I																	16667	33333
Chain saws (forestry)	1981-1990	8000	8000	5048	2381														
Chain saws (forestry)	1991-Stage I			2524	4762	6714	6286	5857	5429	5000	4571	4143	3714	3286	2857	2429	2000	1333	667
Chain saws (forestry)	Stage I																	667	1333
Riders (private)	<1981	40950	11700	5880															
Riders (private)	1981-1990	29250	58500	58796	59388	54248	49167	44056	38828	33392	27660	21544	14954	7910					
Riders (private)	1991-Stage I			5880	11878	18083	24583	31469	38828	46748	55320	64631	74771	87015	101775	109920	119360	117741	114313
Riders (private)	Stage I																	10704	22863
Riders (professional)	1981-1990	4800	4800	3878	2966	2035	1056												
Riders (professional)	1991-Stage I			970	1978	3053	4224	5520	5760	6000	6240	6480	6720	7802	9726	12492	16100	15728	13398
Riders (professional)	Stage I																	3932	8932

Continued

Shrub clearers (private)	<1981	24000																	
Shrub clearers (private)	1981-1990	24000	48000	47520	46080	43680	40320	36000	30720	24480	17280	9120							
Shrub clearers (private)	1991-Stage I			5280	11520	18720	26880	36000	46080	57120	69120	82080	96000	107000	118000	129000	140000	126000	112000
Shrub clearers (private)	Stage I																	14000	28000
Shrub clearers (professio-nal)	1981-1990	2000	2000	1650	1200	650													
Shrub clearers (professio-nal)	1991-Stage I			550	1200	1950	2800	3000	3200	3400	3600	3800	4000	5500	7000	8500	10000	7500	5000
Shrub clearers (professio-nal)	Stage I																	2500	5000
Hedge cutters (private)	<1981	6850																	
Hedge cutters (private)	1981-1990	6850	13700	15237	16128	16373	15972	14925	13232	10893	7908	4277							
Hedge cutters (private)	1991-Stage I			1693	4032	7017	10648	14925	19848	25417	31632	38493	46000	52900	59800	66700	73600	66240	58880
Hedge cutters (private)	Stage I																	7360	14720
Hedge cutters (professio-nal)	1981-1990	1300	1300	1178	920	528													
Hedge cutters (professio-nal)	1991-Stage I			393	920	1583	2380	2650	2920	3190	3460	3730	4000	4600	5200	5800	6400	4800	3200
Hedge cutters (professio-nal)	Stage I																	1600	3200
Trimmers (private)	<1981	25500																	
Trimmers (private)	1981-1990	25500	51000	48086	44686	40800	36429	31571	26229	20400	14086	7286							
Trimmers (private)	1991-Stage I			5343	11171	17486	24286	31571	39343	47600	56343	65571	75286	77714	80143	82571	85000	76500	68000
Trimmers (private)	Stage I																	8500	17000
Trimmers (professional)	1981-1990	9000	9000	7071	4929	2571													
Trimmers (professional)	1991-Stage I			2357	4929	7714	10714	11143	11571	12000	12429	12857	13286	13714	14143	14571	15000	11250	7500
Trimmers (professional)	Stage I																	3750	7500

Stock data for small boats and pleasure crafts 1985-2007.

Motortype	Boat type	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Diesel	Motor boats (27-34 ft)	1550	2228	2397	2567	2736	2906	3075	3244	3414	3583	3753	3922	4092	4261	4431	4600	4600	4600	4600
Diesel	Motor boats (> 34 ft)	450	661	714	767	819	872	925	978	1031	1083	1136	1189	1242	1294	1347	1400	1400	1400	1400
Diesel	Motor boats <(27 ft)	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
Diesel	Motor sailors	3500	3833	3917	4000	4083	4167	4250	4333	4417	4500	4583	4667	4750	4833	4917	5000	5000	5000	5000
Diesel	Sailing boats (> 26 ft)	7500	9167	9583	10000	10417	10833	11250	11667	12083	12500	12917	13333	13750	14167	14583	15000	15000	15000	15000
2-takt	Other boats (< 20 ft)	4000	4222	4278	4333	4389	4444	4500	4556	4565	4527	4439	4300	4108	3862	3560	3200	2750	2250	1800
2-takt	Yawls and cabin boats	4000	4222	4278	4333	4389	4444	4500	4556	4565	4527	4439	4300	4108	3862	3560	3200	2750	2250	1800
2-takt	Sailing boats (< 26 ft)	19000	18111	17889	17667	17444	17222	17000	16778	16390	15843	15144	14300	13317	12201	10960	9600	8250	6750	5400
2-takt	Speed boats	3000	3000	3000	3000	3000	3000	3000	3000	2970	2910	2820	2700	2550	2370	2160	1920	1650	1350	1080
2-takt	Water scooters	1000	1000	1000	1000	1000	1000	1000	1000	990	970	940	900	850	790	720	640	550	450	360
4-takt	Other boats (< 20 ft)									46	140	283	478	725	1027	1384	1800	2250	2750	3200
4-takt	Yawls and cabin boats									46	140	283	478	725	1027	1384	1800	2250	2750	3200
4-takt	Sailing boats (< 26 ft)									166	490	967	1589	2350	3243	4262	5400	6750	8250	9600
4-takt	Speed boats (in board eng.)	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
4-takt	Speed boats (out board eng.)									30	90	180	300	450	630	840	1080	1350	1650	1920
4-takt	Water scooters									10	30	60	100	150	210	280	360	450	550	640

Engine sizes (kW) for recreational craft 1985-2007.

Motor type	Boat type	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
2-takt	Other boats (< 20 ft)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
2-takt	Yawls and cabin boats	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
2-takt	Sailing boats (< 26 ft)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2-takt	Speed boats	25	31	32	33	35	36	38	39	40	42	43	44	46	47	49	50	50	50	50
2-takt	Water scooters	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
4-takt	Other boats (< 20 ft)									8	8	8	8	8	8	8	8	8	8	8
4-takt	Yawls and cabin boats									20	20	20	20	20	20	20	20	20	20	20
4-takt	Sailing boats (< 26 ft)									10	10	10	10	10	10	10	10	10	10	10
4-takt	Speed boats (in board eng.)	45	55	58	60	63	65	68	70	73	75	78	80	83	85	88	90	90	90	90
4-takt	Speed boats (out board eng.)									40	42	43	44	46	47	49	50	50	50	50
4-takt	Water scooters									45	45	45	45	45	45	45	45	45	45	45
Diesel	Motor boats (27-34 ft)	70	88	92	97	101	106	110	114	119	123	128	132	137	141	146	150	150	150	150
Diesel	Motor boats (> 34 ft)	120	149	156	163	171	178	185	192	199	207	214	221	228	236	243	250	250	250	250
Diesel	Motor boats <(27 ft)	20	24	26	27	28	29	30	31	32	33	34	36	37	38	39	40	40	40	40
Diesel	Motor sailors	20	22	23	23	24	24	25	26	26	27	27	28	28	29	29	30	30	30	30
Diesel	Sailing boats (> 26 ft)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30

Annex 3B-11: Traffic data and different technical and operational data for Danish domestic ferries

Annual traffic data for ferries (no. of round trips) for Danish domestic ferries.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Korsør-Nyborg, DSB	9305	9167	9237	8959	8813	8789	8746	3258	0	0	0	0	0	0	0	0	0	0
Korsør-Nyborg, Vogn-mandsruten	7512	7363	7468	7496	7502	7828	7917	8302	3576	0	0	0	0	0	0	0	0	0
Halsskov-Knudshoved	10601	10582	11701	11767	12420	12970	13539	13612	5732	0	0	0	0	0	0	0	0	0
Kalundborg-Juelsminde	0	1326	1733	1542	1541	1508	856	0	0	0	0	0	0	0	0	0	0	0
Kalundborg-Århus	1907	2400	3162	2921	2913	3540	4962	4888	4483	1454	1870	1804	2037	1800	1750	1725	1724	1695
Sjællands Odde-Ebeltoft	3908	3978	4008	3988	4325	4569	5712	8153	7851	7720	4775	4226	3597	3191	2906	2889	2690	2670
Sjællands Odde-Århus	0	0	0	0	0	0	0	0	0	2339	1799	1817	1825	2359	2863	2795	2853	2810
Hundested-Grenaa	1026	1025	1032	1030	718	602	67	0	0	0	0	0	0	0	0	0	0	0
København-Rønne	558	545	484	412	427	426	437	465	458	506	491	430	413	397	293	0	0	0
Køge-Rønne	0	0	0	0	0	0	0	0	0	0	0	0	0	0	154	488	436	399
Kalundborg-Samsø	873	873	860	881	826	811	813	823	824	850	828	817	833	831	841	867	862	887
Tårs-Spodsbjerg	7656	8835	9488	9535	9402	9562	9000	9129	7052	6442	6477	6498	6468	6516	6497	6494	6460	6493
Local ferries	176891	179850	181834	178419	202445	209129	182750	197489	200027	202054	201833	200130	208396	208501	206297	205564	203413	205260

Ferry data: Service, name, engine year, main engine MCR (kW), engine type, specific fuel consumption (sfc), aux. engine (kW).

Ferry service	Ferry name	Engine year	Main engine MCR (kW)	Engine type	Sfc (g pr kWh)	Aux engine (kW)
Halsskov-Knudshoved	ARVEPRINS KNUD	1963	8238	Slow speed (2-stroke)	220	1666
Halsskov-Knudshoved	DRONNING MARGRETHE II	1973	8826	Medium speed (4-stroke)	230	1692
Halsskov-Knudshoved	HEIMDAL	1983	8309	Medium speed (4-stroke)	220	740
Halsskov-Knudshoved	KNUDSHOVED	1961	6400	Slow speed (2-stroke)	220	1840
Halsskov-Knudshoved	KONG FREDERIK IX	1954	6767	Slow speed (2-stroke)	225	1426
Halsskov-Knudshoved	KRAKA	1982	8309	Medium speed (4-stroke)	220	740
Halsskov-Knudshoved	LODBROG	1982	8309	Medium speed (4-stroke)	220	740
Halsskov-Knudshoved	PRINSESSE ANNE-MARIE	1960	8238	Slow speed (2-stroke)	220	1360
Halsskov-Knudshoved	PRINSESSE ELISABETH	1964	8238	Slow speed (2-stroke)	220	1360
Halsskov-Knudshoved	ROMSØ	1973	8826	Medium speed (4-stroke)	230	1728
Halsskov-Knudshoved	SPROGØ	1962	6400	Slow speed (2-stroke)	220	1840
Hundested-Grenaa	DJURSLAND	1974	9856	Medium speed (4-stroke)	230	900
Hundested-Grenaa	KATTEGAT	1995	23200	High speed (4-stroke)	205	1223
Hundested-Grenaa	KONG FREDERIK IX	1954	6767	Slow speed (2-stroke)	235	1375
Hundested-Grenaa	PRINSESSE ANNE-MARIE	1960	8238	Slow speed (2-stroke)	220	1360
Kalundborg-Juelsminde	Mercandia I	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Juelsminde	Mercandia II	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Juelsminde	Mercandia III	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Juelsminde	Mercandia IV	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Samsø	HOLGER DANSKE	1976	2354	High speed (4-stroke)	225	600
Kalundborg-Samsø	KALUNDBORG	1952	3825	Slow speed (2-stroke)	235	570
Kalundborg-Samsø	KYHOLM	1998	2940	High speed (4-stroke)	195	864
Kalundborg-Samsø	VESBORG	1995	1770	High speed (4-stroke)	200	494
Kalundborg-Århus	ASK	1984	8826	Medium speed (4-stroke)	215	2220
Kalundborg-Århus	ASK	1984	8826	Medium speed (4-stroke)	215	3000
Kalundborg-Århus	ASK	1984	9840	Medium speed (4-stroke)	215	3000
Kalundborg-Århus	CAT-LINK I	1995	17280	High speed (4-stroke)	205	1160
Kalundborg-Århus	CAT-LINK II	1995	17280	High speed (4-stroke)	205	1160
Kalundborg-Århus	CAT-LINK III	1995	22000	High speed (4-stroke)	205	800
Kalundborg-Århus	CAT-LINK III	1995	22000	High speed (4-stroke)	205	801
Kalundborg-Århus	CAT-LINK III	1995	22000	High speed (4-stroke)	205	802
Kalundborg-Århus	CAT-LINK IV	1998	28320	High speed (4-stroke)	205	920
Kalundborg-Århus	CAT-LINK V	1998	28320	High speed (4-stroke)	205	920
Kalundborg-Århus	KATTEGAT SYD	1979	7650	Medium speed (4-stroke)	225	1366
Kalundborg-Århus	KNUDSHOVED	1961	6400	Slow speed (2-stroke)	220	1840
Kalundborg-Århus	KONG FREDERIK IX	1954	6767	Slow speed (2-stroke)	225	1426

Continued						
Kalundborg-Århus	KRAKA	1982	8309	Medium speed (4-stroke)	220	740
Kalundborg-Århus	MAREN MOLS	1996	11700	Slow speed (2-stroke)	180	2530
Kalundborg-Århus	METTE MOLS	1996	11700	Slow speed (2-stroke)	180	2530
Kalundborg-Århus	NIELS KLIM	1986	12474	Slow speed (2-stroke)	215	4440
Kalundborg-Århus	PEDER PAARS	1985	12474	Slow speed (2-stroke)	215	4440
Kalundborg-Århus	PRINSESSE ELISABETH	1964	8238	Slow speed (2-stroke)	220	1360
Kalundborg-Århus	ROSTOCK LINK	1975	8385	Medium speed (4-stroke)	230	2500
Kalundborg-Århus	SØLØVEN/SØBJØRNEN	1992	4000	High speed (4-stroke)	210	272
Kalundborg-Århus	URD	1981	8826	Medium speed (4-stroke)	215	2220
Kalundborg-Århus	URD	1981	8826	Medium speed (4-stroke)	215	3000
Kalundborg-Århus	URD	1981	9840	Medium speed (4-stroke)	215	3000
Korsør-Nyborg, DSB	ASA-THOR	1965	6472	Slow speed (2-stroke)	220	1305
Korsør-Nyborg, DSB	DRONNING INGRID	1980	18720	Medium speed (4-stroke)	220	2932
Korsør-Nyborg, DSB	DRONNING MARGRETHE II	1973	8826	Medium speed (4-stroke)	230	1692
Korsør-Nyborg, DSB	KONG FREDERIK IX	1954	6767	Slow speed (2-stroke)	225	1426
Korsør-Nyborg, DSB	KRONPRINS FREDERIK	1981	18720	Medium speed (4-stroke)	220	2932
Korsør-Nyborg, DSB	PRINS JOACHIM	1980	18720	Medium speed (4-stroke)	220	2932
Korsør-Nyborg, DSB	SPROGØ/KNUDSHOVED	1962	6400	Slow speed (2-stroke)	220	1840
Korsør-Nyborg, Vognmandsruten	Superflex Alfa	1989	2950	High speed (4-stroke)	220	0
Korsør-Nyborg, Vognmandsruten	Superflex Bravo	1989	2950	High speed (4-stroke)	220	0
Korsør-Nyborg, Vognmandsruten	Superflex Charlie	1988	2950	High speed (4-stroke)	220	0
København-Rønne	JENS KOFOED	1979	12950	Medium speed (4-stroke)	106	2889
København-Rønne	JENS KOFOED	1979	12950	Medium speed (4-stroke)	109	2889
København-Rønne	POVL ANKER	1979	12950	Medium speed (4-stroke)	106	2889
København-Rønne	POVL ANKER	1979	12950	Medium speed (4-stroke)	109	2889
Køge-Rønne	DUEODDE	2005	8640	Medium speed (4-stroke)	183	1545
Køge-Rønne	HAMMERODDE	2005	8640	Medium speed (4-stroke)	183	1545
Køge-Rønne	JENS KOFOED	1979	12950	Medium speed (4-stroke)	108	2889
Køge-Rønne	POVL ANKER	1979	12950	Medium speed (4-stroke)	108	2889
Sjællands Odde-Ebeltoft	MAI MOLS	1996	24800	Gas turbine	240	752
Sjællands Odde-Ebeltoft	MAREN MOLS	1975	12062	Medium speed (4-stroke)	230	1986
Sjællands Odde-Ebeltoft	MAREN MOLS 2	1996	11700	Slow speed (2-stroke)	180	2530
Sjællands Odde-Ebeltoft	METTE MOLS	1975	12062	Medium speed (4-stroke)	230	1986
Sjællands Odde-Ebeltoft	METTE MOLS 2	1996	11700	Slow speed (2-stroke)	180	2530
Sjællands Odde-Ebeltoft	MIE MOLS	1971	5884	Medium speed (4-stroke)	230	
Sjællands Odde-Ebeltoft	MIE MOLS 2	1996	24800	Gas turbine	240	752
Sjællands Odde-Århus	MADS MOLS	1998	28320	High speed (4-stroke)	205	920

Continued

Sjællands Odde-Århus	MAI MOLS	1996	24800	Gas turbine	240	752
Sjællands Odde-Århus	MAX MOLS	1998	28320	High speed (4-stroke)	205	920
Sjællands Odde-Århus	MIE MOLS	1996	24800	Gas turbine	240	752
Tårs-Spodsbjerg	FRIGG SYDFYEN	1984	1300	Medium speed (4-stroke)	220	780
Tårs-Spodsbjerg	ODIN SYDFYEN	1982	1180	Medium speed (4-stroke)	220	780
Tårs-Spodsbjerg	SPODSBJERG	1972	1530	Medium speed (4-stroke)	225	300
Tårs-Spodsbjerg	THOR SYDFYEN	1978	1176	Medium speed (4-stroke)	225	300

Ferry data: Sailing time (single trip).

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Halsskov-Knudshoved	ARVEPRINS KNUD	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	DRONNING MARGRETHE II	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	HEIMDAL	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	KNUDSHOVED	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	KONG FREDERIK IX	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	KRAKA	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	LODBROG	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	PRINSESSE ANNE-MARIE	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	PRINSESSE ELISABETH	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	ROMSØ	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	SPROGØ	60	60	60	60	60	60	60	60	60							
Hundested-Grenaa	DJURSLAND	160	160	160	160	160											
Hundested-Grenaa	KATTEGAT						90	90									
Hundested-Grenaa	KONG FREDERIK IX					170											
Hundested-Grenaa	PRINSESSE ANNE-MARIE					165											
Kalundborg-Juelsminde	Mercandia I	160	160	160	160	160	160	160									
Kalundborg-Juelsminde	Mercandia II	160	160	160	160	160	160	160									
Kalundborg-Juelsminde	Mercandia III	160	160	160	160	160	160	160									
Kalundborg-Juelsminde	Mercandia IV	160	160	160	160	160	160	160									
Kalundborg-Samsø	HOLGER DANSKE			120	120	120	120	120	120	120							
Kalundborg-Samsø	KALUNDBORG	120	120	120													
Kalundborg-Samsø	KYHOLM									110	110	110	110	110	110	110	110
Kalundborg-Samsø	VESBORG									120							
Kalundborg-Århus	ASK		195	195	195	195	195	195	195	195	195						
Kalundborg-Århus	CAT-LINK I						80	85	90	95							
Kalundborg-Århus	CAT-LINK II						80	85	90	95							
Kalundborg-Århus	CAT-LINK III							85	90	95							
Kalundborg-Århus	CAT-LINK IV									80	80						
Kalundborg-Århus	CAT-LINK V									80	80						
Kalundborg-Århus	KATTEGAT SYD										195						
Kalundborg-Århus	KNUDSHOVED		190														
Kalundborg-Århus	KONG FREDERIK IX		190	190	190	190	190	190									
Kalundborg-Århus	KRAKA									195							
Kalundborg-Århus	MAREN MOLS											160	160	155	155	155	155
Kalundborg-Århus	METTE MOLS											160	160	155	155	155	155
Kalundborg-Århus	NIELS KLIM	185	185														

Continued

Kalundborg-Århus	PEDER PAARS	185	185														
Kalundborg-Århus	PRINSESSE ELISABETH		185														
Kalundborg-Århus	ROSTOCK LINK										195						
Kalundborg-Århus	SØLØVEN/SØBJØRNEN		90	90	90	90	90	90									
Kalundborg-Århus	URD		195	195	195	195	195	195	195	195	195						
Korsør-Nyborg, DSB	ASA-THOR	65	65	65	65	65	65	65	65								
Korsør-Nyborg, DSB	DRONNING INGRID	65	65	65	65	65	65	65	65								
Korsør-Nyborg, DSB	DRONNING MARGRETHE II	65	65	65	65	65	65	65	65								
Korsør-Nyborg, DSB	KONG FREDERIK IX	75	75	75	75	75	75	75	75								
Korsør-Nyborg, DSB	KRONPRINS FREDERIK	65	65	65	65	65	65	65	65								
Korsør-Nyborg, DSB	PRINS JOACHIM	65	65	65	65	65	65	65	65								
Korsør-Nyborg, DSB	SPROGØ/KNUDSHOVED	75	75	75	75	75	75	75	75								
Korsør-Nyborg, Vognmandsruten	Superflex Alfa	70	70	70	70	70	70	70	70	70							
Korsør-Nyborg, Vognmandsruten	Superflex Bravo	70	70	70	70	70	70	70	70	70							
Korsør-Nyborg, Vognmandsruten	Superflex Charlie	70	70	70	70	70	70	70	70	70							
København-Rønne	JENS KOFOED	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420
København-Rønne	POVL ANKER	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420
Køge-Rønne	DUEODDE																375
Køge-Rønne	HAMMERODDE																375
Køge-Rønne	JENS KOFOED															375	375
Køge-Rønne	POVL ANKER															375	375
Sjællands Odde-Ebeltoft	MAI MOLS							45	45	45	45	45	45	45	45	45	45
Sjællands Odde-Ebeltoft	MAREN MOLS	100	100	100	100	100	100	100									
Sjællands Odde-Ebeltoft	MAREN MOLS 2							100	100	100	95						
Sjællands Odde-Ebeltoft	METTE MOLS	100	100	100	100	100	100	100									
Sjællands Odde-Ebeltoft	METTE MOLS 2							100	100	100	95						
Sjællands Odde-Ebeltoft	MIE MOLS	105	105	105	105	105	105	105									
Sjællands Odde-Ebeltoft	MIE MOLS 2							45	45	45	45	45	45	45	45	45	45
Sjællands Odde-Århus	MADS MOLS										60	65	65	65	65	65	65
Sjællands Odde-Århus	MAI MOLS													65	65	65	65
Sjællands Odde-Århus	MAX MOLS										60	65	65	65	65	65	65
Sjællands Odde-Århus	MIE MOLS													65	65	65	65
Tårs-Spodsbjerg	FRIGG SYDFYEN	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Tårs-Spodsbjerg	ODIN SYDFYEN	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Tårs-Spodsbjerg	SPODSBJERG	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Tårs-Spodsbjerg	THOR SYDFYEN	45	45	45	45	45	17	45	45	45	45	45	45	45	45	45	45

Ferry data: Load factor (% MCR).

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Halsskov-Knudshoved	ARVEPRINS KNUD	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	DRONNING MARGRETHE II	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	HEIMDAL	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	KNUDSHOVED	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	KONG FREDERIK IX	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	KRAKA	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	LODBROG	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	PRINSESSE ANNE-MARIE	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	PRINSESSE ELISABETH	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	ROMSØ	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	SPROGØ	85	85	85	85	85	85	85	85	85							
Hundested-Grenaa	DJURSLAND	80	80	80	80	80											
Hundested-Grenaa	KATTEGAT						85	85									
Hundested-Grenaa	KONG FREDERIK IX					65											
Hundested-Grenaa	PRINSESSE ANNE-MARIE					85											
Kalundborg-Juelsminde	Mercandia I	75	75	75	75	75	75	75									
Kalundborg-Juelsminde	Mercandia II	70	70	70	70	70	70	70									
Kalundborg-Juelsminde	Mercandia III	70	70	70	70	70	70	70									
Kalundborg-Juelsminde	Mercandia IV	70	70	70	70	70	70	70									
Kalundborg-Samsø	HOLGER DANSKE			85	85	85	85	85	85	85							
Kalundborg-Samsø	KALUNDBORG	80	80	80													
Kalundborg-Samsø	KYHOLM									85	85	85	85	85	85	85	85
Kalundborg-Samsø	VESBORG									95							
Kalundborg-Århus	ASK		85	85	85	80	80	80	80	80	80						
Kalundborg-Århus	CAT-LINK I						95	90	90	85							
Kalundborg-Århus	CAT-LINK II						95	90	90	85							
Kalundborg-Århus	CAT-LINK III							95	95	90							
Kalundborg-Århus	CAT-LINK IV									95	95						
Kalundborg-Århus	CAT-LINK V									95	95						
Kalundborg-Århus	KATTEGAT SYD										85						
Kalundborg-Århus	KNUDSHOVED		85														
Kalundborg-Århus	KONG FREDERIK IX		85	85	85	85	85	85									
Kalundborg-Århus	KRAKA									85							
Kalundborg-Århus	MAREN MOLS											85	85	85	85	85	85
Kalundborg-Århus	METTE MOLS											85	85	85	85	85	85
Kalundborg-Århus	NIELS KLIM	85	85														

Continued

Kalundborg-Århus	PEDER PAARS	85	85														
Kalundborg-Århus	PRINSESSE ELISABETH		80														
Kalundborg-Århus	ROSTOCK LINK										80						
Kalundborg-Århus	SØLØVEN/SØBJØRNEN		90	90	90	90	90	90									
Kalundborg-Århus	URD		85	85	85	85	85	85	85	80	80						
Korsør-Nyborg, DSB	ASA-THOR	85	85	85	85	85	85	85	85								
Korsør-Nyborg, DSB	DRONNING INGRID	60	60	60	60	60	60	60	60								
Korsør-Nyborg, DSB	DRONNING MARGRETHE II	85	85	85	85	85	85	85	85								
Korsør-Nyborg, DSB	KONG FREDERIK IX	70	70	70	70	70	70	70	70								
Korsør-Nyborg, DSB	KRONPRINS FREDERIK	60	60	60	60	60	60	60	60								
Korsør-Nyborg, DSB	PRINS JOACHIM	60	60	60	60	60	60	60	60								
Korsør-Nyborg, DSB	SPROGØ/KNUDSHOVED	70	70	70	70	70	70	70	70								
Korsør-Nyborg, Vognmandsruten	Superflex Alfa	70	70	70	70	70	70	70	70	70							
Korsør-Nyborg, Vognmandsruten	Superflex Bravo	70	70	70	70	70	70	70	70	70							
Korsør-Nyborg, Vognmandsruten	Superflex Charlie	70	70	70	70	70	70	70	70	70							
København-Rønne	JENS KOFOED	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
København-Rønne	POVL ANKER	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Køge-Rønne	DUEODDE																80
Køge-Rønne	HAMMERODDE																80
Køge-Rønne	JENS KOFOED															80	80
Køge-Rønne	POVL ANKER															80	80
Sjællands Odde-Ebeltoft	MAI MOLS							80	80	80	80	80	80	80	80	80	80
Sjællands Odde-Ebeltoft	MAREN MOLS	75	75	75	75	75	75	75									
Sjællands Odde-Ebeltoft	MAREN MOLS 2							80	80	80	85						
Sjællands Odde-Ebeltoft	METTE MOLS	75	75	75	75	75	75	75									
Sjællands Odde-Ebeltoft	METTE MOLS 2							80	80	80	85						
Sjællands Odde-Ebeltoft	MIE MOLS	85	85	85	85	85	85	85									
Sjællands Odde-Ebeltoft	MIE MOLS 2							80	80	80	80	80	80	80	80	80	80
Sjællands Odde-Århus	MADS MOLS										90	85	85	85	85	85	85
Sjællands Odde-Århus	MAI MOLS													75	75	75	75
Sjællands Odde-Århus	MAX MOLS										90	85	85	85	85	85	85
Sjællands Odde-Århus	MIE MOLS													75	75	75	75
Tårs-Spodsbjerg	FRIGG SYDFYEN	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Tårs-Spodsbjerg	ODIN SYDFYEN	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Tårs-Spodsbjerg	SPODSBJERG	75	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Tårs-Spodsbjerg	THOR SYDFYEN	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80

Ferry data: Round trip shares (%).

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Halsskov-Knudshoved	ARVEPRINS KNUD	21.1	20.2	19.7	19.8	20.6	18.6	18.8	17.6	20.0							
Halsskov-Knudshoved	DRONNING MARGRETHE II	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0							
Halsskov-Knudshoved	HEIMDAL	22.5	23.8	22.3	24.3	23.4	21.3	21.1	19.3	21.5							
Halsskov-Knudshoved	KNUDSHOVED	0.0	0.0	0.0	0.0	0.0	0.0	2.4	4.6	0.0							
Halsskov-Knudshoved	KONG FREDERIK IX	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0							
Halsskov-Knudshoved	KRAKA	24.3	25.4	22.7	23.4	21.1	20.4	20.3	19.9	21.0							
Halsskov-Knudshoved	LODBROG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	14.0							
Halsskov-Knudshoved	PRINSESSE ANNE-MARIE	0.0	0.0	0.0	0.0	0.0	5.5	2.4	0.0	0.0							
Halsskov-Knudshoved	PRINSESSE ELISABETH	0.0	0.0	0.0	2.5	0.1	0.0	0.0	0.0	0.0							
Halsskov-Knudshoved	ROMSØ	20.6	21.6	20.5	16.2	20.1	19.0	21.1	20.5	22.9							
Halsskov-Knudshoved	SPROGØ	9.1	9.0	14.8	13.8	14.7	14.9	13.9	11.0	0.6							
Hundested-Grenaa	DJURSLAND	100.0	100.0	100.0	100.0	50.0											
Hundested-Grenaa	KATTEGAT						100.0	100.0									
Hundested-Grenaa	KONG FREDERIK IX					5.0											
Hundested-Grenaa	PRINSESSE ANNE-MARIE					45.0											
Kalundborg-Juelsminde	Mercandia I	25.0	25.0	25.0	25.0	25.0	25.0	25.0									
Kalundborg-Juelsminde	Mercandia II	25.0	25.0	25.0	25.0	25.0	25.0	25.0									
Kalundborg-Juelsminde	Mercandia III	25.0	25.0	25.0	25.0	25.0	25.0	25.0									
Kalundborg-Juelsminde	Mercandia IV	25.0	25.0	25.0	25.0	25.0	25.0	25.0									
Kalundborg-Samsø	HOLGER DANSKE			95.0	100.0	100.0	100.0	100.0	100.0	92.0							
Kalundborg-Samsø	KALUNDBORG	100.0	100.0	5.0													
Kalundborg-Samsø	KYHOLM									6.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Kalundborg-Samsø	VESBORG									2.0							
Kalundborg-Århus	ASK		15.8	31.8	26.3	32.8	26.8	18.5	10.7	11.8	2.4						
Kalundborg-Århus	CAT-LINK I						17.2	25.4	27.5	11.4							
Kalundborg-Århus	CAT-LINK II						0.9	22.6	27.5	7.6							
Kalundborg-Århus	CAT-LINK III							8.5	23.6	19.1							
Kalundborg-Århus	CAT-LINK IV									22.9	25.8						
Kalundborg-Århus	CAT-LINK V									15.3	25.8						
Kalundborg-Århus	KATTEGAT SYD										2.4						
Kalundborg-Århus	KNUDSHOVED		4.0														
Kalundborg-Århus	KONG FREDERIK IX		4.0	0.0	6.6	0.0	0.0	1.5									
Kalundborg-Århus	KRAKA									2.4							
Kalundborg-Århus	MAREN MOLS											50.0	50.0	50.0	50.0	50.0	50.0
Kalundborg-Århus	METTE MOLS											50.0	50.0	50.0	50.0	50.0	50.0
Kalundborg-Århus	NIELS KLIM	50.0	19.8														

Continued																	
Kalundborg-Århus	PEDER PAARS	50.0	15.8														
Kalundborg-Århus	PRINSESSE ELISABETH		4.0														
Kalundborg-Århus	ROSTOCK LINK										21.8						
Kalundborg-Århus	SØLØVEN/SØBJØRNEN		20.8	36.4	34.2	34.3	28.2	5.0									
Kalundborg-Århus	URD		15.8	31.8	32.9	32.8	26.8	18.5	10.7	9.5	21.8						
Korsør-Nyborg, DSB	ASA-THOR	12.6	13.4	13.1	11.1	9.3	8.9	9.2	6.3								
Korsør-Nyborg, DSB	DRONNING INGRID	26.2	27.6	25.9	28.3	28.0	28.8	28.2	31.0								
Korsør-Nyborg, DSB	DRONNING MARGRETHE II	3.0	0.0	3.4	0.9	2.8	0.5	2.3	0.0								
Korsør-Nyborg, DSB	KONG FREDERIK IX	0.1	0.0	0.0	0.2	3.4	4.4	0.7	0.0								
Korsør-Nyborg, DSB	KRONPRINS FREDERIK	26.8	28.1	26.9	28.8	28.2	29.3	28.6	31.9								
Korsør-Nyborg, DSB	PRINS JOACHIM	25.2	26.6	25.4	26.9	26.9	27.4	27.1	27.8								
Korsør-Nyborg, DSB	SPROGØ/KNUDSHOVED	6.1	4.3	5.3	3.8	1.4	0.7	3.9	3.0								
Korsør-Nyborg, Vognmandsruten	Superflex Alfa	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0							
Korsør-Nyborg, Vognmandsruten	Superflex Bravo	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0							
Korsør-Nyborg, Vognmandsruten	Superflex Charlie	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0							
København-Rønne	JENS KOFOED	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
København-Rønne	POVL ANKER	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Køge-Rønne	DUEODDE																25.0
Køge-Rønne	HAMMERODDE																35.0
Køge-Rønne	JENS KOFOED															50.0	20.0
Køge-Rønne	POVL ANKER															50.0	20.0
Sjællands Odde-Ebeltoft	MAI MOLS							21.0	35.0	35.0	35.0	50.0	50.0	50.0	50.0	50.0	50.0
Sjællands Odde-Ebeltoft	MAREN MOLS	40.0	40.0	40.0	40.0	40.0	40.0	15.0									
Sjællands Odde-Ebeltoft	MAREN MOLS 2							18.0	15.0	15.0	15.0						
Sjællands Odde-Ebeltoft	METTE MOLS	40.0	40.0	40.0	40.0	40.0	40.0	17.0									
Sjællands Odde-Ebeltoft	METTE MOLS 2							15.0	15.0	15.0	15.0						
Sjællands Odde-Ebeltoft	MIE MOLS	20.0	20.0	20.0	20.0	20.0	20.0	5.0									
Sjællands Odde-Ebeltoft	MIE MOLS 2							9.0	35.0	35.0	35.0	50.0	50.0	50.0	50.0	50.0	50.0
Sjællands Odde-Århus	MADS MOLS										50.0	95.0	90.0	95.0	60.0	60.0	35.0
Sjællands Odde-Århus	MAI MOLS													1.0	10.0	15.0	15.0
Sjællands Odde-Århus	MAX MOLS										50.0	5.0	10.0	3.0	20.0	10.0	35.0
Sjællands Odde-Århus	MIE MOLS													1.0	10.0	15.0	15.0
Tårs-Spodsbjerg	FRIGG SYDFYEN	41.0	40.0	39.0	38.0	36.0	36.0	36.0	32.0	33.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Tårs-Spodsbjerg	ODIN SYDFYEN	41.0	40.0	39.0	38.0	36.0	36.0	36.0	32.0	33.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Tårs-Spodsbjerg	SPODSBJERG	4.0	2.0	8.0	8.0	9.0	8.0	8.0	19.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Tårs-Spodsbjerg	THOR SYDFYEN	14.0	18.0	14.0	16.0	19.0	20.0	20.0	17.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Annex 2B-12: Fuel use and emission factors, engine specific (NO_x, CO, VOC (NMVOC and CH_4)), and fuel type specific (S- %, SO_2, PM) for ship engines

Specific fuel consumption and NO_x emission factors (g pr kWh) per engine year for diesel ship engines.

Year	High speed 4-stroke sfc (g pr kWh)	Medium speed 4-stroke sfc (g pr kWh)	Slow speed 2-stroke sfc (g pr kWh)	High speed 4-stroke NO_X (g pr kWh)	Medium speed 4-stroke NO_X (g pr kWh)	Slow speed 2-stroke NO_X (g pr kWh)
1949	265.5	255.5	235.5	7.3	8.0	14.5
1950	265.0	255.0	235.0	7.3	8.0	14.5
1951	264.5	254.5	234.5	7.3	8.0	14.5
1952	264.0	254.0	234.0	7.3	8.0	14.5
1953	263.5	253.5	233.5	7.3	8.0	14.5
1954	263.0	253.0	233.0	7.3	8.0	14.5
1955	262.4	252.4	232.4	7.3	8.0	14.5
1956	261.9	251.9	231.9	7.4	8.1	14.6
1957	261.3	251.3	231.3	7.5	8.2	14.7
1958	260.7	250.7	230.7	7.6	8.3	14.8
1959	260.1	250.1	230.1	7.7	8.4	14.9
1960	259.5	249.5	229.5	7.8	8.5	15.0
1961	258.9	248.9	228.9	7.9	8.6	15.1
1962	258.2	248.2	228.2	8.0	8.7	15.1
1963	257.6	247.6	227.6	8.1	8.8	15.2
1964	256.9	246.9	226.9	8.2	8.9	15.3
1965	256.1	246.1	226.1	8.3	9.0	15.4
1966	255.4	245.4	225.4	8.3	9.1	15.5
1967	254.6	244.6	224.6	8.4	9.2	15.6
1968	253.8	243.8	223.8	8.5	9.3	15.7
1969	253.0	243.0	223.0	8.6	9.4	15.8
1970	252.1	242.1	222.1	8.7	9.5	15.9
1971	251.2	241.2	221.2	8.8	9.6	16.0
1972	250.3	240.3	220.3	8.9	9.7	16.1
1973	249.3	239.3	219.3	9.0	9.8	16.2
1974	248.3	238.3	218.3	9.1	9.9	16.3
1975	247.3	237.3	217.3	9.2	10.0	16.4
1976	246.2	236.2	216.2	9.3	10.1	16.4
1977	245.0	235.0	215.0	9.3	10.2	16.5
1978	243.8	233.8	213.8	9.4	10.3	16.6

Continued

1979	242.6	232.6	212.6	9.5	10.4	16.7
1980	241.3	231.3	211.3	9.6	10.5	16.8
1981	239.9	229.9	209.9	9.7	10.6	16.9
1982	238.5	228.5	208.5	9.8	10.7	17.0
1983	237.0	227.0	207.0	9.9	10.8	17.4
1984	235.5	225.5	205.5	10.0	10.9	17.8
1985	233.9	223.9	203.9	10.1	11.0	18.2
1986	232.2	222.2	202.2	10.2	11.1	18.6
1987	230.5	220.5	200.5	10.3	11.3	19.0
1988	228.6	218.6	198.6	10.5	11.4	19.3
1989	226.7	216.7	196.7	10.6	11.6	19.5
1990	224.8	214.8	194.8	10.7	11.7	19.8
1991	222.7	212.7	192.7	10.9	11.9	20.0
1992	220.5	210.5	190.5	11.0	12.0	19.8
1993	218.3	208.3	188.3	11.1	12.1	19.6
1994	216.0	206.0	186.0	11.3	12.3	19.4
1995	213.6	203.6	183.6	11.4	12.4	19.3
1996	211.0	201.0	181.0	11.5	12.6	19.1
1997	208.4	198.4	178.4	11.7	12.7	18.9
1998	205.7	195.7	175.7	11.8	12.9	18.7
1999	202.9	192.9	172.9	11.9	13.0	18.5
2000	199.9	189.9	169.9	11.0	12.0	16.0

CO, VOC, NMVOC and CH_4 emission factors (g pr kg fuel) for ship engines.

	High speed 4-stroke CO	Medium speed 4-stroke CO	Slow speed 2-stroke CO	High speed 4-stroke VOC	Medium speed 4-stroke VOC	Slow speed 2-stroke VOC
1949	6.03	6.26	6.79	1.88	1.96	2.12
1950	6.04	6.27	6.81	1.89	1.96	2.13
1951	6.05	6.29	6.82	1.89	1.96	2.13
1952	6.06	6.30	6.84	1.89	1.97	2.14
1953	6.07	6.31	6.85	1.90	1.97	2.14
1954	6.08	6.33	6.87	1.90	1.98	2.15
1955	6.10	6.34	6.88	1.91	1.98	2.15
1956	6.11	6.35	6.90	1.91	1.99	2.16
1957	6.12	6.37	6.92	1.91	1.99	2.16
1958	6.14	6.38	6.93	1.92	1.99	2.17
1959	6.15	6.40	6.95	1.92	2.00	2.17
1960	6.17	6.41	6.97	1.93	2.00	2.18
1961	6.18	6.43	6.99	1.93	2.01	2.18
1962	6.20	6.45	7.01	1.94	2.01	2.19
1963	6.21	6.46	7.03	1.94	2.02	2.20
1964	6.23	6.48	7.05	1.95	2.03	2.20
1965	6.25	6.50	7.08	1.95	2.03	2.21
1966	6.26	6.52	7.10	1.96	2.04	2.22
1967	6.28	6.54	7.12	1.96	2.04	2.23
1968	6.30	6.56	7.15	1.97	2.05	2.23
1969	6.32	6.58	7.17	1.98	2.06	2.24
1970	6.35	6.61	7.20	1.98	2.06	2.25
1971	6.37	6.63	7.23	1.99	2.07	2.26
1972	6.39	6.66	7.26	2.00	2.08	2.27
1973	6.42	6.69	7.29	2.01	2.09	2.28
1974	6.44	6.71	7.33	2.01	2.10	2.29
1975	6.47	6.74	7.36	2.02	2.11	2.30
1976	6.50	6.77	7.40	2.03	2.12	2.31
1977	6.53	6.81	7.44	2.04	2.13	2.33
1978	6.56	6.84	7.48	2.05	2.14	2.34
1979	6.60	6.88	7.53	2.06	2.15	2.35
1980	6.63	6.92	7.57	2.07	2.16	2.37
1981	6.67	6.96	7.62	2.08	2.17	2.38
1982	6.71	7.00	7.67	2.10	2.19	2.40

Continued						
1983	6.75	7.05	7.73	2.11	2.20	2.42
1984	6.79	7.10	7.79	2.12	2.22	2.43
1985	6.84	7.15	7.85	2.14	2.23	2.45
1986	6.89	7.20	7.91	2.15	2.25	2.47
1987	6.94	7.26	7.98	2.17	2.27	2.49
1988	7.00	7.32	8.05	2.19	2.29	2.52
1989	7.06	7.38	8.13	2.21	2.31	2.54
1990	7.12	7.45	8.22	2.22	2.33	2.57
1991	7.18	7.52	8.30	2.25	2.35	2.59
1992	7.25	7.60	8.40	2.27	2.37	2.62
1993	7.33	7.68	8.50	2.29	2.40	2.66
1994	7.41	7.77	8.60	2.31	2.43	2.69
1995	7.49	7.86	8.72	2.34	2.46	2.72
1996	7.58	7.96	8.84	2.37	2.49	2.76
1997	7.68	8.06	8.97	2.40	2.52	2.80
1998	7.78	8.18	9.11	2.43	2.56	2.85
1999	7.89	8.30	9.26	2.46	2.59	2.89
2000	8.00	8.43	9.42	2.50	2.63	2.94

	High speed 4-stroke NMVOC	Medium speed 4-stroke NMVOC	Slow speed 2-stroke NMVOC	High speed 4-stroke CH_4	Medium speed 4-stroke CH_4	Slow speed 2-stroke CH_4
1949	1.83	1.90	2.06	0.06	0.06	0.06
1950	1.83	1.90	2.06	0.06	0.06	0.06
1951	1.83	1.91	2.07	0.06	0.06	0.06
1952	1.84	1.91	2.07	0.06	0.06	0.06
1953	1.84	1.91	2.08	0.06	0.06	0.06
1954	1.84	1.92	2.08	0.06	0.06	0.06
1955	1.85	1.92	2.09	0.06	0.06	0.06
1956	1.85	1.93	2.09	0.06	0.06	0.06
1957	1.86	1.93	2.10	0.06	0.06	0.06
1958	1.86	1.93	2.10	0.06	0.06	0.07
1959	1.86	1.94	2.11	0.06	0.06	0.07
1960	1.87	1.94	2.11	0.06	0.06	0.07
1961	1.87	1.95	2.12	0.06	0.06	0.07
1962	1.88	1.95	2.13	0.06	0.06	0.07
1963	1.88	1.96	2.13	0.06	0.06	0.07
1964	1.89	1.96	2.14	0.06	0.06	0.07
1965	1.89	1.97	2.14	0.06	0.06	0.07
1966	1.90	1.98	2.15	0.06	0.06	0.07
1967	1.90	1.98	2.16	0.06	0.06	0.07
1968	1.91	1.99	2.17	0.06	0.06	0.07
1969	1.92	2.00	2.17	0.06	0.06	0.07
1970	1.92	2.00	2.18	0.06	0.06	0.07
1971	1.93	2.01	2.19	0.06	0.06	0.07
1972	1.94	2.02	2.20	0.06	0.06	0.07
1973	1.95	2.03	2.21	0.06	0.06	0.07
1974	1.95	2.04	2.22	0.06	0.06	0.07
1975	1.96	2.04	2.23	0.06	0.06	0.07
1976	1.97	2.05	2.24	0.06	0.06	0.07
1977	1.98	2.06	2.26	0.06	0.06	0.07
1978	1.99	2.07	2.27	0.06	0.06	0.07
1979	2.00	2.09	2.28	0.06	0.06	0.07
1980	2.01	2.10	2.30	0.06	0.06	0.07
1981	2.02	2.11	2.31	0.06	0.07	0.07
1982	2.03	2.12	2.33	0.06	0.07	0.07

Continued						
1983	2.05	2.14	2.34	0.06	0.07	0.07
1984	2.06	2.15	2.36	0.06	0.07	0.07
1985	2.07	2.17	2.38	0.06	0.07	0.07
1986	2.09	2.18	2.40	0.06	0.07	0.07
1987	2.10	2.20	2.42	0.07	0.07	0.07
1988	2.12	2.22	2.44	0.07	0.07	0.08
1989	2.14	2.24	2.47	0.07	0.07	0.08
1990	2.16	2.26	2.49	0.07	0.07	0.08
1991	2.18	2.28	2.52	0.07	0.07	0.08
1992	2.20	2.30	2.55	0.07	0.07	0.08
1993	2.22	2.33	2.58	0.07	0.07	0.08
1994	2.25	2.35	2.61	0.07	0.07	0.08
1995	2.27	2.38	2.64	0.07	0.07	0.08
1996	2.30	2.41	2.68	0.07	0.07	0.08
1997	2.33	2.44	2.72	0.07	0.08	0.08
1998	2.36	2.48	2.76	0.07	0.08	0.09
1999	2.39	2.51	2.81	0.07	0.08	0.09
2000	2.43	2.55	2.85	0.08	0.08	0.09

S- %, SO_2 and PM emission factors (g pr kg fuel and g pr GJ) per fuel type for diesel ship engines.

Fuel type	SNAPCode	Year	S %	SO_2 (g pr kg)	TSP (g pr kg)	PM_{10} (g pr kg)	$PM_{2,5}$ (g pr kg)	SO_2 (g pr GJ)	TSP (g pr GJ)	PM_{10} (g pr GJ)	$PM_{2,5}$ (g pr GJ)
Fuel	National sea	1990	2.64	52.8	6.1	6.0	6.0	1291.0	149.2	147.8	147.0
Fuel	National sea	1991	2.35	47	4.9	4.9	4.8	1149.1	120.2	119.0	118.4
Fuel	National sea	1992	1.8	36	3.3	3.2	3.2	880.2	79.8	79.0	78.6
Fuel	National sea	1993	2.39	47.8	5.1	5.0	5.0	1168.7	123.9	122.6	122.0
Fuel	National sea	1994	2.62	52.4	6.0	6.0	5.9	1281.2	147.0	145.6	144.8
Fuel	National sea	1995	2.95	59	7.7	7.6	7.6	1442.5	188.0	186.1	185.2
Fuel	National sea	1996	2.57	51.4	5.8	5.7	5.7	1256.7	141.7	140.2	139.5
Fuel	National sea	1997	2.74	54.8	6.6	6.5	6.5	1339.9	160.8	159.2	158.4
Fuel	National sea	1998	1.97	39.4	3.7	3.7	3.6	963.3	90.6	89.7	89.2
Fuel	National sea	1999	1.97	39.4	3.7	3.7	3.6	963.3	90.6	89.7	89.2
Fuel	National sea	2000	1.81	36.2	3.3	3.3	3.2	885.1	80.4	79.6	79.2
Fuel	National sea	2001	1.7	34	3.0	3.0	3.0	831.3	74.1	73.4	73.0
Fuel	National sea	2002	1.51	30.2	2.6	2.6	2.6	738.4	64.3	63.7	63.3
Fuel	National sea	2003	1.62	32.4	2.9	2.8	2.8	792.2	69.8	69.1	68.8
Fuel	National sea	2004	1.98	39.6	3.7	3.7	3.7	968.2	91.3	90.4	89.9
Fuel	National sea	2005	2	40	3.8	3.8	3.7	978.0	92.6	91.7	91.3
Fuel	National sea	2006	1.94	38.8	3.6	3.6	3.6	948.7	88.6	87.7	87.3
Fuel	National sea	2007	1.2	24	2.1	2.1	2.1	586.8	51.0	50.5	50.3
Fuel	National sea	2008	1.2	24	2.1	2.1	2.1	586.8	51.0	50.5	50.3
Fuel	International sea	1990	2.96	59.2	7.7	7.7	7.6	1447.4	189.4	187.5	186.6
Fuel	International sea	1991	2.89	57.8	7.4	7.3	7.2	1413.2	179.8	178.0	177.1
Fuel	International sea	1992	2.88	57.6	7.3	7.2	7.2	1408.3	178.5	176.7	175.8
Fuel	International sea	1993	3.2	64	9.3	9.2	9.1	1564.8	226.5	224.2	223.1
Fuel	International sea	1994	3.03	60.6	8.2	8.1	8.0	1481.7	199.6	197.6	196.6
Fuel	International sea	1995	3.3	66	10.0	9.9	9.8	1613.7	244.0	241.6	240.4
Fuel	International sea	1996	3.42	68.4	10.9	10.8	10.8	1672.4	266.9	264.2	262.9
Fuel	International sea	1997	3.45	69	11.2	11.0	11.0	1687.0	272.9	270.2	268.8
Fuel	International sea	1998	3.42	68.4	10.9	10.8	10.8	1672.4	266.9	264.2	262.9
Fuel	International sea	1999	3.45	69	11.2	11.0	11.0	1687.0	272.9	270.2	268.8
Fuel	International sea	2000	3.36	67.2	10.4	10.3	10.3	1643.0	255.2	252.6	251.4
Fuel	International sea	2001	3.42	68.4	10.9	10.8	10.8	1672.4	266.9	264.2	262.9
Fuel	International sea	2002	3.44	68.8	11.1	11.0	10.9	1682.2	270.9	268.2	266.8
Fuel	International sea	2003	3.11	62.2	8.7	8.6	8.5	1520.8	211.8	209.7	208.6
Fuel	International sea	2004	3.2	64	9.3	9.2	9.1	1564.8	226.5	224.2	223.1
Fuel	International sea	2005	3.5	70	11.6	11.5	11.4	1711.5	283.2	280.4	279.0

Continued											
Fuel	International sea	2006	3.35	67	10.4	10.3	10.2	1638.1	253.3	250.8	249.5
Fuel	International sea	2007	1.5	30	2.6	2.6	2.6	733.5	63.8	63.2	62.9
Fuel	International sea	2008	1.5	30	2.6	2.6	2.6	733.5	63.8	63.2	62.9
Diesel	-	1990	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1991	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1992	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1993	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1994	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1995	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1996	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1997	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1998	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	1999	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2000	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2001	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2002	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2003	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2004	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2005	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2006	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2007	0.2	4.0	1.0	1.0	1.0	93.7	23.2	23.0	22.9
Diesel	-	2008	0.1	2.0	0.9	0.9	0.9	46.8	21.5	21.3	21.2

Annex 2B-13: Fuel sales figures from DEA, and further processed fuel consumption data suited for the Danish inventory

Enhed: TJ	1985	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007
Agriculture and forestry, DEA statistics											
- LPG	88	438	204	179	190	159	153	138	121	116	110
- gasoline	425	274	161	38	39	28	42	51	52	20	21
- gas/diesel oil	9 199	10 528	11 585	13 689	13 437	13 706	13 463	12 934	12 464	13 047	11 791
Gartneri, DEA statistics											
- LPG	8	50	23	19	20	17	16	14	12	12	11
- gasoline	10	10	18	4	4	3	5	6	6	2	2
- gas/diesel oil	1 705	1 409	1 138	698	581	529	556	488	407	391	353
Fishery, DEA statistics											
- LPG	-	42	16	13	19	21	20	18	20	20	18
- gasoline	-	9	8	67	3	3	0	0	0	1	1
- kerosene	7	26	4	25	1	1	1	1	1	0	0
- gas/diesel oil	9 152	10 422	8 277	9 347	8 908	8 888	8 428	7 337	7 340	7 362	6 854
- fuel oil	27	285	19	-	-	4	84	35	126	86	13
Manufacturing industry, DEA statistics											
- LPG	2 860	2 032	2 234	1 819	1 526	1 405	1 472	1 488	1 478	1 482	1 216
- gasoline	262	177	110	97	69	42	26	30	21	32	16
- gas/diesel oil	15 576	12 259	10 401	8 635	10 099	9 155	9 964	10 515	10 022	9 132	8 883
- fuel oil	29 465	15 989	14 000	8 221	7 395	7 818	6 916	6 940	6 055	8 527	7 642
Building and construction, DEA statistics											
- LPG	305	500	501	165	179	236	226	228	224	248	222
- gasoline	19	34	25	33	24	26	27	27	27	27	28
- gas/diesel oil	5 313	3 548	5 317	5 950	6 356	6 226	6 226	6 227	6 338	6 187	6 410
Housing, DEA statistics											
- gasoline	1 006	1 131	1 233	1 355	1 317	1 313	1 303	1 288	1 250	1 216	1 193
Road transport, DEA statistics											
- gasoline	66 037	74 326	80 998	88 975	86 474	86 247	85 611	84 629	82 118	79 822	78 328
- gas/diesel oil	45 609	54 746	58 561	64 282	66 254	66 814	70 875	75 422	79 476	86 256	95 156
- bioethanol	-	-	-	-	-	-	-	-	-	151	252
Non-road, DEA statistics											
- LPG	2 955	2 520	2 461	2 018	1 736	1 581	1 641	1 640	1 612	1 610	1 337

Continued											
- gasoline	1 722	1 626	1 547	1 525	1 453	1 412	1 404	1 402	1 356	1 296	1 260
- gas/diesel oil	31 793	27 744	28 441	28 972	30 473	29 616	30 209	30 164	29 232	28 757	27 438
Non-road, NERI model											
- LPG	1232	1185	1099	1071	1073	1084	1079	1065	1049	1038	1040
- gasoline	2998	2770	2521	2458	2622	2833	3090	3391	3604	3807	3795
- gas/diesel oil	26357	26800	25798	24630	24893	25053	25233	25558	26199	27495	29161
Recreational craft, NERI model											
- gasoline	270	309	358	396	400	403	404	404	393	382	371
- gas/diesel oil	219	343	537	777	831	886	944	1002	1002	1002	1002
Non-road, added 0203 and 0301											
- gas/diesel oil	5436	944	2642	4342	5580	4563	4976	4606	3033	1263	-1724
- LPG	1724	1335	1362	947	662	497	563	575	562	572	298
Non-road, added 0203											
- gas/diesel oil	1864	406	1182	2156	2567	2193	2309	2050	1335	590	-763
- LPG	56	259	125	93	80	55	58	53	46	46	27
Non-road, added 0301											
- gas/diesel oil	3572	538	1460	2186	3013	2370	2667	2557	1697	673	-961
- LPG	1668	1076	1237	854	582	442	505	522	516	526	271
Non-road, added road transport											
- gasoline	-1276	-1145	-975	-932	-1169	-1421	-1686	-1990	-2248	-2511	-2536
Fisheries, added national sea transport											
- fuel oil	27	285	19	0	0	4	84	35	126	86	13
Fisheries, consumed by recreational craft											
- gasoline	0	9	8	67	3	3	0	0	0	1	1
National sea transport, input NERI model											
- LPG	3	2	2	0	-	-	0	0	0	0	0
- kerosene	5	0	1	1	1	1	1	1	1	0	-

Continued											
- gas/diesel oil	3 074	2 782	6 049	3 367	3 240	3 780	3 828	3 463	4 358	3 699	3 411
- fuel oil	2 541	3 845	1 592	1 509	1 513	2 068	1 907	1 704	1 506	1 367	1 110
Fisheries, input NERI model											
- LPG	-	42	16	13	19	21	20	18	20	20	18
- gasoline	-	-	-	-	-	-	-	-	-	-	-
- kerosene	7	26	4	25	1	1	1	1	1	0	0
- gas/diesel oil	8 932	10 080	7 740	8 570	8 077	8 001	7 484	6 335	6 338	6 360	5 852
National sea transport, output NERI model											
- gas/diesel oil	4942	4942	6655	4515	4301	4192	4199	4308	4260	4180	4119
- fuel oil	3843	3843	2653	715	671	659	647	673	679	633	610
- kerosene	5	0	1	1	1	1	1	1	1	0	0
- LPG	3	2	2	0	0	0	0	0	0	0	0
Fisheries, output NERI model											
- gas/diesel oil	7064	7920	7134	7422	7016	7590	7113	5490	6437	5879	5144
- kerosene	7	26	4	25	1	1	1	1	1	0	0
- LPG	0	42	16	13	19	21	20	18	20	20	18
National sea transport, added 0301											
- fuel oil	-1 302	3	-1 061	794	842	1 409	1 260	1 032	826	734	500
Road transport, NERI excl. traded fuels											
- gasoline	64 492	72 882	79 674	87 713	84 907	84 426	83 521	82 235	79 477	76 930	75 423
- gas/diesel oil	45 609	54 746	58 561	64 282	66 254	66 814	70 875	75 422	79 476	86 256	95 156
- bioethanol	-	-	-	-	-	-	-	-	-	151	252
Road transport, input NERI model incl. traded fuels											
- gasoline	62 077	66 279	80 101	83 312	81 852	81 963	81 878	80 593	77 835	76 109	75 423
- gas/diesel oil	49 016	59 947	64 013	69 196	70 916	72 552	78 766	84 209	88 264	95 043	103 944
- bioethanol	-	-	-	-	-	-	-	-	-	151	252

Annex 2B-14: Emission factors and total emissions in CollectER format

1990 emission factors for CO_2, CH_4 and N_2O.

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	CH_4 [g pr GJ]	CO_2 [kg pr GJ]	N_2O [g pr GJ]
1990	070101	Passenger cars	Diesel	Highway driving	666655	3,74	74	0,00
1990	070101	Passenger cars	Gasoline 2-stroke	Highway driving	29026	10,03	73	2,61
1990	070101	Passenger cars	Gasoline conventional	Highway driving	7515158	11,09	73	2,77
1990	070101	Passenger cars	LPG	Highway driving	1527	10,06	65	0,00
1990	070102	Passenger cars	Diesel	Rural driving	1898541	6,82	74	0,00
1990	070102	Passenger cars	Gasoline 2-stroke	Rural driving	116542	13,84	73	2,25
1990	070102	Passenger cars	Gasoline conventional	Rural driving	23176807	13,92	73	3,11
1990	070102	Passenger cars	LPG	Rural driving	4406	16,91	65	0,00
1990	070103	Passenger cars	Diesel	Urban driving	2836128	8,78	74	0,00
1990	070103	Passenger cars	Gasoline 2-stroke	Urban driving	222806	30,02	73	1,69
1990	070103	Passenger cars	Gasoline conventional	Urban driving	31997478	48,94	73	3,24
1990	070103	Passenger cars	LPG	Urban driving	6537	24,31	65	0,00
1990	070201	Light duty vehicles	Diesel	Highway driving	1906443	2,60	74	0,00
1990	070201	Light duty vehicles	Gasoline conventional	Highway driving	220436	10,11	73	2,63
1990	070202	Light duty vehicles	Diesel	Rural driving	6824381	4,26	74	0,00
1990	070202	Light duty vehicles	Gasoline conventional	Rural driving	915549	15,25	73	2,48
1990	070203	Light duty vehicles	Diesel	Urban driving	7966383	6,54	74	0,00
1990	070203	Light duty vehicles	Gasoline conventional	Urban driving	1336101	40,67	73	2,28
1990	070301	Heavy duty vehicles	Diesel	Highway driving	8665327	6,07	74	2,91
1990	070301	Heavy duty vehicles	Gasoline	Highway driving	10264	9,69	73	0,83
1990	070302	Heavy duty vehicles	Diesel	Rural driving	15837441	6,79	74	3,09
1990	070302	Heavy duty vehicles	Gasoline	Rural driving	29859	16,74	73	0,91
1990	070303	Heavy duty vehicles	Diesel	Urban driving	13345616	12,56	74	2,51
1990	070303	Heavy duty vehicles	Gasoline	Urban driving	34524	14,21	73	0,61
1990	0704	Mopeds	Gasoline	Mopeds and Motorcycles < 50 cm3	286683	200,00	73	0,91
1990	070501	Motorcycles	Gasoline	Highway driving	76549	122,02	73	1,27
1990	070502	Motorcycles	Gasoline	Rural driving	142895	146,11	73	1,52
1990	070503	Motorcycles	Gasoline	Urban driving	167965	147,20	73	1,53
1990	0801	Military	Diesel		146162	7,58	74	1,80
1990	0801	Military	Jet fuel	< 3000 ft	149678	2,65	72	2,30
1990	0801	Military	Jet fuel	> 3000 ft	1347105	2,65	72	2,30
1990	0801	Military	Gasoline		986	32,66	73	3,08

Continued								
1990	0801	Military	Aviation gasoline		4913	21,90	73	2,00
1990	0802	Railways	Diesel		4010007	3,07	74	2,04
1990	0802	Railways	Kerosene		70	7,00	72	2,00
1990	0802	Railways	Gasoline		0	33,78	73	2,24
1990	0803	Inland waterways	Diesel		342623	2,79	74	2,96
1990	0803	Inland waterways	Gasoline		309136	50,38	73	0,78
1990	080402	Maritime activities	Residual oil		3842534	1,65	78	4,89
1990	080402	Maritime activities	Diesel		4942218	1,57	74	4,68
1990	080402	Maritime activities	Kerosene		452	7,00	72	0,00
1990	080402	Maritime activities	LPG		1794	20,26	65	0,00
1990	080403	Maritime activities	Residual oil		0	1,76	78	4,89
1990	080403	Maritime activities	Diesel		7919928	1,52	74	4,68
1990	080403	Maritime activities	Kerosene		25787	7,00	72	0,00
1990	080403	Maritime activities	Gasoline		0	108,10	73	0,52
1990	080403	Maritime activities	LPG		42320	20,26	65	0,00
1990	080404	Maritime activities	Residual oil		28543368	1,67	78	4,89
1990	080404	Maritime activities	Diesel		11632674	1,53	74	4,68
1990	080501	Air traffic	Jet fuel	Dom. < 3000 ft	422173	1,59	72	5,70
1990	080501	Air traffic	Aviation gasoline		104947	21,90	73	2,00
1990	080502	Air traffic	Jet fuel	Int. < 3000 ft	132339	1,75	72	7,10
1990	080502	Air traffic	Aviation gasoline		30660	21,90	73	2,00
1990	080503	Air traffic	Jet fuel	Dom. > 3000 ft	1026021	1,31	72	2,30
1990	080504	Air traffic	Jet fuel	Int. > 3000 ft	1611915	0,69	72	2,30
1990	0806	Agriculture	Diesel		16496273	2,55	74	2,93
1990	0806	Agriculture	Gasoline		708864	88,42	73	1,28
1990	0807	Forestry	Diesel		145346	2,54	74	2,97
1990	0807	Forestry	Gasoline		341430	60,42	73	0,37
1990	0808	Industry	Diesel		10158406	2,90	74	2,94
1990	0808	Industry	Gasoline		175227	120,61	73	1,33
1990	0808	Industry	LPG		1184856	7,69	65	3,50
1990	0809	Household and gardening	Gasoline		1544959	96,95	73	1,11
1990	80501,00	Air traffic, Copenhagen airport	Jet fuel	Dom. < 3000 ft	502153	2,20	72	4,58
1990	80501,00	Air traffic, Copenhagen airport	Aviation gasoline		8642	21,90	73	2,00
1990	80502,00	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	2001204	3,64	72	3,79
1990	80502,00	Air traffic, Copenhagen airport	Aviation gasoline		5612	21,90	73	2,00
1990	80503,00	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	1305208	1,25	72	2,30

Continued

1990	80504,00	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	20330315	1,07	72	2,30

1990 emission factors for SO_2, NO_x; NMVOC, NH_3 and TSP.

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	SO_2 [g pr GJ]	NO_x [g pr GJ]	NMVOC [g pr GJ]	CO [g pr GJ]	NH_3 [g pr GJ]	TSP [g pr GJ]
1990	070101	Passenger cars	Diesel	Highway driving	666655	93,68	254,03	25,07	179,70	0,47	79,48
1990	070101	Passenger cars	Gasoline 2-stroke	Highway driving	29026	2,28	288,90	2357,34	3490,86	0,80	48,15
1990	070101	Passenger cars	Gasoline conventional	Highway driving	7515158	2,28	1317,10	364,60	3459,92	0,85	12,09
1990	070101	Passenger cars	LPG	Highway driving	1527	0,00	1151,70	187,09	3914,25	0,00	10,06
1990	070102	Passenger cars	Diesel	Rural driving	1898541	93,68	253,60	42,09	268,08	0,57	75,13
1990	070102	Passenger cars	Gasoline 2-stroke	Rural driving	116542	2,28	352,84	2476,82	2594,44	0,69	41,51
1990	070102	Passenger cars	Gasoline conventional	Rural driving	23176807	2,28	1140,07	483,50	3992,26	0,96	13,93
1990	070102	Passenger cars	LPG	Rural driving	4406	0,00	1248,46	305,18	1146,38	0,00	14,49
1990	070103	Passenger cars	Diesel	Urban driving	2836128	93,68	208,50	79,41	310,69	0,36	117,16
1990	070103	Passenger cars	Gasoline 2-stroke	Urban driving	222806	2,28	53,06	4365,48	7114,48	0,34	20,27
1990	070103	Passenger cars	Gasoline conventional	Urban driving	31997478	2,28	634,09	890,32	9372,17	0,65	13,72
1990	070103	Passenger cars	LPG	Urban driving	6537	0,00	642,80	431,03	1249,98	0,00	12,16
1990	070201	Light duty vehicles	Diesel	Highway driving	1906443	93,68	270,67	30,19	344,14	0,32	104,48
1990	070201	Light duty vehicles	Gasoline conventional	Highway driving	220436	2,28	1369,26	170,29	2987,40	0,81	16,17
1990	070202	Light duty vehicles	Diesel	Rural driving	6824381	93,68	299,25	33,22	358,42	0,36	107,73
1990	070202	Light duty vehicles	Gasoline conventional	Rural driving	915549	2,28	1188,86	262,59	2316,18	0,76	15,25
1990	070203	Light duty vehicles	Diesel	Urban driving	7966383	93,68	489,77	53,27	403,83	0,27	126,74
1990	070203	Light duty vehicles	Gasoline conventional	Urban driving	1336101	2,28	638,11	689,36	7008,46	0,46	9,12
1990	070301	Heavy duty vehicles	Diesel	Highway driving	8665327	93,68	1032,66	47,58	190,41	0,29	38,30
1990	070301	Heavy duty vehicles	Gasoline	Highway driving	10264	2,28	1037,78	474,61	7610,35	0,28	55,35
1990	070302	Heavy duty vehicles	Diesel	Rural driving	15837441	93,68	1055,19	70,91	215,24	0,31	41,02
1990	070302	Heavy duty vehicles	Gasoline	Rural driving	29859	2,28	1141,55	820,40	8371,39	0,30	60,88
1990	070303	Heavy duty vehicles	Diesel	Urban driving	13345616	93,68	1013,26	98,07	267,09	0,25	47,92
1990	070303	Heavy duty vehicles	Gasoline	Urban driving	34524	2,28	456,62	696,09	7102,99	0,20	40,59
1990	0704	Mopeds	Gasoline	Mopeds and Motorcycles < 50 cm3	286683	2,28	18,26	12503,20	12602,74	0,91	171,69
1990	070501	Motorcycles	Gasoline	Highway driving	76549	2,28	215,28	1274,65	17695,34	1,27	29,79
1990	070502	Motorcycles	Gasoline	Rural driving	142895	2,28	173,21	1528,99	16838,71	1,52	35,67
1990	070503	Motorcycles	Gasoline	Urban driving	167965	2,28	93,24	2017,69	15315,93	1,53	35,94
1990	0801	Military	Diesel		146162	93,68	782,10	64,64	274,45	0,31	68,28
1990	0801	Military	Jet fuel	< 3000 ft	149678	22,99	250,57	24,94	229,89		1,16

Continued

1990	0801	Military	Jet fuel	> 3000 ft	1347105	22,99	250,57	24,94	229,89		1,16
1990	0801	Military	Gasoline		986	2,28	890,75	1175,82	6684,91	0,78	14,48
1990	0801	Military	Aviation gasoline		4913	22,83	859,00	1242,60	6972,00	1,60	10,00
1990	0802	Railways	Diesel		4010007	93,68	1225,13	79,94	223,21	0,20	50,26
1990	0802	Railways	Kerosene		70	5,00	50,00	3,00	20,00		121,95
1990	0802	Railways	Gasoline		0	2,28	871,06	1129,29	6687,29	1,63	0,00
1990	0803	Inland waterways	Diesel		342623	93,68	983,64	171,79	453,65	0,17	106,93
1990	0803	Inland waterways	Gasoline		309136	2,28	291,33	3606,55	13853,27	0,08	182,44
1990	080402	Maritime activities	Residual oil		3842534	1290,95	1601,17	53,33	175,95		149,25
1990	080402	Maritime activities	Diesel		4942218	93,68	1100,31	50,67	167,17		23,21
1990	080402	Maritime activities	Kerosene		452	2,30	50,00	3,00	20,00		5,00
1990	080402	Maritime activities	LPG		1794		1249,00	384,94	443,00		0,20
1990	080403	Maritime activities	Residual oil		0	1466,99	1393,64	56,92	180,93		139,40
1990	080403	Maritime activities	Diesel		7919928	93,68	1052,12	49,13	162,08		23,21
1990	080403	Maritime activities	Kerosene		25787	2,30	50,00	3,00	20,00		5,00
1990	080403	Maritime activities	Gasoline		0	2,28	64,34	10809,58	18485,08	0,10	23,25
1990	080403	Maritime activities	LPG		42320		1249,00	384,94	443,00		0,20
1990	080404	Maritime activities	Residual oil		28543368	1447,43	1689,57	53,98	178,09		189,43
1990	080404	Maritime activities	Diesel		11632674	93,68	1208,60	49,46	163,17		23,21
1990	080501	Air traffic	Jet fuel	Dom. < 3000 ft	422173	22,99	314,51	14,93	90,41		1,16
1990	080501	Air traffic	Aviation gasoline		104947	22,83	859,00	1242,60	6972,00	1,60	10,00
1990	080502	Air traffic	Jet fuel	Int. < 3000 ft	132339	22,99	309,25	16,47	168,98		1,16
1990	080502	Air traffic	Aviation gasoline		30660	22,83	859,00	1242,60	6972,00	1,60	10,00
1990	080503	Air traffic	Jet fuel	Dom. > 3000 ft	1026021	22,99	330,11	12,36	90,75		1,16
1990	080504	Air traffic	Jet fuel	Int. > 3000 ft	1611915	22,99	244,20	6,48	54,10		1,16
1990	0806	Agriculture	Diesel		16496273	93,68	758,87	156,85	635,53	0,17	144,45
1990	0806	Agriculture	Gasoline		708864	2,28	31,60	949,55	47524,17	0,09	6,56
1990	0807	Forestry	Diesel		145346	93,68	857,48	156,47	645,65	0,17	149,05
1990	0807	Forestry	Gasoline		341430	2,28	40,39	7206,91	18057,40	0,07	101,22
1990	0808	Industry	Diesel		10158406	93,68	933,58	178,23	655,80	0,17	154,50
1990	0808	Industry	Gasoline		175227	2,28	136,27	1610,77	14797,46	0,09	12,40
1990	0808	Industry	LPG		1184856	0,00	1328,11	146,09	104,85	0,21	4,89
1990	0809	Household and gardening	Gasoline		1544959	2,28	67,15	2656,60	30931,24	0,08	22,88
1990	80501,00	Air traffic, Copenhagen airport	Jet fuel	Dom. < 3000 ft	502153	22,99	283,87	20,73	129,70		1,16
1990	80501,00	Air traffic, Copenhagen airport	Aviation gasoline		8642	22,83	859,00	1242,60	6972,00	1,60	10,00
1990	80502,00	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	2001204	22,99	324,87	34,25	157,15		1,16

Continued

1990	80502,00	Air traffic, Copenhagen airport	Aviation gasoline		5612	22,83	859,00	1242,60	6972,00	1,60	10,00
1990	80503,00	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	1305208	22,99	314,86	11,78	84,05		1,16
1990	80504,00	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	20330315	22,99	290,20	10,08	37,65		1,16

2007 emission factors for CO_2, CH_4 and N_2O.

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	CH_4 [g pr GJ]	CO_2 [kg pr GJ]	N_2O [g pr GJ]
2007	70101	Passenger cars	Diesel	Highway driving	4239149	0,76	74,00	2,01
2007	70101	Passenger cars	Gasoline 2-stroke	Highway driving	0	10,03	73,00	2,01
2007	70101	Passenger cars	Gasoline conventional	Highway driving	961877	11,53	72,76	2,88
2007	70101	Passenger cars	Gasoline catalyst	Highway driving	11094084	3,09	72,76	0,70
2007	70101	Passenger cars	LPG	Highway driving	44	10,06	65,00	0,00
2007	70102	Passenger cars	Diesel	Rural driving	9387821	1,58	74,00	2,20
2007	70102	Passenger cars	Gasoline 2-stroke	Rural driving	2113477	13,84	73,00	1,73
2007	70102	Passenger cars	Gasoline conventional	Rural driving	25543136	14,22	72,76	3,18
2007	70102	Passenger cars	Gasoline catalyst	Rural driving	0	3,45	72,76	1,37
2007	70102	Passenger cars	LPG	Rural driving	89	16,91	65,00	0,00
2007	70103	Passenger cars	Diesel	Urban driving	9636862	2,66	74,00	3,01
2007	70103	Passenger cars	Gasoline 2-stroke	Urban driving	0	43,97	73,00	0,82
2007	70103	Passenger cars	Gasoline conventional	Urban driving	2466010	51,98	72,76	3,19
2007	70103	Passenger cars	Gasoline catalyst	Urban driving	28568228	8,98	72,76	2,54
2007	70103	Passenger cars	LPG	Urban driving	112	23,50	65,00	0,00
2007	70201	Light duty vehicles	Diesel	Highway driving	4882419	0,66	74,00	1,43
2007	70201	Light duty vehicles	Gasoline conventional	Highway driving	351803	10,11	72,76	2,63
2007	70201	Light duty vehicles	Gasoline catalyst	Highway driving	36252	2,47	72,76	1,57
2007	70202	Light duty vehicles	Diesel	Rural driving	14874951	1,41	74,00	1,57
2007	70202	Light duty vehicles	Gasoline conventional	Rural driving	128141	15,25	72,76	2,48
2007	70202	Light duty vehicles	Gasoline catalyst	Rural driving	1242164	2,37	72,76	2,52
2007	70203	Light duty vehicles	Diesel	Urban driving	14454320	2,28	74,00	2,18
2007	70203	Light duty vehicles	Gasoline conventional	Urban driving	154585	40,55	72,76	2,21
2007	70203	Light duty vehicles	Gasoline catalyst	Urban driving	1494595	5,26	72,76	4,38
2007	70301	Heavy duty vehicles	Diesel	Highway driving	13114006	5,77	74,00	3,21
2007	70301	Heavy duty vehicles	Gasoline	Highway driving	15491	9,69	72,76	0,83
2007	70302	Heavy duty vehicles	Diesel	Rural driving	19682352	6,34	74,00	3,25
2007	70302	Heavy duty vehicles	Gasoline	Rural driving	31518	16,74	72,76	0,91

Continued

2007	70303	Heavy duty vehicles	Diesel	Urban driving	13672121	9,24	74,00	2,67
2007	70303	Heavy duty vehicles	Gasoline	Urban driving	32188	14,21	72,76	0,61
2007	704	Mopeds	Gasoline		188922	135,18	72,76	1,26
2007	70501	Motorcycles	Gasoline	Highway driving	213387	106,14	72,76	1,20
2007	70502	Motorcycles	Gasoline	Rural driving	473994	132,33	72,76	1,51
2007	70503	Motorcycles	Gasoline	Urban driving	565148	135,37	72,76	1,53
2007	801	Military	Diesel		678945	4,12	74,00	2,53
2007	801	Military	Jet fuel	< 3000 ft	171808	2,65	72,00	2,30
2007	801	Military	Jet fuel	> 3000 ft	1546268	2,65	72,00	2,30
2007	801	Military	Gasoline		6373	10,00	72,76	1,93
2007	801	Military	Aviation gasoline		6313	21,90	73,00	2,00
2007	802	Railways	Diesel		3075538	2,88	74,00	2,04
2007	803	Inland waterways	Diesel		1002148	2,70	74,00	2,97
2007	803	Inland waterways	Gasoline		370806	58,91	73,00	1,28
2007	80402	National sea traffic	Residual oil		609869	1,91	78,00	4,89
2007	80402	National sea traffic	Diesel		4118801	1,48	74,00	4,68
2007	80402	National sea traffic	Kerosene		0			
2007	80402	National sea traffic	LPG		0			
2007	80403	Fishing	Residual oil		0	1,76	78,00	4,90
2007	80403	Fishing	Diesel		5143684	1,75	74,00	4,68
2007	80403	Fishing	Kerosene		278	7,00	72,00	0,00
2007	80403	Fishing	Gasoline		0	108,10	73,00	0,52
2007	80403	Fishing	LPG		18216	20,26	65,00	0,00
2007	80404	International sea traffic	Residual oil		35243144	1,89	78,00	4,89
2007	80404	International sea traffic	Diesel		10946734	1,72	74,00	4,68
2007	80501	Air traffic, other airports	Jet fuel	Dom. < 3000 ft	218081	2,46	72,00	12,63
2007	80501	Air traffic, other airports	Aviation gasoline		97612	21,90	73,00	2,00
2007	80502	Air traffic, other airports	Jet fuel	Int. < 3000 ft	292943	4,64	72,00	8,18
2007	80502	Air traffic, other airports	Aviation gasoline		651	21,90	73,00	2,00
2007	80503	Air traffic, other airports	Jet fuel	Dom. > 3000 ft	546082	2,04	72,00	2,30
2007	80504	Air traffic, other airports	Jet fuel	Int. > 3000 ft	3352561	1,01	72,00	2,30
2007	806	Agriculture	Diesel		15378079	1,22	74,00	3,15
2007	806	Agriculture	Gasoline		382327	152,40	73,00	1,68
2007	807	Forestry	Diesel		159065	0,72	74,00	3,21
2007	807	Forestry	Gasoline		74145	57,62	73,00	0,43
2007	808	Industry	Diesel		13624003	1,32	74,00	3,09

Continued								
2007	808	Industry	Gasoline		161029	106,02	73,00	1,44
2007	808	Industry	LPG		1039571	7,69	65,00	3,50
2007	809	Household and gardening	Gasoline		3177713	74,06	73,00	1,13
2007	80501	Air traffic, Copenhagen airport	Jet fuel	Dom. < 3000 ft	208725	3,42	72,00	8,42
2007	80501	Air traffic, Copenhagen airport	Aviation gasoline		782	21,90	73,00	2,00
2007	80502	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	2789582	4,64	72,00	3,94
2007	80502	Air traffic, Copenhagen airport	Aviation gasoline		95	21,90	73,00	2,00
2007	80503	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	409239	2,21	72,00	2,30
2007	80504	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	31083722	1,19	72,00	2,30

2007 emission factors for SO_2, NO_x; NMVOC, NH_3 and TSP.

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	SO_2 [g pr GJ]	NO_x [g pr GJ]	NMVOC [g pr GJ]	CO [g pr GJ]	NH_3 [g pr GJ]	TSP [g pr GJ]
2007	70101	Passenger cars	Diesel	Highway driving	4239149	0,47	320,46	7,84	36,63	0,48	29,60
2007	70101	Passenger cars	Gasoline 2-stroke	Highway driving	0	2,28	288,90	2357,34	3490,86	0,80	48,15
2007	70101	Passenger cars	Gasoline conventional	Highway driving	961877	0,46	1332,24	331,15	2773,37	0,89	10,46
2007	70101	Passenger cars	Gasoline catalyst	Highway driving	11094084	0,46	114,52	24,84	691,33	32,04	0,67
2007	70101	Passenger cars	LPG	Highway driving	44	0,00	1151,70	187,09	3914,25	0,00	10,06
2007	70102	Passenger cars	Diesel	Rural driving	9387821	0,47	295,69	11,03	61,01	0,52	22,91
2007	70102	Passenger cars	Gasoline 2-stroke	Rural driving	2113477	2,28	352,84	2476,82	2594,44	0,69	41,51
2007	70102	Passenger cars	Gasoline conventional	Rural driving	25543136	0,46	1156,70	453,39	3162,05	0,98	11,73
2007	70102	Passenger cars	Gasoline catalyst	Rural driving	0	0,46	91,66	26,18	515,08	37,49	0,60
2007	70102	Passenger cars	LPG	Rural driving	89	0,00	1248,46	305,18	1146,38	0,00	14,49
2007	70103	Passenger cars	Diesel	Urban driving	9636862	0,47	277,45	27,32	136,83	0,39	35,33
2007	70103	Passenger cars	Gasoline 2-stroke	Urban driving	0	2,28	51,89	4470,04	7400,54	0,33	19,72
2007	70103	Passenger cars	Gasoline conventional	Urban driving	2466010	0,46	634,50	858,71	7875,97	0,64	11,30
2007	70103	Passenger cars	Gasoline catalyst	Urban driving	28568228	0,46	123,99	198,46	2274,41	13,46	0,68
2007	70103	Passenger cars	LPG	Urban driving	112	0,00	616,11	440,44	1327,53	0,00	11,75
2007	70201	Light duty vehicles	Diesel	Highway driving	4882419	0,47	283,52	27,45	161,76	0,36	35,30
2007	70201	Light duty vehicles	Gasoline conventional	Highway driving	351803	0,46	1369,26	170,29	2987,40	0,81	16,17
2007	70201	Light duty vehicles	Gasoline catalyst	Highway driving	36252	0,46	95,07	10,67	425,55	24,36	0,51
2007	70202	Light duty vehicles	Diesel	Rural driving	14874951	0,47	297,95	30,72	145,27	0,40	31,07
2007	70202	Light duty vehicles	Gasoline conventional	Rural driving	128141	0,46	1188,86	262,59	2316,18	0,76	15,25
2007	70202	Light duty vehicles	Gasoline catalyst	Rural driving	1242164	0,46	83,64	15,05	318,58	24,89	0,41
2007	70203	Light duty vehicles	Diesel	Urban driving	14454320	0,47	304,39	50,61	173,30	0,29	40,43

Continued

2007	70203	Light duty vehicles	Gasoline conventional	Urban driving	154585	0,46	624,19	717,35	7390,65	0,44	8,85
2007	70203	Light duty vehicles	Gasoline catalyst	Urban driving	1494595	0,46	97,04	113,84	2657,70	7,00	0,40
2007	70301	Heavy duty vehicles	Diesel	Highway driving	13114006	0,47	715,05	22,66	139,68	0,32	17,42
2007	70301	Heavy duty vehicles	Gasoline	Highway driving	15491	0,46	1037,78	474,61	7610,35	0,28	55,35
2007	70302	Heavy duty vehicles	Diesel	Rural driving	19682352	0,47	740,33	30,25	146,23	0,33	17,95
2007	70302	Heavy duty vehicles	Gasoline	Rural driving	31518	0,46	1141,55	820,40	8371,39	0,30	60,88
2007	70303	Heavy duty vehicles	Diesel	Urban driving	13672121	0,47	745,30	41,47	173,67	0,27	21,89
2007	70303	Heavy duty vehicles	Gasoline	Urban driving	32188	0,46	456,62	696,09	7102,99	0,20	40,59
2007	704	Mopeds	Gasoline		188922	0,46	112,42	8440,75	9577,73	1,26	137,39
2007	70501	Motorcycles	Gasoline	Highway driving	213387	0,46	249,42	1006,99	14684,49	1,20	23,58
2007	70502	Motorcycles	Gasoline	Rural driving	473994	0,46	195,74	1257,04	14427,72	1,51	29,57
2007	70503	Motorcycles	Gasoline	Urban driving	565148	0,46	110,37	1701,44	13209,28	1,53	29,89
2007	801	Military	Diesel		678945	0,47	492,21	30,61	140,33	0,35	26,76
2007	801	Military	Jet fuel	< 3000 ft	171808	22,99	250,57	24,94	229,89	0,00	1,16
2007	801	Military	Jet fuel	> 3000 ft	1546268	22,99	250,57	24,94	229,89	0,00	1,16
2007	801	Military	Gasoline		6373	0,46	176,04	227,05	1856,59	23,18	2,33
2007	801	Military	Aviation gasoline		6313	22,99	859,00	1242,60	6972,00	1,60	10,00
2007	802	Railways	Diesel		3075538	0,47	1155,92	74,96	204,41	0,20	39,02
2007	803	Inland waterways	Diesel		1002148	93,68	859,98	166,16	448,87	0,17	102,24
2007	803	Inland waterways	Gasoline		370806	0,46	471,95	1805,80	15316,45	0,09	75,54
2007	80402	National sea traffic	Residual oil		609869	586,80	1853,36	61,68	203,47		51,05
2007	80402	National sea traffic	Diesel		4118801	93,68	913,41	51,67	77,70	0,00	23,21
2007	80402	National sea traffic	Kerosene		0						
2007	80402	National sea traffic	LPG		0						
2007	80403	Fishing	Residual oil		0	1101,71	1393,60	56,90	180,90		139,40
2007	80403	Fishing	Diesel		5143684	93,68	1361,84	56,69	187,03	0,00	23,21
2007	80403	Fishing	Kerosene		278	2,30	50,00	3,00	20,00		5,00
2007	80403	Fishing	Gasoline		0	2,28	64,34	10809,60	18485,10	0,10	23,25
2007	80403	Fishing	LPG		18216	0,00	1249,00	384,94	443,00	0,00	0,20
2007	80404	International sea traffic	Residual oil		35243144	733,50	2069,79	61,20	201,91		63,83
2007	80404	International sea traffic	Diesel		10946734	93,68	1532,37	55,75	183,92		23,21
2007	80501	Air traffic, other airports	Jet fuel	Dom. < 3000 ft	218081	22,99	293,55	23,12	141,74		1,16
2007	80501	Air traffic, other airports	Aviation gasoline		97612	22,83	859,00	1242,60	6972,00	1,60	10,00
2007	80502	Air traffic, other airports	Jet fuel	Int. < 3000 ft	292943	22,99	291,92	43,72	198,15		1,16
2007	80502	Air traffic, other airports	Aviation gasoline		651	22,83	859,00	1242,60	6972,00	1,60	10,00
2007	80503	Air traffic, other airports	Jet fuel	Dom. > 3000 ft	546082	22,99	291,19	19,21	129,09		1,16

Continued

2007	80504	Air traffic, other airports	Jet fuel	Int. > 3000 ft	3352561	22,99	237,35	9,52	58,63		1,16
2007	806	Agriculture	Diesel		15378079	2,34	716,23	74,95	391,81	0,18	56,80
2007	806	Agriculture	Gasoline		382327	0,46	107,62	1143,27	21924,54	1,41	29,26
2007	807	Forestry	Diesel		159065	2,34	566,80	44,17	275,21	0,18	30,98
2007	807	Forestry	Gasoline		74145	0,46	86,32	6899,22	16933,82	0,09	77,69
2007	808	Industry	Diesel		13624003	2,34	678,30	80,88	376,58	0,18	68,25
2007	808	Industry	Gasoline		161029	0,46	200,51	1509,22	13278,13	0,10	14,57
2007	808	Industry	LPG		1039571	0,00	1328,11	146,09	104,85	0,21	4,89
2007	809	Household and gardening	Gasoline		3177713	0,46	90,65	2549,32	28132,76	0,09	25,05
2007	80501	Air traffic, Copenhagen airport	Jet fuel	Dom. < 3000 ft	208725	22,99	280,40	32,20	176,61		1,16
2007	80501	Air traffic, Copenhagen airport	Aviation gasoline		782	22,83	859,00	1242,60	6972,00	1,60	10,00
2007	80502	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	2789582	22,99	342,69	43,65	229,09	0,00	1,16
2007	80502	Air traffic, Copenhagen airport	Aviation gasoline		95	22,83	859,00	1242,60	6972,00	1,60	10,00
2007	80503	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	409239	22,99	321,59	20,83	112,70	0,00	1,16
2007	80504	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	31083722	22,99	314,27	11,22	34,26	0,00	1,16

1990 emissions for CO_2, CH_4, N_2O, SO_2, NO_x; NMVOC, NH_3 and TSP.

	Category	Mode		SO_2 [tonne]	NO_x [tonne]	NMVOC [tonne]	CH_4 [tonne]	CO [tonne]	CO_2 [ktonne]	N_2O [tonne]	NH_3 [tonne]	TSP [tonne]
1990	Passenger cars	Highway driving	70101	80	10078	2825	86	26229	600	21	7	145
1990	Passenger cars	Rural driving	70102	231	26952	11576	337	93345	1841	72	23	470
1990	Passenger cars	Urban driving	70103	339	20897	29689	1598	302362	2562	104	22	776
1990	Light duty vehicles	Highway driving	70201	179	818	95	7	1315	157	1	1	203
1990	Light duty vehicles	Rural driving	70202	641	3131	467	43	4567	572	2	3	749
1990	Light duty vehicles	Urban driving	70203	749	4754	1345	106	12581	687	3	3	1022
1990	Heavy duty vehicles	Highway driving	70301	812	8959	417	53	1728	642	25	3	332
1990	Heavy duty vehicles	Rural driving	70302	1484	16746	1148	108	3659	1174	49	5	651
1990	Heavy duty vehicles	Urban driving	70303	1250	13538	1333	168	3810	990	34	3	641
1990	Mopeds		704	1	5	3584	57	3613	21	0	0	49
1990	Motorcycles	Highway driving	70501	0	16	98	9	1355	6	0	0	2
1990	Motorcycles	Rural driving	70502	0	25	218	21	2406	10	0	0	5
1990	Motorcycles	Urban driving	70503	0	16	339	25	2573	12	0	0	6
1990	Evaporation		706			28676						
1990	Tyre and brake wear		707									1104
1990	Road abrasion		708									773
1990	Military		801	48	494	54	5	425	119	4	0	12
1990	Railways		802	376	4913	321	12	895	297	8	1	202
1990	Inland waterways		803	33	427	1174	17	4438	48	1	0	93
1990	National sea traffic		80402	5424	11593	456	14	1503	666	42		688
1990	Fishing		80403	742	8387	405	13	1303	591	37	0	184
1990	International sea traffic		80404	42404	62285	2116	65	6981	3087	194		5677
1990	Air traffic, Dom. < 3000 ft.		80501	24	373	158	4	895	75	5	0	2
1990	Air traffic, Int. < 3000 ft.		80502	50	722	116	8	590	156	9	0	3
1990	Air traffic, Dom. > 3000 ft.		80503	54	750	28	3	203	168	5		3
1990	Air traffic, Int. > 3000 ft.		80504	504	6293	215	23	853	1580	50		25
1990	Agriculture		806	1547	12541	3260	105	44172	1272	49	3	2388
1990	Forestry		807	14	138	2483	21	6259	36	1	0	56
1990	Industry		808	952	11081	2266	60	9379	842	34	2	1577
1990	Household and gardening		809	4	104	4104	150	47787	113	2	0	35

2007 emissions for CO_2, CH_4, N_2O, SO_2, NO_x; NMVOC, NH_3 and TSP.

	Category	Mode			SO_2 [tonne]	NO_x [tonne]	NMVOC [tonne]	CH_4 [tonne]	CO [tonne]	CO_2 [ktonne]	N_2O [tonne]	NH_3 [tonne]	TSP [tonne]
2007	Passenger cars	Highway driving	70101	070101	7	3910	627	49	10493	1191	19	358	143
2007	Passenger cars	Rural driving	70102	070102	17	7562	1730	133	20413	2707	62	964	255
2007	Passenger cars	Urban driving	70103	070103	19	7781	8051	410	85717	2971	110	390	388
2007	Light duty vehicles	Highway driving	70201	070201	2	1467	144	4	1048	390	8	10	173
2007	Light duty vehicles	Rural driving	70202	070202	8	4688	509	26	2853	1200	27	37	465
2007	Light duty vehicles	Urban driving	70203	070203	8	4641	1013	47	7620	1190	38	15	586
2007	Heavy duty vehicles	Highway driving	70301	070301	6	9393	305	76	1950	972	42	4	229
2007	Heavy duty vehicles	Rural driving	70302	070302	9	14607	621	125	3142	1459	64	6	355
2007	Heavy duty vehicles	Urban driving	70303	070303	6	10205	589	127	2603	1014	37	4	301
2007	Mopeds		704	070400	0	21	1595	26	1809	14	0	0	26
2007	Motorcycles	Highway driving	70501	070501	0	53	215	23	3133	16	0	0	5
2007	Motorcycles	Rural driving	70502	070502	0	93	596	63	6839	34	1	1	14
2007	Motorcycles	Urban driving	70503	070503	0	62	962	77	7465	41	1	1	17
2007	Evaporation		706	070600			3408						
2007	Tyre and brake wear		707	070700									1661
2007	Road abrasion		708	070800									1144
2007	Military		801	080100	40	771	73	8	546	175	6	0	20
2007	Railways		802	080200	1	3555	231	9	629	228	6	1	120
2007	Inland waterways		803	080300	94	1037	836	25	6129	101	3	0	130
2007	National sea traffic		80402	080402	744	4892	250	7	444	352	22	0	127
2007	Fishing		80403	080403	482	7028	299	9	970	382	24	0	119
2007	International sea traffic		80404	080404	26876	89720	2767	86	9129	3559	224		2504
2007	Air traffic, Dom. < 3000 ft.		80501	080501	12	207	134	3	754	38	5	0	1
2007	Air traffic, Int. < 3000 ft.		80502	080502	71	1042	136	14	702	222	13	0	4
2007	Air traffic, Dom. > 3000 ft.		80503	080503	22	291	19	2	117	69	2	0	1
2007	Air traffic, Int. > 3000 ft.		80504	080504	792	10564	381	40	1261	2479	79	0	40
2007	Agriculture		806	080600	36	11055	1590	77	14408	1166	49	3	885
2007	Forestry		807	080700	0	97	519	4	1299	17	1	0	11
2007	Industry		808	080800	32	10654	1497	43	7378	1088	46	3	937
2007	Household and gardening		809	080900	1	288	8101	235	89398	232	4	0	80

Non-exhaust emission factors, activity data and total non-exhaust emissions of TSP, PM_{10} and $PM_{2.5}$ in 2007.

Year	Source	Category	Mileage [kmkveh]	TSP [mg pr km]	PM_{10} [mg pr km]	$PM_{2.5}$ [mg pr km]	TSP [tonne]	PM_{10} [tonne]	$PM_{2.5}$ [tonne]
2007	Brake wear	1	38975465	7.6	7.5	3.0	297	291	116
2007	Brake wear	2	12707725	13.7	13.4	5.3	174	171	68
2007	Brake wear	3	3788995	34.8	34.1	13.6	132	129	51
2007	Brake wear	4	975262	47.4	46.4	18.5	46	45	18
2007	Brake wear	5	238308	6.2	6.1	2.4	1	1	1
2007	Brake wear	6	917018	4.2	4.2	1.7	4	4	2
2007	Road abrasion	1	38975465	15.0	7.5	4.1	585	292	158
2007	Road abrasion	2	12707725	15.0	7.5	4.1	191	95	51
2007	Road abrasion	3	3788995	76.0	38.0	20.5	288	144	78
2007	Road abrasion	4	975262	76.0	38.0	20.5	74	37	20
2007	Road abrasion	5	238308	6.0	3.0	1.6	1	1	0
2007	Road abrasion	6	917018	6.0	3.0	1.6	6	3	1
2007	Tyre wear	1	38975465	12.4	7.5	5.2	485	291	204
2007	Tyre wear	2	12707725	20.5	12.3	8.6	260	156	109
2007	Tyre wear	3	3788995	59.8	35.9	25.1	226	136	95
2007	Tyre wear	4	975262	29.4	17.7	12.4	29	17	12
2007	Tyre wear	5	238308	6.4	3.8	2.7	2	1	1
2007	Tyre wear	6	917018	5.6	3.3	2.3	5	3	2
2007	Total	1	38975465	35.1	22.4	12.2	1367	874	477
2007	Total	2	12707725	49.1	33.2	18.0	625	422	228
2007	Total	3	3788995	170.5	107.9	59.2	646	409	224
2007	Total	4	975262	152.8	102.1	51.4	149	100	50
2007	Total	5	238308	18.6	12.9	6.7	4	3	2
2007	Total	6	917018	15.8	10.5	5.6	14	10	5

Heavy metal emission factors and total emissions for 1990 and 2006 in CollectER format.

SNAP ID	Category	Fuel type	Mode	Arsenic [g pr GJ]	Cadmium [g pr GJ]	Chromium [g pr GJ]	Copper [g pr GJ]	Mercury [g pr GJ]	Nickel [g pr GJ]	Lead [g pr GJ]	Selenium [g pr GJ]	Zinc [g pr GJ]
070101	Passenger cars	Diesel	Highway driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070101	Passenger cars	Gasoline 2-stroke	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070101	Passenger cars	Gasoline conventional	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070101	Passenger cars	Gasoline catalyst	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070101	Passenger cars	LPG	Highway driving		0,000000	0,000000	0,000000		0,000000	0,000000	0,000000	0,000000
070102	Passenger cars	Diesel	Rural driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070102	Passenger cars	Gasoline 2-stroke	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070102	Passenger cars	Gasoline conventional	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070102	Passenger cars	Gasoline catalyst	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070102	Passenger cars	LPG	Rural driving		0,000000	0,000000	0,000000		0,000000	0,000000	0,000000	0,000000
070103	Passenger cars	Diesel	Urban driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070103	Passenger cars	Gasoline 2-stroke	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070103	Passenger cars	Gasoline conventional	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070103	Passenger cars	Gasoline catalyst	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070103	Passenger cars	LPG	Urban driving		0,000000	0,000000	0,000000		0,000000	0,000000	0,000000	0,000000
070201	Light duty vehicles	Diesel	Highway driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070201	Light duty vehicles	Gasoline conventional	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070201	Light duty vehicles	Gasoline catalyst	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070202	Light duty vehicles	Diesel	Rural driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070202	Light duty vehicles	Gasoline conventional	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070202	Light duty vehicles	Gasoline catalyst	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070203	Light duty vehicles	Diesel	Urban driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070203	Light duty vehicles	Gasoline conventional	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070203	Light duty vehicles	Gasoline catalyst	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070301	Heavy duty vehicles	Diesel	Highway driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070301	Heavy duty vehicles	Gasoline	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070302	Heavy duty vehicles	Diesel	Rural driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070302	Heavy duty vehicles	Gasoline	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070303	Heavy duty vehicles	Diesel	Urban driving		0,000234	0,001171	0,039812		0,001639	0,000000	0,000234	0,023419
070303	Heavy duty vehicles	Gasoline	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
0704	Mopeds	Gasoline			0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070501	Motorcycles	Gasoline	Highway driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070502	Motorcycles	Gasoline	Rural driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831
070503	Motorcycles	Gasoline	Urban driving		0,000228	0,001141	0,038813		0,001598	0,000685	0,000228	0,022831

SNAP ID	Category	Fuel type	Mode	Arsenic [mg pr GJ]	Cadmium [mg pr GJ]	Chromium [mg pr GJ]	Copper [mg pr GJ]	Mercury [mg pr GJ]	Nickel [mg pr GJ]	Lead [mg pr GJ]	Selenium [mg pr GJ]	Zinc [mg pr GJ]
0801	Military	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0801	Military	Jet fuel	< 3000 ft	0,00	0,23	1,14	38,81	0,00	1,60	0,00	0,23	22,83
0801	Military	Jet fuel	> 3000 ft	0,00	0,23	1,14	38,81	0,00	1,60	0,00	0,23	22,83
0801	Military	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
0801	Military	Aviation gasoline		0,00	0,23	1,14	38,81	0,00	1,60	12785,39	0,23	22,83
0802	Railways	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0802	Railways	Kerosene										
0802	Railways	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
0803	Inland waterways	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0803	Inland waterways	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
080402	National sea traffic	Residual oil		12,22	0,73	4,89	12,22	0,49	733,50	4,89	9,78	22,00
080402	National sea traffic	Diesel		1,17	0,23	0,94	1,17	1,17	1,64	2,34	4,68	11,71
080402	National sea traffic	Kerosene										
080402	National sea traffic	LPG										
080403	Fishing	Residual oil		12,22	0,73	4,89	12,22	0,49	733,50	4,89	9,78	22,00
080403	Fishing	Diesel		1,17	0,23	0,94	1,17	1,17	1,64	2,34	4,68	11,71
080403	Fishing	Kerosene										
080403	Fishing	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
080403	Fishing	LPG										
080404	International sea traffic	Residual oil		12,22	0,73	4,89	12,22	0,49	733,50	4,89	9,78	22,00
080404	International sea traffic	Diesel		1,17	0,23	0,94	1,17	1,17	1,64	2,34	4,68	11,71
080501	Air traffic, other airports	Jet fuel	Dom. < 3000 ft		0,23	1,14	38,81		1,60	0,00	0,23	22,83
080501	Air traffic, other airports	Aviation gasoline			0,23	1,14	38,81		1,60	13505,69	0,23	22,83
080502	Air traffic, other airports	Jet fuel	Int. < 3000 ft		0,23	1,14	38,81		1,60	0,00	0,23	22,83
080502	Air traffic, other airports	Aviation gasoline			0,23	1,14	38,81		1,60	13505,69	0,23	22,83
080503	Air traffic, other airports	Jet fuel	Dom. > 3000 ft		0,23	1,14	38,81		1,60	0,00	0,23	22,83
080504	Air traffic, other airports	Jet fuel	Int. > 3000 ft		0,23	1,14	38,81		1,60	0,00	0,23	22,83
0806	Agriculture	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0806	Agriculture	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
0807	Forestry	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0807	Forestry	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
0808	Industry	Diesel			0,23	1,17	39,81		1,64		0,23	23,42
0808	Industry	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
0808	Industry	LPG										
0809	Household and gardening	Gasoline			0,23	1,14	38,81		1,60	0,68	0,23	22,83
080501	Air traffic, CPH. airport	Jet fuel	Dom. < 3000 ft		0,23	1,14	38,81		1,60		0,23	22,83
080501	Air traffic, CPH. airport	Aviation gasoline			0,23	1,14	38,81		1,60	13505,69	0,23	22,83
080502	Air traffic, CPH. airport	Jet fuel	Int. < 3000 ft	0,00	0,23	1,14	38,81	0,00	1,60	0,00	0,23	22,83
080502	Air traffic, CPH. airport	Aviation gasoline		0,00	0,23	1,14	38,81	0,00	1,60	13505,69	0,23	22,83
080503	Air traffic, CPH. airport	Jet fuel	Dom. > 3000 ft	0,00	0,23	1,14	38,81	0,00	1,60	0,00	0,23	22,83
080504	Air traffic, CPH. airport	Jet fuel	Int. > 3000 ft	0,00	0,23	1,14	38,81	0,00	1,60	0,00	0,23	22,83

Year	Category	Mode	SNAP ID	Arsenic [kg]	Cadmium [kg]	Chromium [kg]	Copper [kg]	Mercury [kg]	Nickel [kg]	Lead [kg]	Selenium [kg]	Zinc [kg]
1990	Passenger cars	Highway driving	70101		2	9	315		13	11099	2	185
1990	Passenger cars	Rural driving	70102		6	28	966		40	34269	6	568
1990	Passenger cars	Urban driving	70103		8	40	1350		56	47403	8	794
1990	Light duty vehicles	Highway driving	70201		1	3	87		4	324	1	51
1990	Light duty vehicles	Rural driving	70202		2	9	318		13	1347	2	187
1990	Light duty vehicles	Urban driving	70203		2	11	385		16	1966	2	226
1990	Heavy duty vehicles	Highway driving	70301		2	10	346		14	15	2	203
1990	Heavy duty vehicles	Rural driving	70302		4	19	632		26	44	4	372
1990	Heavy duty vehicles	Urban driving	70303		3	16	533		22	51	3	314
1990	Mopeds		704		0	0	14		1	422	0	9
1990	Motorcycles	Highway driving	70501		0	0	4		0	113	0	2
1990	Motorcycles	Rural driving	70502		0	0	7		0	210	0	4
1990	Motorcycles	Urban driving	70503		0	0	8		0	247	0	5
1990	Evaporation		706									
1990	Military		801		0	2	64		3	64	0	38
1990	Railways		802		1	5	160		7	0	1	94
1990	Inland waterways		803		0	1	26		1	455	0	15
1990	National sea traffic		80402	53	4	23	53	8	2827	30	61	142
1990	Fishing		80403	9	2	7	9	9	13	19	37	93
1990	International sea traffic		80404	363	24	150	363	28	20956	167	334	764
1990	Air traffic, Dom. < 3000 ft.		80501		0	1	40		2	1534	0	24
1990	Air traffic, Int. < 3000 ft.		80502		0	2	84		3	490	0	50
1990	Air traffic, Dom. > 3000 ft.		80503		1	3	90		4		1	53
1990	Air traffic, Int. > 3000 ft.		80504		5	25	852		35		5	501
1990	Agriculture		806		4	20	684		28	1043	4	403
1990	Forestry		807		0	1	19		1	502	0	11
1990	Industry		808		2	12	411		17	258	2	242
1990	Household and gardening		809		0	2	60		2	2273	0	35

Year	Category	Mode	SNAP ID	Arsenic [kg]	Cadmium [kg]	Chromium [kg]	Copper [kg]	Mercury [kg]	Nickel [kg]	Lead [kg]	Selenium [kg]	Zinc [kg]
2007	Passenger cars	Rural driving	70101		4	19	637		26	8	4	375
2007	Passenger cars	Urban driving	70102		9	43	1447		60	19	9	851
2007	Light duty vehicles	Highway driving	70103		9	47	1588		65	21	9	934
2007	Light duty vehicles	Rural driving	70201		1	6	209		9	0	1	123
2007	Light duty vehicles	Urban driving	70202		4	19	645		27	1	4	380
2007	Heavy duty vehicles	Highway driving	70203		4	19	639		26	1	4	376
2007	Heavy duty vehicles	Rural driving	70301		3	15	523		22	0	3	307
2007	Heavy duty vehicles	Urban driving	70302		5	23	785		32	0	5	462
2007	Mopeds		70303		3	16	546		22	0	3	321
2007	Motorcycles	Highway driving	704		0	0	7		0	0	0	4
2007	Motorcycles	Rural driving	70501		0	0	8		0	0	0	5
2007	Motorcycles	Urban driving	70502		0	1	18		1	0	0	11
2007	Evaporation		70503		0	1	22		1	0	0	13
2007	Military		706									
2007	Railways		801	0	1	3	94	0	4	81	1	55
2007	Inland waterways		802		1	4	122		5		1	72
2007	National sea traffic		803		0	2	54		2	0	0	32
2007	Fishing		80402	12	1	7	12	5	454	13	25	62
2007	International sea traffic		80403	6	1	5	6	6	8	12	24	60
2007	Air traffic, Dom. < 3000 ft.		80404	443	28	183	443	30	25869	198	396	904
2007	Air traffic, Int. < 3000 ft.		80501		0	1	20		1	1329	0	12
2007	Air traffic, Dom. > 3000 ft.		80502	0	1	4	120	0	5	10	1	70
2007	Air traffic, Int. > 3000 ft.		80503	0	0	1	37	0	2	0	0	22
2007	Agriculture		80504	0	8	39	1336	0	55	0	8	786
2007	Forestry		806		4	18	627		26	0	4	369
2007	Industry		807		0	0	9		0	0	0	5
2007	Household and gardening		808		3	16	549		23	0	3	323
2007	Passenger cars	Rural driving	809		1	4	123		5	2	1	73

PAH emission factors and total emissions for 1990 and 2007 in CollectER format.

Year	SNAP ID	Category	Fuel type	Mode	Dioxins/ Furans [g pr GJ]	Flouranthene [g pr GJ]	Benzo(b) flouranthene [g pr GJ]	Benzo(k) flouranthene [g pr GJ]	Benzo(a) pyrene [g pr GJ]	Benzo(g,h,i) perylene [g pr GJ]	indeno(1,2,3-c,d) pyrene [g pr GJ]
1990	070101	Passenger cars	Diesel	Highway driving	2,34E-04	2,34E-02	7,01E-10	1,22E-02	7,48E-04	6,78E-04	8,18E-04
1990	070101	Passenger cars	Gasoline 2-stroke	Highway driving	2,97E-04	2,97E-02					
1990	070101	Passenger cars	Gasoline conventional	Highway driving	2,25E-04	2,25E-02	1,34E-08	8,54E-03	5,55E-04	4,27E-04	4,69E-04
1990	070101	Passenger cars	Gasoline catalyst	Highway driving	0,00E+00	0,00E+00					
1990	070101	Passenger cars	LPG	Highway driving	2,34E-04	2,34E-02	8,52E-10	1,49E-02	9,09E-04	8,24E-04	9,94E-04
1990	070102	Passenger cars	Diesel	Rural driving	2,97E-04	2,97E-02					
1990	070102	Passenger cars	Gasoline 2-stroke	Rural driving	2,24E-04	2,24E-02	1,51E-08	9,58E-03	6,23E-04	4,79E-04	5,27E-04
1990	070102	Passenger cars	Gasoline conventional	Rural driving	0,00E+00	0,00E+00					
1990	070102	Passenger cars	Gasoline catalyst	Rural driving	2,34E-04	2,34E-02	5,33E-10	9,30E-03	5,68E-04	5,15E-04	6,21E-04
1990	070102	Passenger cars	LPG	Rural driving	2,97E-04	2,97E-02					
1990	070103	Passenger cars	Diesel	Urban driving	2,25E-04	2,25E-02	1,02E-08	6,47E-03	4,20E-04	3,23E-04	3,56E-04
1990	070103	Passenger cars	Gasoline 2-stroke	Urban driving	0,00E+00	0,00E+00					
1990	070103	Passenger cars	Gasoline conventional	Urban driving	2,34E-04	2,34E-02	4,87E-10	8,51E-03	5,19E-04	4,70E-04	5,68E-04
1990	070103	Passenger cars	Gasoline catalyst	Urban driving	2,97E-04	2,97E-02	1,27E-08	8,09E-03	5,26E-04	4,04E-04	4,45E-04
1990	070103	Passenger cars	LPG	Urban driving	2,34E-04	2,34E-02	5,33E-10	9,31E-03	5,68E-04	5,15E-04	6,22E-04
1990	070201	Light duty vehicles	Diesel	Highway driving	2,97E-04	2,97E-02	1,20E-08	7,63E-03	4,95E-04	3,81E-04	4,19E-04
1990	070201	Light duty vehicles	Gasoline conventional	Highway driving	2,34E-04	2,34E-02	3,98E-10	6,95E-03	4,25E-04	3,85E-04	4,64E-04
1990	070201	Light duty vehicles	Gasoline catalyst	Highway driving	2,97E-04	2,97E-02	7,18E-09	4,56E-03	2,96E-04	2,28E-04	2,51E-04
1990	070202	Light duty vehicles	Diesel	Rural driving	2,34E-04	2,34E-02	1,06E-09	2,09E-03	5,26E-04	7,80E-04	9,74E-05
1990	070202	Light duty vehicles	Gasoline conventional	Rural driving	2,97E-04	2,97E-02					
1990	070202	Light duty vehicles	Gasoline catalyst	Rural driving	2,34E-04	2,34E-02	1,12E-09	2,21E-03	5,57E-04	8,25E-04	1,03E-04
1990	070203	Light duty vehicles	Diesel	Urban driving	2,97E-04	2,97E-02					
1990	070203	Light duty vehicles	Gasoline conventional	Urban driving	2,34E-04	2,34E-02	9,11E-10	1,79E-03	4,51E-04	6,68E-04	8,34E-05
1990	070203	Light duty vehicles	Gasoline catalyst	Urban driving	2,97E-04	2,97E-02					
1990	070301	Heavy duty vehicles	Diesel	Highway driving	2,97E-04	2,97E-02					
1990	070301	Heavy duty vehicles	Gasoline	Highway driving	2,97E-04	2,97E-02	2,00E-08	1,27E-02	8,24E-04	6,34E-04	6,97E-04
1990	070302	Heavy duty vehicles	Diesel	Rural driving	2,97E-04	2,97E-02	2,39E-08	1,52E-02	9,86E-04	7,59E-04	8,34E-04
1990	070302	Heavy duty vehicles	Gasoline	Rural driving	2,97E-04	2,97E-02	2,41E-08	1,53E-02	9,94E-04	7,65E-04	8,41E-04
1990	070303	Heavy duty vehicles	Diesel	Urban driving	2,34E-04	2,34E-02	7,01E-10	1,22E-02	7,48E-04	6,78E-04	8,18E-04
1990	070303	Heavy duty vehicles	Gasoline	Urban driving	2,97E-04	2,97E-02					
1990	0704	Mopeds	Gasoline		2,25E-04	2,25E-02	1,34E-08	8,54E-03	5,55E-04	4,27E-04	4,69E-04
1990	070501	Motorcycles	Gasoline	Highway driving	0,00E+00	0,00E+00					
1990	070502	Motorcycles	Gasoline	Rural driving	2,34E-04	2,34E-02	8,52E-10	1,49E-02	9,09E-04	8,24E-04	9,94E-04
1990	070503	Motorcycles	Gasoline	Urban driving	2,97E-04	2,97E-02					

Year	SNAP ID	Category	Fuel type	Mode	Dioxins/ Furans [g pr GJ]	Flouranthene [g pr GJ]	Benzo(b) flouranthene [g pr GJ]	Benzo(k) flouranthene [g pr GJ]	Benzo(a) pyrene [g pr GJ]	Benzo(g,h,i) perylene [g pr GJ]	indeno(1,2,3-c,d) pyrene [g pr GJ]
2007	070101	Passenger cars	Diesel	Highway driving	0,00E+00	1,28E-02	7,82E-04	7,09E-04	8,56E-04	1,66E-03	8,07E-04
2007	070101	Passenger cars	Gasoline 2-stroke	Highway driving							
2007	070101	Passenger cars	Gasoline conventional	Highway driving	1,39E-08	8,82E-03	5,73E-04	4,41E-04	4,85E-04	1,15E-03	4,41E-04
2007	070101	Passenger cars	Gasoline catalyst	Highway driving	0,00E+00	8,84E-04	1,96E-04	2,45E-04	1,96E-04	3,93E-04	2,95E-04
2007	070101	Passenger cars	LPG	Highway driving							
2007	070102	Passenger cars	Diesel	Rural driving	8,35E-10	1,46E-02	8,91E-04	8,07E-04	9,75E-04	1,89E-03	9,19E-04
2007	070102	Passenger cars	Gasoline 2-stroke	Rural driving							
2007	070102	Passenger cars	Gasoline conventional	Rural driving	1,53E-08	9,74E-03	6,33E-04	4,87E-04	5,36E-04	1,27E-03	4,87E-04
2007	070102	Passenger cars	Gasoline catalyst	Rural driving	0,00E+00	9,87E-04	2,19E-04	2,74E-04	2,19E-04	4,39E-04	3,29E-04
2007	070102	Passenger cars	LPG	Rural driving							
2007	070103	Passenger cars	Diesel	Urban driving	5,54E-10	9,68E-03	5,91E-04	5,36E-04	6,47E-04	1,26E-03	6,10E-04
2007	070103	Passenger cars	Gasoline 2-stroke	Urban driving							
2007	070103	Passenger cars	Gasoline conventional	Urban driving	9,99E-09	6,34E-03	4,12E-04	3,17E-04	3,49E-04	8,25E-04	3,17E-04
2007	070103	Passenger cars	Gasoline catalyst	Urban driving	0,00E+00	5,38E-04	1,19E-04	1,49E-04	1,19E-04	2,39E-04	1,79E-04
2007	070103	Passenger cars	LPG	Urban driving							
2007	070201	Light duty vehicles	Diesel	Highway driving	5,29E-10	9,23E-03	5,64E-04	5,11E-04	6,17E-04	1,20E-03	5,81E-04
2007	070201	Light duty vehicles	Gasoline conventional	Highway driving	1,27E-08	8,09E-03	5,26E-04	4,04E-04	4,45E-04	1,05E-03	4,04E-04
2007	070201	Light duty vehicles	Gasoline catalyst	Highway driving	0,00E+00	6,18E-04	1,37E-04	1,72E-04	1,37E-04	2,75E-04	2,06E-04
2007	070202	Light duty vehicles	Diesel	Rural driving	5,78E-10	1,01E-02	6,17E-04	5,59E-04	6,75E-04	1,31E-03	6,36E-04
2007	070202	Light duty vehicles	Gasoline conventional	Rural driving	1,20E-08	7,63E-03	4,95E-04	3,81E-04	4,19E-04	9,91E-04	3,81E-04
2007	070202	Light duty vehicles	Gasoline catalyst	Rural driving	0,00E+00	5,84E-04	1,30E-04	1,62E-04	1,30E-04	2,59E-04	1,95E-04
2007	070203	Light duty vehicles	Diesel	Urban driving	4,16E-10	7,26E-03	4,43E-04	4,02E-04	4,85E-04	9,42E-04	4,57E-04
2007	070203	Light duty vehicles	Gasoline conventional	Urban driving	6,92E-09	4,39E-03	2,85E-04	2,20E-04	2,42E-04	5,71E-04	2,20E-04
2007	070203	Light duty vehicles	Gasoline catalyst	Urban driving	0,00E+00	3,37E-04	7,49E-05	9,36E-05	7,49E-05	1,50E-04	1,12E-04
2007	070301	Heavy duty vehicles	Diesel	Highway driving	1,03E-09	2,03E-03	5,12E-04	7,59E-04	9,48E-05	7,59E-05	1,33E-04
2007	070301	Heavy duty vehicles	Gasoline	Highway driving							
2007	070302	Heavy duty vehicles	Diesel	Rural driving	1,05E-09	2,07E-03	5,21E-04	7,72E-04	9,65E-05	7,70E-05	1,35E-04
2007	070302	Heavy duty vehicles	Gasoline	Rural driving							
2007	070303	Heavy duty vehicles	Diesel	Urban driving	8,54E-10	1,68E-03	4,23E-04	6,26E-04	7,82E-05	6,25E-05	1,10E-04
2007	070303	Heavy duty vehicles	Gasoline	Urban driving							
2007	0704	Mopeds	Gasoline								
2007	070501	Motorcycles	Gasoline	Highway driving	2,02E-08	1,28E-02	8,32E-04	6,40E-04	7,04E-04	1,66E-03	6,40E-04
2007	070502	Motorcycles	Gasoline	Rural driving	2,41E-08	1,53E-02	9,96E-04	7,66E-04	8,43E-04	1,99E-03	7,66E-04
2007	070503	Motorcycles	Gasoline	Urban driving	2,44E-08	1,55E-02	1,01E-03	7,75E-04	8,52E-04	2,01E-03	7,75E-04

Year	SNAP ID	Category	Fuel type	Mode	Dioxins/ Furans [ng pr GJ]	Flouranthene [microg pr GJ]	Benzo(b) flouranthene [microg pr GJ]	Benzo(k) flouranthene [microg pr GJ]	Benzo(a) pyrene [microg pr GJ]	Benzo(g,h,i) perylene [microg pr GJ]	indeno(1,2,3-c,d) pyrene [microg pr GJ]
1990	0801	Military	Diesel		0.23	23.42	0.71	4391.42	570.64	568.31	289.75
1990	0801	Military	Jet fuel	< 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	0801	Military	Jet fuel	> 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	0801	Military	Gasoline		0.23	22.83	6.27	5257.47	277.33	116.39	141.99
1990	0801	Military	Aviation gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	0802	Railways	Diesel		0.23	23.42	0.70	1365.92	348.03	388.90	57.47
1990	0802	Railways	Kerosene								
1990	0802	Railways	Gasoline		0.23	22.83	6.27	5257.47	277.33	116.39	141.99
1990	0803	Inland waterways	Diesel		0.23	23.42	0.71	4391.42	570.64	568.31	289.75
1990	0803	Inland waterways	Gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080402	National sea traffic	Residual oil		9.78	22.00	13.42	5190.00	270.00	50.00	20.00
1990	080402	National sea traffic	Diesel		4.68	11.71	12.01	7420.00	640.00	300.00	150.00
1990	080402	National sea traffic	Kerosene								
1990	080402	National sea traffic	LPG								
1990	080403	Fishing	Residual oil		9.78	22.00	13.42	5190.00	270.00	50.00	20.00
1990	080403	Fishing	Diesel		4.68	11.71	12.01	7420.00	640.00	300.00	150.00
1990	080403	Fishing	Kerosene								
1990	080403	Fishing	Gasoline		0.23	22.83	11.42	3420.09	342.47	146.12	244.29
1990	080403	Fishing	LPG								
1990	080404	International sea traffic	Residual oil		9.78	22.00	13.42	4120.00	200.00	90.00	70.00
1990	080404	International sea traffic	Diesel		4.68	11.71	12.01	7420.00	640.00	300.00	150.00
1990	080501	Air traffic. other airports	Jet fuel	Dom. < 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080501	Air traffic. other airports	Aviation gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080502	Air traffic. other airports	Jet fuel	Int. < 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080502	Air traffic. other airports	Aviation gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080503	Air traffic. other airports	Jet fuel	Dom. > 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080504	Air traffic. other airports	Jet fuel	Int. > 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	0806	Agriculture	Diesel		0.23	23.42	0.71	4391.42	570.64	568.31	289.75
1990	0806	Agriculture	Gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	0807	Forestry	Diesel		0.23	23.42	0.71	4391.42	570.64	568.31	289.75
1990	0807	Forestry	Gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	0808	Industry	Diesel		0.23	23.42	0.71	4391.42	570.64	568.31	289.75
1990	0808	Industry	Gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	0808	Industry	LPG								
1990	0809	Household and gardening	Gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080501	Air traffic. CPH. airport	Jet fuel	Dom. < 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080501	Air traffic. Copenhagen airport	Aviation gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080502	Air traffic. Copenhagen airport	Jet fuel	Int. < 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080502	Air traffic. Copenhagen airport	Aviation gasoline		0.23	22.83	5.11	4328.53	209.06	71.27	114.03
1990	080503	Air traffic. Copenhagen airport	Jet fuel	Dom. > 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00
1990	080504	Air traffic. Copenhagen airport	Jet fuel	Int. > 3000 ft	0.23	22.83	0.00	0.00	0.00	0.00	0.00

Year	SNAP ID	Category	Fuel type	Mode	Dioxins/ Furans [g pr GJ]	Flouranthene [g pr GJ]	Benzo(b) flouranthene [g pr GJ]	Benzo(k) flouranthene [g pr GJ]	Benzo(a) pyrene [g pr GJ]	Benzo(g,h,i) perylene [g pr GJ]	indeno(1,2,3-c,d) pyrene [g pr GJ]
2007	801	Military	Diesel		0.71	4349.86	510.47	495.91	255.72	464.46	264.30
2007	801	Military	Jet fuel	< 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	801	Military	Jet fuel	> 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	801	Military	Gasoline		6.89	2151.74	179.80	115.04	118.07	357.51	178.80
2007	801	Military	Aviation gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	802	Railways	Diesel		0.72	1411.28	359.58	401.81	59.38	50.80	92.37
2007	803	Inland waterways	Diesel		0.71	4349.86	510.47	495.91	255.72	464.46	264.30
2007	803	Inland waterways	Gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	80402	National sea traffic	Residual oil		13.42	5190.00	270.00	50.00	20.00	70.00	30.00
2007	80402	National sea traffic	Diesel		12.01	7420.00	640.00	300.00	150.00	1430.00	1180.00
2007	80402	National sea traffic	Kerosene								
2007	80402	National sea traffic	LPG								
2007	80403	Fishing	Residual oil		13.42	5190.00	270.00	50.00	20.00	70.00	30.00
2007	80403	Fishing	Diesel		12.01	7420.00	640.00	300.00	150.00	1430.00	1180.00
2007	80403	Fishing	Kerosene								
2007	80403	Fishing	Gasoline		11.42	3420.00	342.00	146.00	244.00	489.00	244.00
2007	80403	Fishing	LPG								
2007	80404	International sea traffic	Residual oil		13.42	4120.00	200.00	90.00	70.00	260.00	200.00
2007	80404	International sea traffic	Diesel		12.01	7420.00	640.00	300.00	150.00	1430.00	1180.00
2007	80501	Air traffic. other airports	Jet fuel	Dom. < 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80501	Air traffic. other airports	Aviation gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	80502	Air traffic. other airports	Jet fuel	Int. < 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80502	Air traffic. other airports	Aviation gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	80503	Air traffic. other airports	Jet fuel	Dom. > 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80504	Air traffic. other airports	Jet fuel	Int. > 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	806	Agriculture	Diesel		0.71	4349.86	510.47	495.91	255.72	464.46	264.30
2007	806	Agriculture	Gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	807	Forestry	Diesel		0.71	4349.86	510.47	495.91	255.72	464.46	264.30
2007	807	Forestry	Gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	808	Industry	Diesel		0.71	4349.86	510.47	495.91	255.72	464.46	264.30
2007	808	Industry	Gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	808	Industry	LPG								

2007	809	Household and gardening	Gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
Continued											
2007	80501	Air traffic. Copenhagen airport	Jet fuel	Dom. < 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80501	Air traffic. Copenhagen airport	Aviation gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	80502	Air traffic. Copenhagen airport	Jet fuel	Int. < 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80502	Air traffic. Copenhagen airport	Aviation gasoline		5.11	4328.53	209.06	71.27	114.03	688.95	244.70
2007	80503	Air traffic. Copenhagen airport	Jet fuel	Dom. > 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	80504	Air traffic. Copenhagen airport	Jet fuel	Int. > 3000 ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Year	Category	Mode	SNAP ID	Dioxins/ Furans [kg]	Flouranthene [kg]	Benzo(b) flouranthene [kg]	Benzo(k) flouranthene [kg]	Benzo(a) pyrene [kg]	Benzo(g,h,i) perylene [kg]	indeno(1,2,3-c,d) pyrene [kg]
1990	Passenger cars	Highway driving	70101	0.10	72.32	4.67	3.66	4.07	9.40	3.72
1990	Passenger cars	Rural driving	70102	0.35	250.39	16.16	12.67	14.10	32.54	12.88
1990	Passenger cars	Urban driving	70103	0.33	233.33	15.06	11.80	13.14	30.32	12.01
1990	Light duty vehicles	Highway driving	70201	0.00	18.00	1.11	0.99	1.18	2.34	1.11
1990	Light duty vehicles	Rural driving	70202	0.01	70.49	4.33	3.86	4.63	9.15	4.35
1990	Light duty vehicles	Urban driving	70203	0.01	61.49	3.78	3.37	4.03	7.98	3.79
1990	Heavy duty vehicles	Highway driving	70301	0.01	18.07	4.56	6.76	0.84	0.67	1.18
1990	Heavy duty vehicles	Rural driving	70302	0.02	34.97	8.82	13.07	1.63	1.31	2.28
1990	Heavy duty vehicles	Urban driving	70303	0.01	23.86	6.02	8.92	1.11	0.89	1.56
1990	Mopeds		704							
1990	Motorcycles	Highway driving	70501	0.00	0.97	0.06	0.05	0.05	0.13	0.05
1990	Motorcycles	Rural driving	70502	0.00	2.17	0.14	0.11	0.12	0.28	0.11
1990	Motorcycles	Urban driving	70503	0.00	2.57	0.17	0.13	0.14	0.33	0.13
1990	Evaporation		706							
1990	Military		801	0.00	0.67	0.08	0.08	0.04	0.08	0.04
1990	Railways		802	0.00	5.48	1.40	1.56	0.23	0.20	0.36
1990	Inland waterways		803	0.00	2.84	0.26	0.22	0.13	0.40	0.18
1990	National sea traffic		80402	0.11	56.61	4.20	1.67	0.82	7.34	5.95
1990	Fishing		80403	0.10	58.77	5.07	2.38	1.19	11.33	9.35
1990	International sea traffic		80404	0.52	203.91	13.15	6.06	3.74	24.06	19.44
1990	Air traffic. Dom. < 3000 ft.		80501	0.00	0.49	0.02	0.01	0.01	0.08	0.03
1990	Air traffic. Int. < 3000 ft.		80502	0.00	0.16	0.01	0.00	0.00	0.02	0.01
1990	Air traffic. Dom. > 3000 ft.		80503	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	Air traffic. Int. > 3000 ft.		80504	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	Agriculture		806	0.02	75.51	9.56	9.43	4.86	9.56	4.96

1990	Forestry		807	0.00	2.12	0.15	0.11	0.08	0.32	0.13
Continued										
1990	Industry		808	0.01	45.37	5.83	5.79	2.96	5.71	2.99
1990	Household and gardening		809	0.01	6.69	0.32	0.11	0.18	1.06	0.38

Year	Category	Mode	SNAP ID	Dioxins/ Furans [kg]	Flouranthene [kg]	Benzo(b) flouranthene [kg]	Benzo(k) flouranthene [kg]	Benzo(a) pyrene [kg]	Benzo(g,h,i) perylene [kg]	indeno(1,2,3-c,d) pyrene [kg]
2007	Passenger cars	Highway driving	70101	0.01	72.61	6.04	6.15	6.27	12.51	7.11
2007	Passenger cars	Rural driving	70102	0.04	182.80	15.30	15.61	15.88	31.66	18.05
2007	Passenger cars	Urban driving	70103	0.03	124.33	10.13	10.21	10.50	20.97	11.78
2007	Light duty vehicles	Highway driving	70201	0.00	45.59	2.82	2.57	3.08	5.98	2.93
2007	Light duty vehicles	Rural driving	70202	0.01	151.98	9.40	8.57	10.25	19.95	9.75
2007	Light duty vehicles	Urban driving	70203	0.01	106.14	6.56	5.98	7.16	13.93	6.81
2007	Heavy duty vehicles	Highway driving	70301	0.01	26.63	6.72	9.95	1.24	1.00	1.74
2007	Heavy duty vehicles	Rural driving	70302	0.02	40.66	10.26	15.20	1.90	1.52	2.66
2007	Heavy duty vehicles	Urban driving	70303	0.01	22.91	5.78	8.56	1.07	0.85	1.50
2007	Mopeds		704							
2007	Motorcycles	Highway driving	70501	0.00	2.73	0.18	0.14	0.15	0.36	0.14
2007	Motorcycles	Rural driving	70502	0.01	7.27	0.47	0.36	0.40	0.94	0.36
2007	Motorcycles	Urban driving	70503	0.01	8.76	0.57	0.44	0.48	1.14	0.44
2007	Evaporation		706							
2007	Military		801	0.00	2.99	0.35	0.34	0.18	0.32	0.18
2007	Railways		802	0.00	4.34	1.11	1.24	0.18	0.16	0.28
2007	Inland waterways		803	0.00	5.96	0.59	0.52	0.30	0.72	0.36
2007	National sea traffic		80402	0.06	33.73	2.80	1.27	0.63	5.93	4.88
2007	Fishing		80403	0.06	38.17	3.29	1.54	0.77	7.36	6.07
2007	International sea traffic		80404	0.60	226.43	14.05	6.46	4.11	24.82	19.97
2007	Air traffic. Dom. < 3000 ft.		80501	0.00	0.43	0.02	0.01	0.01	0.07	0.02
2007	Air traffic. Int. < 3000 ft.		80502	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	Air traffic. Dom. > 3000 ft.		80503	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	Air traffic. Int. > 3000 ft.		80504	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	Agriculture		806	0.01	68.55	7.93	7.65	3.98	7.41	4.16
2007	Forestry		807	0.00	1.01	0.10	0.08	0.05	0.12	0.06
2007	Industry		808	0.01	59.96	6.99	6.77	3.50	6.44	3.64
2007	Household and gardening		809	0.02	13.75	0.66	0.23	0.36	2.19	0.78

Annex 2B-15: Fuel use and emissions in CRF format

Fuel.

IPCC ID	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Industry-Other (1A2f)	11.7	11.7	11.6	11.6	11.6	11.5	11.5	11.5	11.5	11.5	11.6	11.7	11.7	11.9	11.9	12.0	12.1	12.3	12.4	12.5	13.0	13.9	14.8
Civil Aviation (1A3a)	3.6	3.3	3.7	3.8	3.6	3.4	2.8	2.7	2.6	2.7	2.8	2.8	2.9	2.7	2.4	2.1	2.2	1.9	1.9	1.8	1.9	2.0	1.5
Road (1A3b)	111.1	117.4	117.6	118.3	119.6	126.2	131.9	134.3	136.0	142.8	144.1	146.6	149.5	152.0	154.0	152.5	152.8	154.5	160.6	164.8	166.1	171.3	179.6
Railways (1A3c)	4.9	4.9	4.4	4.6	4.2	4.0	4.1	4.3	4.5	4.1	4.1	4.1	4.0	3.3	3.1	3.1	2.9	2.8	3.0	2.9	3.1	3.1	3.1
Navigation (1A3d)	9.3	9.3	9.3	9.4	9.4	9.4	9.5	9.7	9.6	9.7	10.2	11.2	11.0	9.0	7.4	6.4	6.2	6.1	6.2	6.4	6.3	6.2	6.1
Residential (1A4b)	1.6	1.6	1.6	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.8	2.0	2.2	2.5	2.8	3.0	3.2	3.2
Ag./for./fish. (1A4c)	24.4	26.0	23.8	25.5	25.3	25.7	25.7	24.3	23.8	22.9	23.4	22.2	21.0	20.4	21.1	21.8	21.5	22.1	21.7	20.3	21.3	21.1	21.2
Military (1A5)	5.5	4.3	5.0	2.7	2.3	1.6	3.9	1.9	3.3	3.5	3.4	2.4	2.3	2.8	2.5	1.5	1.3	1.2	1.3	3.3	3.7	1.7	2.4
Navigation int. (1A3d)	17.3	20.1	29.4	37.3	38.2	40.2	36.1	37.9	56.1	63.1	66.3	63.0	57.8	58.2	54.6	56.0	47.3	39.1	41.2	33.5	34.5	44.7	46.2
Civil Aviation int. (1A3a)	19.3	20.9	22.4	24.0	25.1	24.1	22.7	23.5	23.0	25.2	25.9	27.4	27.9	30.0	31.8	32.6	33.1	28.6	29.8	34.0	35.8	35.9	37.5

Emissions.

pol_name	IPCC ID	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
SO_2	Industry-Other (1A2f)	[tonne]	2402	1441	1440	1438	956	952	955	957	957	959	968	244	246	249	251	253
SO_2	Civil Aviation (1A3a)	[tonne]	82	77	85	86	83	77	64	62	61	63	63	65	68	62	56	49
SO_2	Road (1A3b)	[tonne]	11621	7862	7847	7857	5488	5767	5903	3820	1569	1669	1682	1721	1744	1768	1088	352
SO_2	Railways (1A3c)	[tonne]	1152	695	618	641	393	376	382	263	105	95	96	95	93	78	40	7
SO_2	Navigation (1A3d)	[tonne]	6363	6363	6367	6127	6130	5456	4232	2822	3522	4005	4502	3458	2647	1555	1292	1129
SO_2	Residential (1A4b)	[tonne]	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
SO_2	Ag./for./fish. (1A4c)	[tonne]	4766	3484	3173	3073	2269	2303	2317	2186	2150	2072	2120	978	853	856	931	1021
SO_2	Military (1A5)	[tonne]	408	260	193	72	70	48	206	82	76	80	80	56	54	65	47	27
SO_2	Navigation int. (1A3d)	[tonne]	18333	22047	36943	48034	48337	42404	34348	31152	59669	60081	66260	62320	57078	48000	50568	56634
SO_2	Civil Aviation int. (1A3a)	[tonne]	444	480	515	551	578	554	521	541	530	580	596	629	642	689	731	750
NO_x	Industry-Other (1A2f)	[tonne]	10903	10964	11011	11044	11065	11081	11282	11440	11558	11677	11882	12080	12248	12425	12262	12096
NO_x	Civil Aviation (1A3a)	[tonne]	1203	1132	1237	1252	1208	1123	920	902	900	940	958	971	998	911	815	723
NO_x	Road (1A3b)	[tonne]	92560	98283	98293	99080	100343	105934	107409	106683	104201	103338	99747	96719	92934	88949	85839	80883
NO_x	Railways (1A3c)	[tonne]	6025	6063	5391	5589	5145	4913	4995	5284	5485	4971	5015	4977	4846	4089	3730	3727
NO_x	Navigation (1A3d)	[tonne]	11778	11798	11852	11902	11962	12020	11433	11104	11007	11236	11898	13043	11805	9411	6608	5830
NO_x	Residential (1A4b)	[tonne]	96	99	101	103	103	104	111	118	125	130	136	140	144	149	151	153
NO_x	Ag./for./fish. (1A4c)	[tonne]	18159	19915	18153	20143	20342	21066	21722	20824	20763	20524	21442	21138	20176	20119	21495	22807
NO_x	Military (1A5)	[tonne]	2340	2020	1625	980	873	494	1861	1011	1291	1272	1760	963	1217	1413	1095	550
NO_x	Navigation int. (1A3d)	[tonne]	23987	28474	43643	56580	58561	62285	55731	57636	89632	101094	106928	102221	94977	94125	91400	96911
NO_x	Civil Aviation int. (1A3a)	[tonne]	5663	6129	6569	7035	7313	7016	6586	6846	6702	7317	7517	7904	8058	8662	9204	9446
NMVOC	Industry-Other (1A2f)	[tonne]	2422	2395	2368	2339	2304	2266	2231	2191	2147	2107	2088	2095	2083	2074	1997	1926
NMVOC	Civil Aviation (1A3a)	[tonne]	216	213	190	198	193	186	168	164	161	191	206	194	186	169	162	156
NMVOC	Road (1A3b)	[tonne]	80995	80718	80084	79594	77996	81811	82697	81762	79504	75253	70469	66193	60022	54887	48958	41578
NMVOC	Railways (1A3c)	[tonne]	393	396	352	365	336	321	326	345	358	324	327	325	316	267	276	253
NMVOC	Navigation (1A3d)	[tonne]	1505	1505	1536	1566	1598	1630	1658	1699	1727	1761	1819	1920	1913	1817	1704	1652
NMVOC	Residential (1A4b)	[tonne]	4191	4166	4139	4112	4108	4104	4111	4094	4054	4070	4147	4231	4314	4395	4499	4602
NMVOC	Ag./for./fish. (1A4c)	[tonne]	6357	6417	6216	6284	6207	6149	5777	5298	4944	4638	4516	4208	3966	3691	3563	3414
NMVOC	Military (1A5)	[tonne]	601	469	175	490	315	54	172	94	128	124	159	95	109	122	111	58
NMVOC	Navigation int. (1A3d)	[tonne]	880	1029	1527	1948	2003	2116	1900	1990	2993	3378	3560	3398	3138	3158	3003	3126
NMVOC	Civil Aviation int. (1A3a)	[tonne]	261	288	313	342	361	331	309	316	309	308	343	360	365	386	395	407
CH_4	Industry-Other (1A2f)	[tonne]	63	63	62	61	61	60	58	57	56	54	53	53	53	53	51	50
CH_4	Civil Aviation (1A3a)	[tonne]	8	8	8	8	8	7	6	6	6	7	7	7	7	7	6	5
CH_4	Road (1A3b)	[tonne]	2378	2437	2450	2481	2472	2619	2658	2627	2592	2503	2371	2264	2176	2090	1980	1861
CH_4	Railways (1A3c)	[tonne]	15	15	14	14	13	12	13	13	14	12	13	12	12	10	11	10
CH_4	Navigation (1A3d)	[tonne]	28	28	29	29	30	31	31	32	33	33	35	37	36	33	31	30
CH_4	Residential (1A4b)	[tonne]	158	156	153	150	150	150	147	144	140	138	136	135	134	134	135	137
CH_4	Ag./for./fish. (1A4c)	[tonne]	155	154	147	146	142	139	132	123	116	110	106	100	94	89	88	88
CH_4	Military (1A5)	[tonne]	31	26	17	18	14	5	19	10	13	13	18	10	12	14	11	6
CH_4	Navigation int. (1A3d)	[tonne]	27	32	47	60	62	65	59	62	93	104	110	105	97	98	93	97
CH_4	Civil Aviation int. (1A3a)	[tonne]	25	27	30	32	33	31	29	30	29	31	35	37	38	40	41	42
CO	Industry-Other (1A2f)	[tonne]	9863	9784	9702	9611	9502	9379	9294	9188	9070	8956	8910	8963	8939	8907	8647	8395

Continued

CO	Civil Aviation (1A3a)	[tonne]	1256	1241	1118	1167	1140	1098	989	955	930	1098	1180	1117	1085	973	932	895
CO	Road (1A3b)	[tonne]	561267	540934	521947	476252	448414	459541	474997	465105	466790	435033	412002	399588	346206	325296	290760	267306
CO	Railways (1A3c)	[tonne]	1098	1105	982	1018	937	895	910	963	999	906	914	907	883	745	717	694
CO	Navigation (1A3d)	[tonne]	5291	5291	5453	5613	5777	5941	6095	6287	6428	6610	6861	7065	6967	6799	6541	6572
CO	Residential (1A4b)	[tonne]	50434	49697	48935	48149	47970	47787	46848	45867	45027	44365	43997	44112	44229	44347	45103	45873
CO	Ag./for./fish. (1A4c)	[tonne]	61165	59707	57256	55768	53717	51734	48771	45427	42608	39735	37673	34858	32455	29823	27820	25842
CO	Military (1A5)	[tonne]	4168	3098	1315	3127	1948	425	1028	525	859	880	905	627	617	704	705	407
CO	Navigation int. (1A3d)	[tonne]	2903	3396	5038	6427	6608	6981	6268	6566	9873	11143	11745	11211	10351	10417	9905	10313
CO	Civil Aviation int. (1A3a)	[tonne]	1103	1207	1289	1416	1564	1442	1357	1399	1388	1342	1421	1502	1564	1662	1743	1790
CO_2	Industry-Other (1A2f)	[ktonne]	852	852	851	849	845	842	843	843	842	841	848	853	860	867	873	879
CO_2	Civil Aviation (1A3a)	[ktonne]	256	241	268	271	262	243	199	193	190	196	199	205	212	194	174	154
CO_2	Road (1A3b)	[ktonne]	8160	8625	8636	8694	8789	9275	9690	9863	9987	10487	10585	10764	10978	11166	11312	11202
CO_2	Railways (1A3c)	[ktonne]	364	366	326	338	311	297	302	319	331	300	303	301	293	247	232	228
CO_2	Navigation (1A3d)	[ktonne]	702	701	705	707	710	714	713	727	717	729	766	840	820	668	553	476
CO_2	Residential (1A4b)	[ktonne]	114	114	113	113	113	113	113	114	115	116	118	120	122	124	127	129
CO_2	Ag./for./fish. (1A4c)	[ktonne]	1806	1922	1758	1887	1874	1899	1903	1794	1760	1695	1728	1642	1554	1510	1564	1615
CO_2	Military (1A5)	[ktonne]	402	316	361	196	165	119	287	141	237	252	252	176	171	204	182	111
CO_2	Navigation int. (1A3d)	[ktonne]	1320	1537	2261	2869	2936	3087	2762	2887	4300	4829	5061	4803	4403	4414	4155	4279
CO_2	Civil Aviation int. (1A3a)	[ktonne]	1391	1503	1613	1725	1809	1736	1632	1693	1659	1818	1867	1971	2010	2159	2290	2350
N_2O	Industry-Other (1A2f)	[tonne]	34	34	34	34	34	34	34	35	35	35	35	36	36	36	37	37
N_2O	Civil Aviation (1A3a)	[tonne]	10	10	11	11	11	10	9	9	9	9	10	11	11	9	9	8
N_2O	Road (1A3b)	[tonne]	275	289	289	293	295	312	335	352	365	398	414	430	443	447	450	444
N_2O	Railways (1A3c)	[tonne]	10	10	9	9	9	8	8	9	9	8	8	8	8	7	6	6
N_2O	Navigation (1A3d)	[tonne]	43	43	43	43	43	43	43	44	43	44	46	51	49	40	32	27
N_2O	Residential (1A4b)	[tonne]	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
N_2O	Ag./for./fish. (1A4c)	[tonne]	81	87	78	85	85	87	88	83	81	79	81	77	71	70	74	78
N_2O	Military (1A5)	[tonne]	12	10	11	6	5	4	8	4	7	8	7	5	5	6	6	3
N_2O	Navigation int. (1A3d)	[tonne]	83	97	142	180	185	194	174	182	270	304	318	302	277	278	262	269
N_2O	Civil Aviation int. (1A3a)	[tonne]	47	50	54	58	61	59	56	58	57	63	64	69	70	75	80	82
NH_3	Industry-Other (1A2f)	[tonne]	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
NH_3	Civil Aviation (1A3a)	[tonne]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NH_3	Road (1A3b)	[tonne]	62	64	64	66	66	70	248	441	623	946	1198	1428	1862	2226	2492	2657
NH_3	Railways (1A3c)	[tonne]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NH_3	Navigation (1A3d)	[tonne]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NH_3	Residential (1A4b)	[tonne]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NH_3	Ag./for./fish. (1A4c)	[tonne]	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
NH_3	Military (1A5)	[tonne]	1	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0
NH_3	Navigation int. (1A3d)	[tonne]		0						0	0							
NH_3	Civil Aviation int. (1A3a)	[tonne]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TSP	Industry-Other (1A2f)	[tonne]	1823	1778	1733	1686	1634	1577	1533	1484	1433	1383	1349	1317	1284	1249	1193	1135
TSP	Civil Aviation (1A3a)	[tonne]	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	3
TSP	Road (1A3b)	[tonne]	4431	4764	4781	4722	4796	5053	5179	5026	5041	5161	4914	4803	4432	4179	3974	3718
TSP	Railways (1A3c)	[tonne]	247	249	222	229	211	202	205	217	225	204	206	204	199	168	146	141

Continued

TSP	Navigation (1A3d)	[tonne]	948	948	953	948	953	781	612	451	561	646	773	613	546	378	337	307
TSP	Residential (1A4b)	[tonne]	37	36	36	36	36	35	35	34	33	34	35	36	38	39	40	41
TSP	Ag./for./fish. (1A4c)	[tonne]	2783	2820	2673	2723	2665	2628	2534	2362	2300	2119	2087	1892	1783	1633	1576	1507
TSP	Military (1A5)	[tonne]	103	103	51	18	26	12	116	69	66	57	120	48	77	84	52	19
TSP	Navigation int. (1A3d)	[tonne]	3047	3663	6129	8024	8081	5677	4512	4139	8822	8348	10262	10169	9437	7917	8390	8994
TSP	Civil Aviation int. (1A3a)	[tonne]	23	24	26	28	30	28	27	28	27	29	30	32	32	35	37	38
PM_{10}	Industry-Other (1A2f)	[tonne]	1823	1778	1733	1686	1634	1577	1533	1484	1433	1383	1349	1317	1284	1249	1193	1135
PM_{10}	Civil Aviation (1A3a)	[tonne]	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	3
PM_{10}	Road (1A3b)	[tonne]	4431	4764	4781	4722	4796	5053	5179	5026	5041	5161	4914	4803	4432	4179	3974	3718
PM_{10}	Railways (1A3c)	[tonne]	247	249	222	229	211	202	205	217	225	204	206	204	199	168	146	141
PM_{10}	Navigation (1A3d)	[tonne]	940	939	944	939	944	774	607	447	556	641	767	608	542	376	335	306
PM_{10}	Residential (1A4b)	[tonne]	37	36	36	36	36	35	35	34	33	34	35	36	38	39	40	41
PM_{10}	Ag./for./fish. (1A4c)	[tonne]	2781	2818	2671	2721	2663	2626	2532	2360	2298	2117	2086	1891	1782	1632	1575	1505
PM_{10}	Military (1A5)	[tonne]	103	103	51	18	26	12	116	69	66	57	120	48	77	84	52	19
PM_{10}	Navigation int. (1A3d)	[tonne]	3016	3626	6068	7944	8000	5620	4467	4098	8734	8264	10160	10068	9342	7838	8306	8904
PM_{10}	Civil Aviation int. (1A3a)	[tonne]	23	24	26	28	30	28	27	28	27	29	30	32	32	35	37	38
$PM_{2.5}$	Industry-Other (1A2f)	[tonne]	1823	1778	1733	1686	1634	1577	1533	1484	1433	1383	1349	1317	1284	1249	1193	1135
$PM_{2.5}$	Civil Aviation (1A3a)	[tonne]	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	3
$PM_{2.5}$	Road (1A3b)	[tonne]	4431	4764	4781	4722	4796	5053	5179	5026	5041	5161	4914	4803	4432	4179	3974	3718
$PM_{2.5}$	Railways (1A3c)	[tonne]	247	249	222	229	211	202	205	217	225	204	206	204	199	168	146	141
$PM_{2.5}$	Navigation (1A3d)	[tonne]	935	935	939	935	940	771	604	446	554	638	764	606	540	375	334	305
$PM_{2.5}$	Residential (1A4b)	[tonne]	37	36	36	36	36	35	35	34	33	34	35	36	38	39	40	41
$PM_{2.5}$	Ag./for./fish. (1A4c)	[tonne]	2780	2817	2670	2720	2662	2625	2531	2359	2297	2116	2085	1890	1781	1631	1574	1504
$PM_{2.5}$	Military (1A5)	[tonne]	103	103	51	18	26	12	116	69	66	57	120	48	77	84	52	19
$PM_{2.5}$	Navigation int. (1A3d)	[tonne]	3001	3608	6037	7904	7959	5592	4445	4077	8690	8223	10108	10017	9295	7799	8264	8859
$PM_{2.5}$	Civil Aviation int. (1A3a)	[tonne]	23	24	26	28	30	28	27	28	27	29	30	32	32	35	37	38
Arsenic	Civil Aviation (1A3a)	[kg]															0	0
Arsenic	Navigation (1A3d)	[kg]						53	46	38	38	39	40	35	26	19	15	14
Arsenic	Ag./for./fish. (1A4c)	[kg]						9	10	9	8	8	8	8	6	7	7	9
Arsenic	Military (1A5)	[kg]										0					0	0
Arsenic	Navigation int. (1A3d)	[kg]						363	302	276	475	505	514	332	426	366	379	432
Arsenic	Civil Aviation int. (1A3a)	[kg]															0	0
Cadmium	Industry-Other (1A2f)	[kg]						2	2	2	2	2	2	2	2	3	2	3
Cadmium	Civil Aviation (1A3a)	[kg]						1	1	1	1	1	1	1	1	1	1	0
Cadmium	Road (1A3b)	[kg]						29	30	31	31	33	33	34	34	35	36	35
Cadmium	Railways (1A3c)	[kg]						1	1	1	1	1	1	1	1	1	1	1
Cadmium	Navigation (1A3d)	[kg]						4	4	4	3	4	4	4	3	3	2	2
Cadmium	Residential (1A4b)	[kg]						0	0	0	0	0	0	0	0	0	0	0
Cadmium	Ag./for./fish. (1A4c)	[kg]						6	6	6	6	5	5	5	5	5	5	5
Cadmium	Military (1A5)	[kg]						0	1	0	1	1	1	1	1	1	1	0
Cadmium	Navigation int. (1A3d)	[kg]						24	20	19	32	34	35	20	30	27	27	29
Cadmium	Civil Aviation int. (1A3a)	[kg]						6	5	5	5	6	6	6	6	7	7	8
Chromium	Industry-Other (1A2f)	[kg]						12	12	12	12	12	12	12	12	13	13	13

Continued

Chromium	Civil Aviation (1A3a)	[kg]	4	3	3	3	3	3	3	3	3	3	2
Chromium	Road (1A3b)	[kg]	146	152	155	157	165	166	169	173	176	178	176
Chromium	Railways (1A3c)	[kg]	5	5	5	5	5	5	5	5	4	4	4
Chromium	Navigation (1A3d)	[kg]	24	22	19	19	20	20	19	16	12	10	9
Chromium	Residential (1A4b)	[kg]	2	2	2	2	2	2	2	2	2	2	2
Chromium	Ag./for./fish. (1A4c)	[kg]	28	28	27	26	25	26	24	23	23	23	24
Chromium	Military (1A5)	[kg]	2	5	2	4	4	4	3	3	3	3	2
Chromium	Navigation int. (1A3d)	[kg]	150	127	118	199	213	218	133	182	161	164	184
Chromium	Civil Aviation int. (1A3a)	[kg]	28	26	27	26	29	30	31	32	34	36	37
Copper	Industry-Other (1A2f)	[kg]	411	413	413	413	414	418	421	425	429	432	435
Copper	Civil Aviation (1A3a)	[kg]	131	107	104	102	106	107	110	114	104	94	83
Copper	Road (1A3b)	[kg]	4965	5184	5273	5337	5605	5657	5754	5867	5968	6047	5989
Copper	Railways (1A3c)	[kg]	160	162	172	178	162	163	162	157	133	125	123
Copper	Navigation (1A3d)	[kg]	78	73	67	69	73	76	73	66	61	60	60
Copper	Residential (1A4b)	[kg]	60	60	61	61	62	63	64	65	66	67	69
Copper	Ag./for./fish. (1A4c)	[kg]	713	706	674	672	636	653	623	630	597	594	581
Copper	Military (1A5)	[kg]	64	154	76	128	136	136	95	92	110	98	60
Copper	Navigation int. (1A3d)	[kg]	363	302	276	475	505	514	332	426	366	379	432
Copper	Civil Aviation int. (1A3a)	[kg]	936	880	913	894	980	1006	1063	1084	1164	1234	1267
Mercury	Civil Aviation (1A3a)	[kg]										0	0
Mercury	Navigation (1A3d)	[kg]	8	8	9	9	9	9	11	11	9	7	6
Mercury	Ag./for./fish. (1A4c)	[kg]	9	10	9	8	8	8	8	6	7	7	9
Mercury	Military (1A5)	[kg]					0					0	0
Mercury	Navigation int. (1A3d)	[kg]	28	26	30	40	47	51	14	46	50	44	43
Mercury	Civil Aviation int. (1A3a)	[kg]										0	0
Nickel	Industry-Other (1A2f)	[kg]	17	17	17	17	17	17	17	17	18	18	18
Nickel	Civil Aviation (1A3a)	[kg]	5	4	4	4	4	4	5	5	4	4	3
Nickel	Road (1A3b)	[kg]	204	213	217	220	231	233	237	242	246	249	247
Nickel	Railways (1A3c)	[kg]	7	7	7	7	7	7	7	6	5	5	5
Nickel	Navigation (1A3d)	[kg]	2828	2355	1826	1825	1943	1958	1553	987	645	543	534
Nickel	Residential (1A4b)	[kg]	2	2	2	3	3	3	3	3	3	3	3
Nickel	Ag./for./fish. (1A4c)	[kg]	42	42	40	39	37	38	36	34	33	35	36
Nickel	Military (1A5)	[kg]	3	6	3	5	6	6	4	4	5	4	2
Nickel	Navigation int. (1A3d)	[kg]	20956	17236	15429	27162	28664	29023	19856	23826	19820	20967	24364
Nickel	Civil Aviation int. (1A3a)	[kg]	39	36	38	37	40	41	44	45	48	51	52
Lead	Industry-Other (1A2f)	[kg]	258	187	160	67	12	12	12	0	0	0	0
Lead	Civil Aviation (1A3a)	[kg]	1534	1423	1378	1328	1639	1788	1640	1559	1399	1387	1369
Lead	Road (1A3b)	[kg]	97510	75857	68775	29818	54	55	55	57	58	58	57
Lead	Railways (1A3c)	[kg]	0	0	0	0		0	0	0	0	0	0
Lead	Navigation (1A3d)	[kg]	485	371	331	159	51	53	55	27	21	17	14
Lead	Residential (1A4b)	[kg]	2273	1666	1442	612	109	110	112	1	1	1	1
Lead	Ag./for./fish. (1A4c)	[kg]	1564	1069	859	346	71	67	63	13	13	15	18
Lead	Military (1A5)	[kg]	64	80	62	120	86	102	98	123	116	78	114

Continued													
Lead	Navigation int. (1A3d)	[kg]	167	144	142	226	247	256	134	218	205	201	216
Lead	Civil Aviation int. (1A3a)	[kg]	490	465	452	456	153	175	126	145	145	124	118
Selenium	Industry-Other (1A2f)	[kg]	2	2	2	2	2	2	2	2	3	2	3
Selenium	Civil Aviation (1A3a)	[kg]	1	1	1	1	1	1	1	1	1	1	0
Selenium	Road (1A3b)	[kg]	29	30	31	31	33	33	34	34	35	36	35
Selenium	Railways (1A3c)	[kg]	1	1	1	1	1	1	1	1	1	1	1
Selenium	Navigation (1A3d)	[kg]	61	58	55	54	55	57	59	54	42	34	28
Selenium	Residential (1A4b)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Selenium	Ag./for./fish. (1A4c)	[kg]	41	42	39	37	37	37	35	29	30	33	38
Selenium	Military (1A5)	[kg]	0	1	0	1	1	1	1	1	1	1	0
Selenium	Navigation int. (1A3d)	[kg]	334	289	284	451	495	512	269	436	410	401	431
Selenium	Civil Aviation int. (1A3a)	[kg]	6	5	5	5	6	6	6	6	7	7	8
Zinc	Industry-Other (1A2f)	[kg]	242	243	243	243	243	246	248	250	252	254	256
Zinc	Civil Aviation (1A3a)	[kg]	77	63	61	60	62	63	65	67	61	55	49
Zinc	Road (1A3b)	[kg]	2921	3050	3102	3140	3297	3328	3384	3451	3511	3557	3523
Zinc	Railways (1A3c)	[kg]	94	95	101	105	95	96	95	93	78	73	72
Zinc	Navigation (1A3d)	[kg]	158	152	147	146	151	157	164	154	126	107	96
Zinc	Residential (1A4b)	[kg]	35	35	36	36	36	37	37	38	39	40	40
Zinc	Ag./for./fish. (1A4c)	[kg]	506	505	479	474	453	463	441	429	412	420	423
Zinc	Military (1A5)	[kg]	38	91	45	75	80	80	56	54	65	58	35
Zinc	Navigation int. (1A3d)	[kg]	764	664	660	1038	1141	1183	607	1010	959	933	997
Zinc	Civil Aviation int. (1A3a)	[kg]	551	518	537	526	576	592	625	638	685	726	745
Dioxins/furans	Industry-Other (1A2f)	[g]	0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Civil Aviation (1A3a)	[g]	0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Road (1A3b)	[g]	1	1	1	1	1	1	1	1	0	0	0
Dioxins/furans	Railways (1A3c)	[g]	0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Navigation (1A3d)	[g]	0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Residential (1A4b)	[g]	0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Ag./for./fish. (1A4c)	[g]	0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Military (1A5)	[g]	0	0	0	0	0	0	0	0	0	0	0
Dioxins/furans	Navigation int. (1A3d)	[g]	1	0	0	1	1	1	1	1	1	1	1
Dioxins/furans	Civil Aviation int. (1A3a)	[g]	0	0	0	0	0	0	0	0	0	0	0
Flouranthene	Industry-Other (1A2f)	[kg]	45	44	45	46	45	46	46	46	46	46	48
Flouranthene	Civil Aviation (1A3a)	[kg]	0	0	0	0	1	1	1	0	0	0	0
Flouranthene	Road (1A3b)	[kg]	789	795	789	772	757	718	683	650	621	599	582
Flouranthene	Railways (1A3c)	[kg]	5	5	6	6	6	6	6	6	5	4	4
Flouranthene	Navigation (1A3d)	[kg]	59	61	64	63	64	67	76	76	61	50	42
Flouranthene	Residential (1A4b)	[kg]	7	7	7	7	7	7	7	7	7	8	8
Flouranthene	Ag./for./fish. (1A4c)	[kg]	136	135	128	127	121	124	117	107	104	110	118
Flouranthene	Military (1A5)	[kg]	1	7	4	4	3	8	3	6	6	4	2
Flouranthene	Navigation int. (1A3d)	[kg]	204	190	212	294	340	361	349	322	343	311	306
Flouranthene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(b) flouranthene	Industry-Other (1A2f)	[kg]	6	6	6	6	6	6	6	6	6	6	6

Continued													
Benzo(b) flouranthene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(b) flouranthene	Road (1A3b)	[kg]	65	66	66	65	66	65	64	62	61	61	59
Benzo(b) flouranthene	Railways (1A3c)	[kg]	1	1	1	2	1	1	1	1	1	1	1
Benzo(b) flouranthene	Navigation (1A3d)	[kg]	4	5	5	5	5	5	6	6	5	4	4
Benzo(b) flouranthene	Residential (1A4b)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(b) flouranthene	Ag./for./fish. (1A4c)	[kg]	15	15	14	14	13	13	13	12	11	12	12
Benzo(b) flouranthene	Military (1A5)	[kg]	0	1	1	1	0	1	0	1	1	1	0
Benzo(b) flouranthene	Navigation int. (1A3d)	[kg]	13	13	15	20	23	25	25	23	25	22	21
Benzo(b) flouranthene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Industry-Other (1A2f)	[kg]	6	6	6	6	6	6	6	6	6	6	6
Benzo(k) flouranthene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Road (1A3b)	[kg]	65	67	67	66	69	69	69	69	69	69	68
Benzo(k) flouranthene	Railways (1A3c)	[kg]	2	2	2	2	2	2	2	2	1	1	1
Benzo(k) flouranthene	Navigation (1A3d)	[kg]	2	2	2	2	2	2	3	3	3	2	2
Benzo(k) flouranthene	Residential (1A4b)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Ag./for./fish. (1A4c)	[kg]	12	12	11	11	11	11	10	10	9	9	9
Benzo(k) flouranthene	Military (1A5)	[kg]	0	1	1	1	0	1	0	1	1	1	0
Benzo(k) flouranthene	Navigation int. (1A3d)	[kg]	6	6	7	9	11	12	11	11	12	10	10
Benzo(k) flouranthene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Industry-Other (1A2f)	[kg]	3	3	3	3	3	3	3	3	3	3	3
Benzo(a) pyrene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Road (1A3b)	[kg]	45	46	46	46	47	45	44	44	43	43	42
Benzo(a) pyrene	Railways (1A3c)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Navigation (1A3d)	[kg]	1	1	1	1	1	1	1	2	1	1	1
Benzo(a) pyrene	Residential (1A4b)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Ag./for./fish. (1A4c)	[kg]	6	6	6	6	5	5	5	5	5	5	5
Benzo(a) pyrene	Military (1A5)	[kg]	0	0	0	0	0	1	0	0	0	0	0
Benzo(a) pyrene	Navigation int. (1A3d)	[kg]	4	4	4	5	6	7	7	6	7	6	6
Benzo(a) pyrene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Industry-Other (1A2f)	[kg]	6	6	6	6	5	6	5	5	5	5	5
Benzo(g,h,i) perylene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Road (1A3b)	[kg]	95	97	98	97	97	93	90	88	86	84	82
Benzo(g,h,i) perylene	Railways (1A3c)	[kg]	0	0	0	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Navigation (1A3d)	[kg]	8	9	10	10	10	10	12	13	11	9	7
Benzo(g,h,i) perylene	Residential (1A4b)	[kg]	1	1	1	1	1	1	1	1	1	1	1
Benzo(g,h,i) perylene	Ag./for./fish. (1A4c)	[kg]	21	21	20	19	19	19	18	16	15	16	18
Benzo(g,h,i) perylene	Military (1A5)	[kg]	0	1	1	1	0	1	0	1	1	0	0
Benzo(g,h,i) perylene	Navigation int. (1A3d)	[kg]	24	24	30	37	45	49	48	45	52	45	41
Benzo(g,h,i) perylene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Industry-Other (1A2f)	[kg]	3	3	3	3	3	3	3	3	3	3	3
indeno(1,2,3-c,d) pyrene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Road (1A3b)	[kg]	43	45	45	46	47	47	46	47	47	47	47
indeno(1,2,3-c,d) pyrene	Railways (1A3c)	[kg]	0	0	0	0	0	0	0	0	0	0	0

Continued

indeno(1,2,3-c,d) pyrene	Navigation (1A3d)	[kg]						6	7	8	8	8	8	10	11	9	7	6
indeno(1,2,3-c,d) pyrene	Residential (1A4b)	[kg]						0	0	0	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Ag./for./fish. (1A4c)	[kg]						14	15	14	13	13	13	12	11	11	11	13
indeno(1,2,3-c,d) pyrene	Military (1A5)	[kg]						0	0	0	0	0	1	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Navigation int. (1A3d)	[kg]						19	20	24	30	36	39	39	36	42	36	34
indeno(1,2,3-c,d) pyrene	Civil Aviation int. (1A3a)	[kg]						0	0	0	0	0	0	0	0	0	0	0

pol_name	IPCC ID	Unit	2000	2001	2002	2003	2004	2005	2006	2007
SO_2	Industry-Other (1A2f)	[tonnes]	253	256	258	261	263	28	30	32
SO_2	Civil Aviation (1A3a)	[tonnes]	49	52	45	44	40	43	45	34
SO_2	Road (1A3b)	[tonnes]	352	353	357	371	381	77	79	83
SO_2	Railways (1A3c)	[tonnes]	7	7	7	7	7	1	1	1
SO_2	Navigation (1A3d)	[tonnes]	1129	1039	963	995	1150	1157	1086	838
SO_2	Residential (1A4b)	[tonnes]	4	4	5	6	6	1	1	1
SO_2	Ag./for./fish. (1A4c)	[tonnes]	1021	986	1041	997	851	637	585	518
SO_2	Military (1A5)	[tonnes]	27	12	19	17	46	57	26	40
SO_2	Navigation int. (1A3d)	[tonnes]	56634	45358	31538	33060	28581	36544	52936	26876
SO_2	Civil Aviation int. (1A3a)	[tonnes]	750	761	658	684	782	822	825	863
NO_x	Industry-Other (1A2f)	[tonnes]	12096	11869	11617	11214	10744	10664	10807	10654
NO_x	Civil Aviation (1A3a)	[tonnes]	723	747	636	590	546	579	596	498
NO_x	Road (1A3b)	[tonnes]	80883	77956	74180	73769	71699	67903	66049	64485
NO_x	Railways (1A3c)	[tonnes]	3727	3396	3396	3540	3478	3724	3542	3555
NO_x	Navigation (1A3d)	[tonnes]	5830	5741	5900	5827	5939	6026	5997	5929
NO_x	Residential (1A4b)	[tonnes]	153	167	183	202	223	249	275	288
NO_x	Ag./for./fish. (1A4c)	[tonnes]	22807	22699	23269	22322	19933	20776	19532	18180
NO_x	Military (1A5)	[tonnes]	550	712	483	539	1310	1327	613	771
NO_x	Navigation int. (1A3d)	[tonnes]	96911	81585	66095	71376	58906	62825	84716	89720
NO_x	Civil Aviation int. (1A3a)	[tonnes]	9446	9610	8737	9097	10481	11037	11175	11606
NMVOC	Industry-Other (1A2f)	[tonnes]	1926	1873	1815	1754	1676	1620	1583	1497
NMVOC	Civil Aviation (1A3a)	[tonnes]	156	155	151	143	157	165	155	153
NMVOC	Road (1A3b)	[tonnes]	41578	37826	34282	31847	28129	25914	22972	20364
NMVOC	Railways (1A3c)	[tonnes]	253	248	243	223	217	235	230	231
NMVOC	Navigation (1A3d)	[tonnes]	1652	1614	1575	1513	1446	1334	1206	1087
NMVOC	Residential (1A4b)	[tonnes]	4602	5328	6082	6869	7685	7859	8037	8101
NMVOC	Ag./for./fish. (1A4c)	[tonnes]	3414	3246	3079	2858	2586	2568	2513	2407
NMVOC	Military (1A5)	[tonnes]	58	60	48	50	110	115	55	73
NMVOC	Navigation int. (1A3d)	[tonnes]	3126	2651	2190	2334	1914	2005	2643	2767
NMVOC	Civil Aviation int. (1A3a)	[tonnes]	407	406	391	399	451	469	492	516
CH_4	Industry-Other (1A2f)	[tonnes]	50	49	48	47	46	45	44	43
CH_4	Civil Aviation (1A3a)	[tonnes]	5	5	5	5	6	7	6	5
CH_4	Road (1A3b)	[tonnes]	1861	1739	1635	1571	1479	1373	1275	1185

Continued										
CH_4	Railways (1A3c)	[tonnes]	10	10	9	9	8	9	9	9
CH_4	Navigation (1A3d)	[tonnes]	30	31	31	32	32	32	32	32
CH_4	Residential (1A4b)	[tonnes]	137	149	164	183	204	219	233	235
CH_4	Ag./for./fish. (1A4c)	[tonnes]	88	86	86	85	82	86	93	91
CH_4	Military (1A5)	[tonnes]	6	7	5	5	13	13	6	8
CH_4	Navigation int. (1A3d)	[tonnes]	97	82	68	72	59	62	82	86
CH_4	Civil Aviation int. (1A3a)	[tonnes]	42	42	41	42	47	49	52	55
CO	Industry-Other (1A2f)	[tonnes]	8395	8227	8030	7842	7600	7497	7515	7378
CO	Civil Aviation (1A3a)	[tonnes]	895	888	860	832	855	858	838	870
CO	Road (1A3b)	[tonnes]	267306	256933	235560	225422	200557	191988	170635	155084
CO	Railways (1A3c)	[tonnes]	694	637	627	611	599	648	626	629
CO	Navigation (1A3d)	[tonnes]	6572	6742	6934	7116	7312	7339	6955	6573
CO	Residential (1A4b)	[tonnes]	45873	50280	56144	63688	72683	80610	87744	89398
CO	Ag./for./fish. (1A4c)	[tonnes]	25842	24006	22167	20229	18183	17153	16884	16677
CO	Military (1A5)	[tonnes]	407	327	321	315	734	823	390	546
CO	Navigation int. (1A3d)	[tonnes]	10313	8745	7225	7701	6316	6615	8719	9129
CO	Civil Aviation int. (1A3a)	[tonnes]	1790	1797	1610	1670	1845	1914	1871	1964
CO_2	Industry-Other (1A2f)	[ktonnes]	879	888	897	907	912	950	1021	1088
CO_2	Civil Aviation (1A3a)	[ktonnes]	154	161	140	137	127	133	141	107
CO_2	Road (1A3b)	[ktonnes]	11202	11223	11352	11806	12115	12214	12589	13198
CO_2	Railways (1A3c)	[ktonnes]	228	211	210	218	216	232	227	228
CO_2	Navigation (1A3d)	[ktonnes]	476	461	457	461	475	471	461	454
CO_2	Residential (1A4b)	[ktonnes]	129	143	161	182	205	220	233	232
CO_2	Ag./for./fish. (1A4c)	[ktonnes]	1615	1592	1636	1602	1498	1577	1563	1565
CO_2	Military (1A5)	[ktonnes]	111	97	89	92	239	271	126	175
CO_2	Navigation int. (1A3d)	[ktonnes]	4279	3605	2966	3130	2545	2636	3433	3559
CO_2	Civil Aviation int. (1A3a)	[ktonnes]	2350	2385	2059	2142	2449	2575	2583	2701
N_2O	Industry-Other (1A2f)	[tonnes]	37	38	38	38	39	40	43	46
N_2O	Civil Aviation (1A3a)	[tonnes]	8	8	8	8	8	8	8	7
N_2O	Road (1A3b)	[tonnes]	444	429	421	420	421	406	402	409
N_2O	Railways (1A3c)	[tonnes]	6	6	6	6	6	6	6	6
N_2O	Navigation (1A3d)	[tonnes]	27	26	26	26	27	27	26	26
N_2O	Residential (1A4b)	[tonnes]	2	2	2	3	3	3	4	4
N_2O	Ag./for./fish. (1A4c)	[tonnes]	78	77	80	78	71	76	75	74
N_2O	Military (1A5)	[tonnes]	3	3	3	3	8	9	4	6
N_2O	Navigation int. (1A3d)	[tonnes]	269	227	187	197	160	166	216	224
N_2O	Civil Aviation int. (1A3a)	[tonnes]	82	82	72	75	85	89	89	93
NH_3	Industry-Other (1A2f)	[tonnes]	2	2	2	2	2	2	2	3
NH_3	Civil Aviation (1A3a)	[tonnes]	0	0	0	0	0	0	0	0
NH_3	Road (1A3b)	[tonnes]	2657	2536	2472	2376	2281	2123	1954	1791
NH_3	Railways (1A3c)	[tonnes]	1	1	1	1	1	1	1	1
NH_3	Navigation (1A3d)	[tonnes]	0	0	0	0	0	0	0	0
NH_3	Residential (1A4b)	[tonnes]	0	0	0	0	0	0	0	0

Continued										
NH_3	Ag./for./fish. (1A4c)	[tonnes]	3	3	3	3	3	3	3	3
NH_3	Military (1A5)	[tonnes]	0	0	0	0	1	1	0	0
NH_3	Navigation int. (1A3d)	[tonnes]								
NH_3	Civil Aviation int. (1A3a)	[tonnes]	0	0	0	0	0	0	0	0
TSP	Industry-Other (1A2f)	[tonnes]	1135	1121	1098	1075	1037	1002	991	937
TSP	Civil Aviation (1A3a)	[tonnes]	3	3	3	3	3	3	3	3
TSP	Road (1A3b)	[tonnes]	3718	3579	3342	3367	3158	3125	3072	2957
TSP	Railways (1A3c)	[tonnes]	141	125	124	119	115	124	120	120
TSP	Navigation (1A3d)	[tonnes]	307	298	290	295	315	309	292	257
TSP	Residential (1A4b)	[tonnes]	41	50	58	67	76	78	79	80
TSP	Ag./for./fish. (1A4c)	[tonnes]	1507	1440	1374	1291	1191	1146	1074	1015
TSP	Military (1A5)	[tonnes]	19	41	19	24	51	45	20	20
TSP	Navigation int. (1A3d)	[tonnes]	8994	7414	5254	4816	4293	6155	8300	2504
TSP	Civil Aviation int. (1A3a)	[tonnes]	38	38	33	35	40	42	42	44
PM_{10}	Industry-Other (1A2f)	[tonnes]	1135	1121	1098	1075	1037	1002	991	937
PM_{10}	Civil Aviation (1A3a)	[tonnes]	3	3	3	3	3	3	3	3
PM_{10}	Road (1A3b)	[tonnes]	3718	3579	3342	3367	3158	3125	3072	2957
PM_{10}	Railways (1A3c)	[tonnes]	141	125	124	119	115	124	120	120
PM_{10}	Navigation (1A3d)	[tonnes]	306	296	289	294	314	307	290	256
PM_{10}	Residential (1A4b)	[tonnes]	41	50	58	67	76	78	79	80
PM_{10}	Ag./for./fish. (1A4c)	[tonnes]	1505	1439	1372	1290	1190	1145	1073	1014
PM_{10}	Military (1A5)	[tonnes]	19	41	19	24	51	45	20	20
PM_{10}	Navigation int. (1A3d)	[tonnes]	8904	7340	5201	4767	4250	6094	8217	2479
PM_{10}	Civil Aviation int. (1A3a)	[tonnes]	38	38	33	35	40	42	42	44
$PM_{2.5}$	Industry-Other (1A2f)	[tonnes]	1135	1121	1098	1075	1037	1002	991	937
$PM_{2.5}$	Civil Aviation (1A3a)	[tonnes]	3	3	3	3	3	3	3	3
$PM_{2.5}$	Road (1A3b)	[tonnes]	3718	3579	3342	3367	3158	3125	3072	2957
$PM_{2.5}$	Railways (1A3c)	[tonnes]	141	125	124	119	115	124	120	120
$PM_{2.5}$	Navigation (1A3d)	[tonnes]	305	295	288	293	313	307	289	255
$PM_{2.5}$	Residential (1A4b)	[tonnes]	41	50	58	67	76	78	79	80
$PM_{2.5}$	Ag./for./fish. (1A4c)	[tonnes]	1504	1438	1372	1289	1189	1144	1072	1013
$PM_{2.5}$	Military (1A5)	[tonnes]	19	41	19	24	51	45	20	20
$PM_{2.5}$	Navigation int. (1A3d)	[tonnes]	8859	7303	5175	4743	4229	6063	8175	2466
$PM_{2.5}$	Civil Aviation int. (1A3a)	[tonnes]	38	38	33	35	40	42	42	44
Arsenic	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Arsenic	Navigation (1A3d)	[kg]	14	13	13	13	13	13	13	12
Arsenic	Ag./for./fish. (1A4c)	[kg]	9	8	9	8	6	8	7	6
Arsenic	Military (1A5)	[kg]	0	0	0	0	0	0	0	0
Arsenic	Navigation int. (1A3d)	[kg]	432	342	240	274	230	268	401	443
Arsenic	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Cadmium	Industry-Other (1A2f)	[kg]	3	3	3	3	3	3	3	3
Cadmium	Civil Aviation (1A3a)	[kg]	0	1	0	0	0	0	0	0
Cadmium	Road (1A3b)	[kg]	35	35	36	37	38	38	40	42

Continued										
Cadmium	Railways (1A3c)	[kg]	1	1	1	1	1	1	1	1
Cadmium	Navigation (1A3d)	[kg]	2	2	2	2	2	2	2	2
Cadmium	Residential (1A4b)	[kg]	0	0	1	1	1	1	1	1
Cadmium	Ag./for./fish. (1A4c)	[kg]	5	5	5	5	5	5	5	5
Cadmium	Military (1A5)	[kg]	0	0	0	0	1	1	0	1
Cadmium	Navigation int. (1A3d)	[kg]	29	24	18	20	16	18	26	28
Cadmium	Civil Aviation int. (1A3a)	[kg]	8	8	7	7	8	8	8	9
Chromium	Industry-Other (1A2f)	[kg]	13	13	13	13	13	14	15	16
Chromium	Civil Aviation (1A3a)	[kg]	2	3	2	2	2	2	2	2
Chromium	Road (1A3b)	[kg]	176	176	179	186	191	192	198	208
Chromium	Railways (1A3c)	[kg]	4	3	3	3	3	4	4	4
Chromium	Navigation (1A3d)	[kg]	9	9	9	9	9	9	9	8
Chromium	Residential (1A4b)	[kg]	2	2	3	3	3	3	4	4
Chromium	Ag./for./fish. (1A4c)	[kg]	24	24	24	24	22	23	23	24
Chromium	Military (1A5)	[kg]	2	2	1	1	4	4	2	3
Chromium	Navigation int. (1A3d)	[kg]	184	147	106	120	100	114	167	183
Chromium	Civil Aviation int. (1A3a)	[kg]	37	38	33	34	39	41	41	43
Copper	Industry-Other (1A2f)	[kg]	435	440	445	450	454	474	513	549
Copper	Civil Aviation (1A3a)	[kg]	83	87	75	74	68	72	76	57
Copper	Road (1A3b)	[kg]	5989	6001	6072	6314	6481	6535	6744	7075
Copper	Railways (1A3c)	[kg]	123	114	113	117	116	125	122	122
Copper	Navigation (1A3d)	[kg]	60	62	64	66	69	68	67	67
Copper	Residential (1A4b)	[kg]	69	76	86	96	109	117	124	123
Copper	Ag./for./fish. (1A4c)	[kg]	581	584	586	586	593	599	613	642
Copper	Military (1A5)	[kg]	60	52	48	50	129	146	68	94
Copper	Navigation int. (1A3d)	[kg]	432	342	240	274	230	268	401	443
Copper	Civil Aviation int. (1A3a)	[kg]	1267	1286	1110	1155	1320	1388	1392	1456
Mercury	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Mercury	Navigation (1A3d)	[kg]	6	5	5	5	5	5	5	5
Mercury	Ag./for./fish. (1A4c)	[kg]	9	8	9	8	6	8	7	6
Mercury	Military (1A5)	[kg]	0	0	0	0	0	0	0	0
Mercury	Navigation int. (1A3d)	[kg]	43	38	34	34	27	26	31	30
Mercury	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Nickel	Industry-Other (1A2f)	[kg]	18	18	18	19	19	20	21	23
Nickel	Civil Aviation (1A3a)	[kg]	3	4	3	3	3	3	3	2
Nickel	Road (1A3b)	[kg]	247	247	250	260	267	269	278	291
Nickel	Railways (1A3c)	[kg]	5	5	5	5	5	5	5	5
Nickel	Navigation (1A3d)	[kg]	534	501	492	484	503	508	474	456
Nickel	Residential (1A4b)	[kg]	3	3	4	4	4	5	5	5
Nickel	Ag./for./fish. (1A4c)	[kg]	36	35	36	35	33	35	35	35
Nickel	Military (1A5)	[kg]	2	2	2	2	5	6	3	4
Nickel	Navigation int. (1A3d)	[kg]	24364	19050	12906	15043	12715	15126	23174	25869
Nickel	Civil Aviation int. (1A3a)	[kg]	52	53	46	48	54	57	57	60

Continued

Lead	Industry-Other (1A2f)	[kg]	0	0	0	0	0	0	0	0
Lead	Civil Aviation (1A3a)	[kg]	1369	1343	1328	1252	1304	1297	1245	1329
Lead	Road (1A3b)	[kg]	57	56	56	56	55	53	52	52
Lead	Railways (1A3c)	[kg]	0	0	0					
Lead	Navigation (1A3d)	[kg]	14	14	13	13	14	14	13	13
Lead	Residential (1A4b)	[kg]	1	1	2	2	2	2	2	2
Lead	Ag./for./fish. (1A4c)	[kg]	18	17	18	17	13	15	14	12
Lead	Military (1A5)	[kg]	114	88	106	78	82	59	47	81
Lead	Navigation int. (1A3d)	[kg]	216	177	136	149	122	133	185	198
Lead	Civil Aviation int. (1A3a)	[kg]	118	114	113	106	111	117	22	10
Selenium	Industry-Other (1A2f)	[kg]	3	3	3	3	3	3	3	3
Selenium	Civil Aviation (1A3a)	[kg]	0	1	0	0	0	0	0	0
Selenium	Road (1A3b)	[kg]	35	35	36	37	38	38	40	42
Selenium	Railways (1A3c)	[kg]	1	1	1	1	1	1	1	1
Selenium	Navigation (1A3d)	[kg]	28	27	26	26	27	27	26	26
Selenium	Residential (1A4b)	[kg]	0	0	1	1	1	1	1	1
Selenium	Ag./for./fish. (1A4c)	[kg]	38	36	39	37	29	34	31	28
Selenium	Military (1A5)	[kg]	0	0	0	0	1	1	0	1
Selenium	Navigation int. (1A3d)	[kg]	431	354	273	297	245	267	370	396
Selenium	Civil Aviation int. (1A3a)	[kg]	8	8	7	7	8	8	8	9
Zinc	Industry-Other (1A2f)	[kg]	256	259	262	265	267	279	302	323
Zinc	Civil Aviation (1A3a)	[kg]	49	51	44	43	40	42	45	34
Zinc	Road (1A3b)	[kg]	3523	3530	3572	3714	3812	3844	3967	4162
Zinc	Railways (1A3c)	[kg]	72	67	67	69	68	73	72	72
Zinc	Navigation (1A3d)	[kg]	96	94	94	95	98	97	95	94
Zinc	Residential (1A4b)	[kg]	40	45	50	57	64	69	73	73
Zinc	Ag./for./fish. (1A4c)	[kg]	423	421	428	423	409	423	425	435
Zinc	Military (1A5)	[kg]	35	31	28	29	76	86	40	55
Zinc	Navigation int. (1A3d)	[kg]	997	821	639	693	570	616	848	904
Zinc	Civil Aviation int. (1A3a)	[kg]	745	756	653	679	776	817	819	857
Dioxins/furans	Industry-Other (1A2f)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Civil Aviation (1A3a)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Road (1A3b)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Railways (1A3c)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Navigation (1A3d)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Residential (1A4b)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Ag./for./fish. (1A4c)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Military (1A5)	[g]	0	0	0	0	0	0	0	0
Dioxins/furans	Navigation int. (1A3d)	[g]	1	1	0	1	0	0	1	1
Dioxins/furans	Civil Aviation int. (1A3a)	[g]	0	0	0	0	0	0	0	0
Flouranthene	Industry-Other (1A2f)	[kg]	48	48	49	49	50	52	56	60
Flouranthene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Flouranthene	Road (1A3b)	[kg]	582	571	575	601	629	665	716	792

Continued										
Flouranthene	Railways (1A3c)	[kg]	4	4	4	4	4	4	4	4
Flouranthene	Navigation (1A3d)	[kg]	42	41	40	40	42	41	40	40
Flouranthene	Residential (1A4b)	[kg]	8	9	10	11	12	13	14	14
Flouranthene	Ag./for./fish. (1A4c)	[kg]	118	115	119	116	105	112	110	108
Flouranthene	Military (1A5)	[kg]	2	4	2	3	6	6	3	3
Flouranthene	Navigation int. (1A3d)	[kg]	306	266	232	238	191	188	227	226
Flouranthene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(b) flouranthene	Industry-Other (1A2f)	[kg]	6	6	6	6	6	6	7	7
Benzo(b) flouranthene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(b) flouranthene	Road (1A3b)	[kg]	59	59	59	62	64	65	69	74
Benzo(b) flouranthene	Railways (1A3c)	[kg]	1	1	1	1	1	1	1	1
Benzo(b) flouranthene	Navigation (1A3d)	[kg]	4	3	3	3	4	4	3	3
Benzo(b) flouranthene	Residential (1A4b)	[kg]	0	0	0	1	1	1	1	1
Benzo(b) flouranthene	Ag./for./fish. (1A4c)	[kg]	12	12	12	12	11	12	11	11
Benzo(b) flouranthene	Military (1A5)	[kg]	0	0	0	0	1	1	0	0
Benzo(b) flouranthene	Navigation int. (1A3d)	[kg]	21	19	17	17	14	13	15	14
Benzo(b) flouranthene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Industry-Other (1A2f)	[kg]	6	5	5	6	6	6	6	7
Benzo(k) flouranthene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Road (1A3b)	[kg]	68	67	68	71	74	75	78	84
Benzo(k) flouranthene	Railways (1A3c)	[kg]	1	1	1	1	1	1	1	1
Benzo(k) flouranthene	Navigation (1A3d)	[kg]	2	2	2	2	2	2	2	2
Benzo(k) flouranthene	Residential (1A4b)	[kg]	0	0	0	0	0	0	0	0
Benzo(k) flouranthene	Ag./for./fish. (1A4c)	[kg]	9	9	9	9	9	9	9	9
Benzo(k) flouranthene	Military (1A5)	[kg]	0	0	0	0	1	1	0	0
Benzo(k) flouranthene	Navigation int. (1A3d)	[kg]	10	9	8	8	6	6	7	6
Benzo(k) flouranthene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Industry-Other (1A2f)	[kg]	3	3	3	3	3	3	3	4
Benzo(a) pyrene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Road (1A3b)	[kg]	42	42	43	45	47	50	53	58
Benzo(a) pyrene	Railways (1A3c)	[kg]	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Navigation (1A3d)	[kg]	1	1	1	1	1	1	1	1
Benzo(a) pyrene	Residential (1A4b)	[kg]	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Ag./for./fish. (1A4c)	[kg]	5	5	5	5	5	5	5	5
Benzo(a) pyrene	Military (1A5)	[kg]	0	0	0	0	0	0	0	0
Benzo(a) pyrene	Navigation int. (1A3d)	[kg]	6	5	4	5	4	4	4	4
Benzo(a) pyrene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Industry-Other (1A2f)	[kg]	5	5	5	5	5	6	6	6
Benzo(g,h,i) perylene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Road (1A3b)	[kg]	82	81	83	86	90	95	101	111
Benzo(g,h,i) perylene	Railways (1A3c)	[kg]	0	0	0	0	0	0	0	0
Benzo(g,h,i) perylene	Navigation (1A3d)	[kg]	7	7	7	7	7	7	7	7
Benzo(g,h,i) perylene	Residential (1A4b)	[kg]	1	1	2	2	2	2	2	2

Continued

Benzo(g,h,i) perylene	Ag./for./fish. (1A4c)	[kg]	18	17	18	17	15	16	16	15
Benzo(g,h,i) perylene	Military (1A5)	[kg]	0	0	0	0	1	1	0	0
Benzo(g,h,i) perylene	Navigation int. (1A3d)	[kg]	41	37	35	35	28	25	27	25
Benzo(g,h,i) perylene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Industry-Other (1A2f)	[kg]	3	3	3	3	3	3	3	4
indeno(1,2,3-c,d) pyrene	Civil Aviation (1A3a)	[kg]	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Road (1A3b)	[kg]	47	47	48	50	52	55	58	63
indeno(1,2,3-c,d) pyrene	Railways (1A3c)	[kg]	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Navigation (1A3d)	[kg]	6	5	5	5	5	5	5	5
indeno(1,2,3-c,d) pyrene	Residential (1A4b)	[kg]	0	0	1	1	1	1	1	1
indeno(1,2,3-c,d) pyrene	Ag./for./fish. (1A4c)	[kg]	13	12	13	12	10	12	11	10
indeno(1,2,3-c,d) pyrene	Military (1A5)	[kg]	0	0	0	0	0	0	0	0
indeno(1,2,3-c,d) pyrene	Navigation int. (1A3d)	[kg]	34	30	29	29	23	21	22	20
indeno(1,2,3-c,d) pyrene	Civil Aviation int. (1A3a)	[kg]	0	0	0	0	0	0	0	0

Annex 2B-16: Percentage distribution of new sold heavy duty trucks into Euro classes

1. reg. year	Conv.	I	II	III	IV	V	VI	Total
1991	100	0	0	0	0	0	0	100
1992	100	0	0	0	0	0	0	100
1993	75	25	0	0	0	0	0	100
1994	0	100	0	0	0	0	0	100
1995	0	100	0	0	0	0	0	100
1996	0	75	25	0	0	0	0	100
1997	0	0	100	0	0	0	0	100
1998	0	0	100	0	0	0	0	100
1999	0	0	100	0	0	0	0	100
2000	0	0	75	25	0	0	0	100
2001	0	0	43	57	0	0	0	100
2002	0	0	2	98	0	0	0	100
2003	0	0	1	99	0	0	0	100
2004	0	0	1	99	0	0	0	100
2005	0	0	0	96	3	1	0	100
2006	0	0	0	81	14	5	0	100
2007	0	0	0	2	71	27	0	100
2008	0	0	0	0	50	50	0	100
2009	0	0	0	0	25	75	0	100
2010	0	0	0	0	0	100	0	100
2011	0	0	0	0	0	100	0	100
2012	0	0	0	0	0	100	0	100
2013	0	0	0	0	0	100	0	100
2014	0	0	0	0	0	75	25	100
2015	0	0	0	0	0	0	100	100

Annex 2B-17: Uncertainty estimates

Uncertainty estimation, CO_2

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg	Gg	%	%	%	%	%	%	%	%	%
Road transport	CO_2	9275	13198	2	5	5,385	4,170	0,10941436	0,9776	0,5471	2,7650	2,8186
Military	CO_2	119	175	2	5	5,385	0,055	0,00182243	0,0130	0,0091	0,0366	0,0378
Railways	CO_2	297	228	2	5	5,385	0,072	-0,0108911	0,0169	-0,0545	0,0477	0,0724
Navigation (small boats)	CO_2	48	101	21	5	21,587	0,128	0,00301649	0,0075	0,0151	0,2227	0,2232
Navigation (large vessels)	CO_2	666	352	11	5	12,083	0,250	-0,0361279	0,0261	-0,1806	0,4060	0,4444
Fisheries	CO_2	591	382	2	5	5,385	0,121	-0,0269452	0,0283	-0,1347	0,0800	0,1567
Agriculture	CO_2	1272	1166	13	5	13,928	0,953	-0,0326106	0,0864	-0,1631	1,5877	1,5961
Forestry	CO_2	36	17	16	5	16,763	0,017	-0,0020639	0,0013	-0,0103	0,0288	0,0306
Industry (mobile)	CO_2	842	1088	18	5	18,682	1,192	0,00185295	0,0806	0,0093	2,0506	2,0506
Residential	CO_2	113	232	18	5	18,682	0,254	0,00663484	0,0172	0,0332	0,4374	0,4387
Civil aviation	CO_2	243	107	10	5	11,180	0,070	-0,0147906	0,0079	-0,0740	0,1118	0,1340
		13.500	17045				19,886					15,1868
				Year (%):			4,459			Trend (%):		3,897

Uncertainty estimation, CH_4

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg	Mg	%	%	%	%	%	%	%	%	%
Road transport	CH_4	2619	1185	2	40	40,050	29,518	-0,0682396	0,3920	-2,7296	1,1087	2,9461
Military	CH_4	5	8	2	100	100,020	0,470	0,00158057	0,0025	0,1581	0,0071	0,1582
Railways	CH_4	12	9	2	100	100,020	0,551	0,00076356	0,0029	0,0764	0,0083	0,0768
Navigation (small boats)	CH_4	17	25	21	100	102,181	1,561	0,00521326	0,0081	0,5213	0,2412	0,5744
Navigation (large vessels)	CH_4	14	7	11	100	100,603	0,455	-8,178E-05	0,0024	-0,0082	0,0374	0,0383
Fisheries	CH_4	13	9	2	100	100,020	0,584	0,00080643	0,0031	0,0806	0,0088	0,0811
Agriculture	CH_4	105	77	13	100	100,841	4,831	0,00704388	0,0255	0,7044	0,4684	0,8459
Forestry	CH_4	21	4	16	100	101,272	0,276	-0,0022431	0,0015	-0,2243	0,0328	0,2267
Industry (mobile)	CH_4	60	43	18	100	101,607	2,717	0,00371782	0,0142	0,3718	0,3620	0,5189
Residential	CH_4	150	235	18	100	101,607	14,875	0,05148108	0,0779	5,1481	1,9820	5,5165
Civil aviation	CH_4	7	5	10	100	100,499	0,339	0,00052019	0,0018	0,0520	0,0254	0,0579
		3023	1608				1126,979					40,5195
				Year (%):			33,571			Trend (%):		6,365

Uncertainty estimation, N_2O

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Mg	Mg	%	%	%	%	%	%	%	%	%
Road transport	N_2O	312	409	2	50	50,040	35,463	0,09764625	0,8171	4,8823	2,3112	5,4017
Military	N_2O	4	6	2	1000	1000,002	9,874	0,00281399	0,0114	2,8140	0,0322	2,8142
Railways	N_2O	8	6	2	1000	1000,002	10,884	-0,0063099	0,0125	-6,3099	0,0355	6,3100
Navigation (small boats)	N_2O	1	3	21	1000	1000,220	5,984	0,004002	0,0069	4,0020	0,2049	4,0072
Navigation (large vessels)	N_2O	42	22	11	1000	1000,060	38,642	-0,0521212	0,0446	-52,1212	0,6931	52,1258
Fisheries	N_2O	37	24	2	1000	1000,002	41,794	-0,0373324	0,0482	-37,3324	0,1363	37,3327
Agriculture	N_2O	49	49	13	1000	1000,084	85,225	-0,0153157	0,0983	-15,3157	1,8064	15,4219
Forestry	N_2O	1	1	16	1000	1000,128	0,940	-0,0002081	0,0011	-0,2081	0,0245	0,2095
Industry (mobile)	N_2O	34	46	18	1000	1000,162	79,795	0,01301216	0,0920	13,0122	2,3416	13,2212
Residential	N_2O	2	4	18	1000	1000,162	6,206	0,0031974	0,0072	3,1974	0,1821	3,2026
Civil aviation	N_2O	10	7	10	1000	1000,050	11,980	-0,009913	0,0138	-9,9130	0,1953	9,9149
		500	576				18562,903					4725,0415
				Year (%):			136,246			Trend (%):		68,739

Uncertainty estimation, SO_2

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions intro-duced by emis-sion factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg SO_2	Gg SO_2	%	%	%	%	%	%	%	%	%
Road Transportation	SO_2	5767	83	2	50	50,040	2,687	- 0,034090009	0,0055	-1,7045005	0,015691643	1,7045727
Other mobile sources	SO_2	9216	1465	10	50	50,990	48,252	0,034012007	0,0978	1,70060037	1,382787945	2,19183579
Total	SO_2	14983,405	1548,171				2335,512					7,70971219
Total uncertainties					Year (%):		48,327			Trend (%):		2,777

Uncertainty estimation, NO_X

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions intro-duced by emis-sion factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg NO_X	Gg NO_X	%	%	%	%	%	%	%	%	%
Road Transportation	NO_X	105934	64485	2	50	50,040	30,920	- 0,038341801	0,4114	-1,91709	1,16368702	2,24263276
Other mobile sources	NO_X	50801	39875	10	100	100,499	38,400	0,038476237	0,2544	3,84762366	3,597925027	5,26775781
Total	NO_X	156734,61	104359,73				2430,600					32,778674
Total uncertainties					Year (%):		49,301			Trend (%):		5,725

Uncertainty estimation, NMVOC

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions intro-duced by emis-sion factor un-certainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data Gg NMVOC	Input data Gg NMVOC	Input data %	Input data %	%	%	%	%	%	%	%
Road Transportation	NMVOC	81811	20364	2	50	50,040	30,049	-0,08608693	0,2110	-4,3043465	0,596744638	4,34551525
Other mobile sources	NMVOC	14710	13548	10	100	100,499	40,149	0,086684494	0,1404	8,6684494	1,985010766	8,89282198
Total	NMVOC	96520,951	33911,917				2514,907					97,9657855
Total uncertainties					Year (%):		50,149			Trend (%):		9,898

Uncertainty estimation, CO

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data Gg CO	Input data Gg CO	Input data %	Input data %	%	%	%	%	%	%	%
Road Transportation	CO	459541	155084	2	50	50,040	28,000	-0,113050655	0,2689	-5,6525327	0,76047864	5,70345984
Other mobile sources	CO	117260	122071	10	100	100,499	44,264	0,113720151	0,2116	11,3720151	2,992968172	11,7592766
Total	CO	576800,88	277155,48				2743,311					170,81004
Total uncertainties					Year (%):		52,377			Trend (%):		13,069

Uncertainty estimation, NH_3

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg NH_3	Gg NH_3	%	%	%	%	%	%	%	%	%
Road Transportation	NH_3	70	1791	2	1000	1000,002	995,755	1,771595369	23,4881	1771,59537	66,43437006	1772,84057
Other mobile sources	NH_3	6	8	10	1000	1000,050	4,247	-1,786463342	0,1002	-1786,4633	1,416844548	1786,4639
Total	NH_3	76,247628	1798,5506				991545,487					6334416,95
Total uncertainties					Year (%):		995,764			Trend (%):		2517

Uncertainty estimation, TSP

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg TSP	Gg TSP	%	%	%	%	%	%	%	%	%
Road Transportation	TSP	6929	5763	2	50	50,040	35,190	0,089615493	0,4735	4,48077465	1,339357379	4,67666758
Other mobile sources	TSP	5240	2432	10	100	100,499	29,824	-0,089739342	0,1998	-8,9739342	2,825938653	9,40836987
Total	TSP	12169,148	8194,1981				2127,809					110,388643
Total uncertainties					Year (%):		46,128			Trend (%):		10,507

Uncertainty estimation, Arsenic

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Arsenic	0	0	2	1000	1000,002	0,000	0	0,0000	0	0	0
Other mobile sources	Arsenic	62	18	10	1000	1000,050	1000,050	0	0,2948	0	4,169455513	4,16945551
Total	Arsenic	62,035802	18,289707				1000100,000					17,3843593
Total uncertainties					Year (%):		1000,050			Trend (%):		4,169

Uncertainty estimation, Cadmium

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Cadmium	29	42	2	1000	1000,002	775,048	0,137824233	0,9419	137,824233	2,664072602	137,849978
Other mobile sources	Cadmium	15	12	10	1000	1000,050	224,965	-0,138266215	0,2734	-138,26622	3,866179481	138,320257
Total	Cadmium	44,162276	53,669181				651308,195					38135,1102
Total uncertainties					Year (%):		807,037			Trend (%):		195,282

Uncertainty estimation, Chromium

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Chromium	146	208	2	1000	1000,002	776,814	0,14440749	0,9348	144,40749	2,644029471	144,431693
Other mobile sources	Chromium	77	60	10	1000	1000,050	223,198	-0,144856567	0,2686	-144,85657	3,798301511	144,906356
Total	Chromium	222,5897	267,86134				653257,946					41858,3661
Total uncertainties					Year (%):		808,244			Trend (%):		204,593

Uncertainty estimation, Copper

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Copper	4965	7075	2	1000	1000,002	810,447	0,07381129	1,0749	73,8112905	3,040386197	73,8738827
Other mobile sources	Copper	1617	1655	10	1000	1000,050	189,564	-0,074185887	0,2514	-74,185887	3,555567582	74,2710432
Total	Copper	6582,1835	8730,3149				692759,082					10973,5384
Total uncertainties					Year (%):		832,322			Trend (%):		104,755

Uncertainty estimation, Mercury

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Mercury	0	0	2	1000	1000,002	0,000	0	0,0000	0	0	0
Other mobile sources	Mercury	17	11	10	1000	1000,050	1000,050	0	0,6577	0	9,301333814	9,30133381
Total	Mercury	16,931552	11,135943				1000100,000					86,5148107
Total uncertainties					Year (%):		1000,050			Trend (%):		9,301

Uncertainty estimation, Nickel

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Nickel	204	291	2	1000	1000,002	354,714	0,076298834	0,0937	76,2988338	0,265109839	76,2992944
Other mobile sources	Nickel	2904	530	10	1000	1000,050	645,319	-0,075642355	0,1705	-75,642355	2,411411931	75,6807817
Total	Nickel	3108,0281	821,27484				542258,689					11549,163
Total uncertainties					Year (%):		736,382			Trend (%):		107,467

Uncertainty estimation, Lead

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Lead	97510	52	2	1000	1000,002	34,812	-0,0128832	0,0005	-12,8832	0,001413895	12,8832003
Other mobile sources	Lead	6178	1437	10	1000	1000,050	965,237	0,012996612	0,0139	12,9966123	0,196009353	12,9980903
Total	Lead	103687,72	1488,9392				932893,866					334,927199
Total uncertainties					Year (%):		965,864			Trend (%):		18,301

Uncertainty estimation, Selenium

Source category	Gas	Base year emission	Year t emission	Activity data uncer-tainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Selenium	29	42	2	1000	1000,002	414,277	0,147111495	0,3055	147,111495	0,864095909	147,114033
Other mobile sources	Selenium	107	59	10	1000	1000,050	585,753	-0,146277627	0,4319	-146,27763	6,10849246	146,405115
Total	Selenium	136,15561	100,40655				514731,980					43076,9965
Total uncertainties					Year (%):		717,448			Trend (%):		207,550

Uncertainty estimation, Zinc

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Zinc	2921	4162	2	1000	1000,002	793,268	0,096891499	1,0225	96,8914994	2,89198534	96,9346493
Other mobile sources	Zinc	1150	1085	10	1000	1000,050	206,744	-0,097311898	0,2665	-97,311898	3,768401792	97,3848364
Total	Zinc	4070,5314	5246,6605				672017,551					18880,1326
Total uncertainties					Year (%):		819,767			Trend (%):		137,405

Uncertainty estimation, Dioxins

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		g dioxins	g dioxins	%	%	%	%	%	%	%	%	%
Road Transportation	Dioxins	1	0	2	1000	1000,002	520,245	-0,080039159	0,1624	-80,039159	0,459468573	80,0404781
Other mobile sources	Dioxins	0	0	10	1000	1000,050	479,780	0,080484104	0,1498	80,484104	2,118549127	80,511982
Total	Dioxins	1,1042442	0,344801				500843,767					12888,6574
Total uncertainties					Year (%):		707,703			Trend (%):		113,528

Uncertainty estimation, Flouranthene

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Flouranthene	789	792	2	1000	1000,002	775,886	0,019330479	0,7596	19,3304785	2,148558482	19,4495168
Other mobile sources	Flouranthene	255	229	10	1000	1000,050	224,127	- 0,019429206	0,2194	-19,429206	3,103076503	19,675445
Total	Flouranthene	1043,1665	1021,313				652231,733					765,406838
Total uncertainties					Year (%):		807,609			Trend (%):		27,666

Uncertainty estimation, Benzo(b) flouranthene

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Benzo(b) flou-ranthene	65	74	2	1000	1000,002	756,944	0,053139614	0,8088	53,1396145	2,287584113	53,1888303
Other mobile sources	Benzo(b) flou-ranthene	27	24	10	1000	1000,050	243,069	- 0,053358819	0,2597	-53,358819	3,672759498	53,4850698
Total	Benzo(b) flou-ranthene	91,784063	98,070026				632047,410					5689,70436
Total uncertainties					Year (%):		795,014			Trend (%):		75,430

Uncertainty estimation, Benzo(k) flouranthene

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Benzo(k) flouranthene	65	84	2	1000	1000,002	809,986	0,066417805	0,9656	66,4178052	2,731213192	66,4739376
Other mobile sources	Benzo(k) flouranthene	21	20	10	1000	1000,050	190,025	- 0,066754184	0,2265	-66,754184	3,20359103	66,8310112
Total	Benzo(k) flouranthene	86,723185	103,38772				692187,392					8885,16843
Total uncertainties					Year (%):		831,978			Trend (%):		94,261

Uncertainty estimation, Benzo(a) pyrene

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Benzo(a) pyrene	45	58	2	1000	1000,002	854,281	0,052927714	1,0506	52,9277139	2,971671387	53,0110717
Other mobile sources	Benzo(a) pyrene	11	10	10	1000	1000,050	145,727	- 0,053256192	0,1792	-53,256192	2,53448926	53,3164669
Total	Benzo(a) pyrene	55,569601	68,342827				751033,377					5652,81937
Total uncertainties					Year (%):		866,622			Trend (%):		75,185

Uncertainty estimation, Benzo(g,h,i) perylene

Source category	Gas	Base year emission	Year t emission	Activity Data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emis-sions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	Benzo(g,h,i) perylene	95	111	2	1000	1000,002	782,979	0,061450736	0,8432	61,4507361	2,384988531	61,497001
Other mobile sour-ces	Benzo(g,h,i) perylene	36	31	10	1000	1000,050	217,034	-0,061727123	0,2337	-61,727123	3,305317485	61,8155554
Total	Benzo(g,h,i) perylene	131,41193	141,52303				660159,072					7603,04403
Total uncertainties					Year (%):		812,502			Trend (%):		87,195

Uncertainty estimation, indeno(1,2,3-c,d) pyrene

Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		kg	kg	%	%	%	%	%	%	%	%	%
Road Transportation	indeno(1,2,3-c,d) pyr.	43	63	2	1000	1000,002	755,918	0,143575794	0,9371	143,575794	2,650384852	143,600255
Other mobile sources	indeno(1,2,3-c,d) pyr.	24	20	10	1000	1000,050	244,096	-0,143974514	0,3026	-143,97451	4,279010543	144,038087
Total	indeno(1,2,3-c,d) pyr.	67,521282	83,701021				630994,834					41368,0038
Total uncertainties					Year (%):		794,352			Trend (%):		203,391

Annex 3C Industrial Processes. CRF sector 2

No annexes for industry 2007.

Annex 3D Agriculture/LULUCF

1 Agriculture

1.1 Background data for estimation of CH_4 emission from Enteric Fermentation

Table 3D.1 Grassing animals 1990 – 2007, number of days on grass pr year.

Livestock category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dairy cattle	55	55	55	55	55	55	55	55	55	55	55	55	55	46	39	32	25	18
Heifer > ½ year	165	171	177	184	190	196	196	196	196	196	196	196	196	180	168	156	144	132
Suckling cattle	184	192	200	208	216	224	224	224	224	224	224	224	224	224	224	224	224	224
Sheep and gotas	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265	265
Horses	183	183	183	183	183	183	183	183	183	183	183	183	183	183	183	183	183	183

Table 3D.2a Average gross energy intake (GE) 1990 – 2007, MJ pr head pr year.

Livestock category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Dairy cattle	278.2	282.4	286.7	290.9	295.3	295.6	295.8	295.9	297.9	297.8	297.9	304.2	310.5	317.8	323.5	328.7	324.2	335.1
Non-dairy cattle (heifer)	107.3	106.9	106.5	106.1	105.7	105.3	105.3	105.5	105.4	105.3	105.3	105.3	105.8	107.3	108.3	109.4	110.1	130.5
Sheep (mother sheep incl. lambs)	43.6	43.6	43.6	43.6	43.6	43.6	43.6	43.6	43.6	43.6	43.6	43.6	43.6	43.6	43.6	43.6	43.6	43.6
Goats (mother goats incl. kids)	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	38.7
Horses (600 kg)	130.1	130.1	130.1	130.1	130.1	130.1	130.1	130.1	130.1	130.1	130.1	130.1	130.1	130.1	130.1	130.1	130.1	133.0
Swine (slaughtering pig)	43.3	43.3	43.3	43.3	38.9	38.9	38.9	38.9	38.1	38.1	38.1	39.2	39.2	38.9	39.1	38.9	39.9	40.7
Poultry (broilers)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.5	1.5	1.3
Other - Fur farming (mink)	6.3	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.8	6.7	6.7

Table 3D.2b Average gross energy intake (GE) 1990 – 2007, MJ pr head pr year – Subcategories for cattle and swine.

Subcategories for cattle and swine	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cattle																		
Dairy, large breed	285.8	289.9	294.1	298.3	302.4	302.4	302.4	302.4	304.1	304.1	304.1	310.6	317.1	324.9	330.6	335.9	330.7	341.5
Dairy, Jersey	237.2	240.6	244.0	247.4	250.7	250.7	250.7	250.7	253.2	253.2	253.2	258.1	262.9	269.1	274.7	278.8	278.5	290.5
Calves, bull	59.6	59.8	59.9	60.0	60.1	60.2	60.2	60.3	60.4	60.4	60.4	61.5	61.5	61.4	61.5	61.6	61.4	61.5
Calves, heifer	86.2	86.3	86.5	86.6	86.7	87.0	87.1	87.0	86.3	86.3	86.3	85.6	85.7	85.6	85.6	85.6	85.6	102.4
Bulls > ½ year	113.6	113.7	113.9	114.0	114.2	114.3	114.4	114.5	114.6	114.6	114.7	115.6	115.6	115.8	115.6	115.8	115.9	115.8
Heifer > ½ year	107.3	106.9	106.5	106.1	105.7	105.3	105.3	105.5	105.4	105.3	105.3	105.3	105.8	107.3	108.3	109.4	110.1	130.5
Suckling cattle	181.7	179.4	177.1	174.8	172.5	170.2	170.2	170.2	170.2	170.2	170.2	170.2	170.2	170.2	160.9	160.9	160.9	163.6
Swine																		
Sows (incl. pigs < 7.5 kg)	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	64.2	64.2	64.2	66.6	66.6	69.3	69.1	69.5	70.5	71.4
Piglets (7.5 – 30 kg)	11.1	11.1	11.1	11.1	13.2	13.2	13.2	13.2	13.8	13.8	13.8	13.8	13.8	13.2	13.6	13.8	14.4	14.6
Slaughtering pigs (30 – 104 kg)	43.3	43.3	43.3	43.3	38.9	38.9	38.9	38.9	38.1	38.1	38.1	39.2	39.2	38.9	39.1	38.9	39.9	40.7

Table 3D.3a Average CH_4 conversion rate (Y_m) – national factor used for dairy cattle and heifer > ½ year 1990 – 2007, %.

Dairy cattle + Heifer > ½ year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Ym - average	6.39	6.35	6.29	6.24	6.19	6.16	6.11	6.09	6.06	6.02	6.00	5.98	5.96	5.95	5.95	5.94	5.93	5.93

Table 3D.3b Area grown with sugar beet for feeding.

Area, ha	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Sugar beet for feeding	102 347	93 170	80 979	70 993	60 380	52 927	41 347	37 414	32 188	22 917	17 577	13 302	9 953	7 991	6 233	4 974	4 035	3 819

1.2 Background data for estimation of CH_4 emission from Manure Management

Table 3D.4a VS daily excretion (average) 1990 – 2007, kg dm pr head pr day – CRF categories.

365 stable days	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Livestock category																		
Dairy cattle	4.13	4.19	4.25	4.31	4.37	4.37	4.37	4.37	4.40	4.40	4.40	4.49	4.59	4.70	4.78	4.86	4.78	4.94
Non-dairy cattle (heifer)	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.37	1.37	1.37	1.36	1.60
Sheep (mother sheep incl. lambs)	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
Goats (mother goats incl. kids)	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Horses (600 kg)	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60
Swine (slaughter pig)	0.44	0.44	0.44	0.44	0.39	0.39	0.39	0.39	0.38	0.38	0.38	0.39	0.39	0.39	0.39	0.39	0.40	0.41
Poultry (broilers)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Other - Fur farming (mink)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07

Table 3D.4b VS daily excretion (average) 1990 – 2007, kg dm pr head pr day – Subcategories.

365 stable days	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cattle:																		
Large breed																		
Dairy cattle	4.13	4.19	4.25	4.31	4.37	4.37	4.37	4.37	4.40	4.40	4.40	4.49	4.59	4.70	4.78	4.86	4.78	4.94
Calves, bull	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.32
Bulls > ½ year	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Calves, heifer	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.48	0.48	0.48	0.48	0.48	0.48	0.58
Heifer > ½ year	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.37	1.37	1.37	1.36	1.60
Suckling cattle	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.65	3.65	3.65	3.65
Jersey	3.43	3.48	3.53	3.58	3.63	3.63	3.63	3.63	3.66	3.66	3.66	3.73	3.80	3.89	3.97	4.03	4.03	4.20
Dairy cattle	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Calves, bull	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
Bulls > ½ year	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.43
Calves, heifer	5.44	5.52	5.60	5.68	5.76	5.76	5.76	5.76	5.79	5.79	5.79	5.91	6.04	4.70	4.78	4.86	4.78	4.94
Heifer > ½ year	4.13	4.19	4.25	4.31	4.37	4.37	4.37	4.37	4.40	4.40	4.40	4.49	4.59	4.70	4.78	4.86	4.78	4.94
365 stable days	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Swine:																		
Sows (incl. pigs < 7.5 kg)	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.65	0.65	0.65	0.67	0.67	0.70	0.70	0.70	0.71	0.72
Piglets (7.5 – 30 kg)	0.11	0.11	0.11	0.11	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.13	0.14	0.14	0.15	0.15
Slaughtering pigs (30 – 104 kg)	0.44	0.44	0.44	0.44	0.39	0.39	0.39	0.39	0.38	0.38	0.38	0.39	0.39	0.39	0.39	0.39	0.40	0.41
Poultry:																		
Outdoor hens	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Organic hens	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Scrabe hens	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Battery hens	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
HPR hens (egg for hacthing)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
Pullet	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Broilers	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fur farming:																		
Mink	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07
Foxes	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16

Table 3D.5 Digestibility of feed, %, 1990 – 2007.

Livestock category	In stable, pct.	On grass, pct.
Dairy cattle	71	78
Bull-calves	79	79
Bulls (> ½ year)	75	78
Heifer-calves	78	78
Heifer (> ½ year)	71	78
Cattle for suckling	67	77
Swine, poultry and fur farming	81	81
Horses, sheep and goats	75	67

1.3 Additional information – The agricultural sector

Table 3D.6 Changes in stable type 1990 – 2007.

Livestock categories	Stable type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
										pct									
Horses		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Cattle																			
Bull, 0-6 mth.	Deep litter (boxes)	100	100	100	100	100	100	100	100	100	100	100	91	86	82	77	95	95	97
	Deep litter, solid floor	0	0	0	0	0	0	0	0	0	0	0	9	14	18	23	5	5	3
Bull, 6 mth -440 kg	Tethered with liquid and solid manure	20	19	17	16	15	14	13	12	11	11	10	9	8	8	7	9	9	4
	Tethered with slurry	20	19	17	16	15	14	13	12	11	11	10	9	8	8	7	2	2	1
	Slatted floor-boxes	41	40	40	39	38	37	37	36	35	34	33	32	31	30	28	31	31	30
	Deep litter (all)	3	3	2	2	2	1	1	0	0	0	0	0	0	0	0	47	47	57
	Deep litter, solid floor	10	12	14	16	18	20	22	24	27	29	33	37	41	45	48	8	8	5
	Deep litter, slatted floor	4	5	6	7	8	8	9	10	11	10	9	8	7	5	6	1	1	1
	Deep litter, slatted floor, scrapes	1	1	1	1	1	2	2	2	2	2	2	2	2	1	1	0	0	1
	Deep litter, solid floor, scrapes	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	2	2	0
	Deep litter, long eating space, solid floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Boxes with sloping bedded floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 (0.1)
Heifer, 0-6 mth.	Deep litter (boxes)	100	100	100	100	100	100	100	100	100	100	100	89	84	83	80	93	93	96
	Deep litter, solid floor	0	0	0	0	0	0	0	0	0	0	0	11	16	17	20	7	7	4
Heifer, 6 mth.-calving	Tethered with liquid and solid manure	19	18	17	16	15	13	12	11	10	10	9	8	7	7	5	14	14	7
	Tethered with slurry	19	18	17	16	15	13	12	11	10	10	9	8	7	7	5	5	5	2
	Slatted floor-boxes	40	39	38	37	36	35	34	33	33	32	32	31	30	30	29	22	22	38
	Loose-housing with beds, slatted floor	4	4	5	6	7	7	8	10	12	13	14	17	20	21	23	19	19	12
	Deep litter (all)	3	3	2	2	2	1	1	0	0	0	0	0	0	0	0	30	30	24
Heifer, 6 mth.-calving	Deep litter, solid floor	9	11	13	15	17	18	22	24	24	24	25	26	26	26	28	3	3	1
	Deep litter, slatted floor	4	4	5	6	7	7	7	7	6	6	6	5	5	5	5	3	3	2
	Deep litter, slatted floor, scrapes	1	1	1	1	1	1	1	1	2	2	2	2	2	1	2	2	2	2
	Deep litter, solid floor, scrapes	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	1	1	0

Continued																			
Livestock categories	Stable type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
											pct								
	Loose-housing with beds, solid floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
	Loose-housing with beds, slatted floor, scarpes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
	Deep litter, long eating space, solid floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Boxes with sloping bedded floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 (0.1)
Dairy cows	Tethered with liquid and solid manure	35	35	34	33	32	31	30	30	30	30	18	15	12	8	6	12	12	7
	Tethered with slurry	44	43	43	43	43	42	42	36	30	30	28	25	23	18	16	14	14	10
	Loose-holding with beds, slatted floor	13	14	15	16	16	17	18	21	24	24	34	36	39	42	44	44	44	41
	Loose-holding with beds, slatted floor, scrapes	1	1	1	1	1	1	1	2	3	3	3	4	4	5	6	11	11	19
	Loose-holding with beds, solid floor	4	3	3	3	3	3	3	3	3	3	6	9	11	16	17	11	11	13
	Deep litter (all)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2
	Deep litter, slatted floor	3	3	3	4	4	5	5	6	8	8	7	7	7	7	7	4	4	3
	Deep litter, slatted floor, scrapes	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	2
	Deep litter, solid floor, scrapes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Loose-holding with beds, drained floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0(0.1)
Dairy cows	Loose-holding with beds, solid floor with tilt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Deep litter, long eating space, solid floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Suckling cattle	Tethered with liquid and solid manure	1	1	1	1	1	1	1	2	2	2	3	3	3	3	3	1	1	18
	Deep litter (all)	35	35	34	33	32	31	30	30	30	30	18	15	12	8	6	19	19	65
	Deep litter, solid floor	44	43	43	43	43	42	42	36	30	30	28	25	23	18	16	8	8	2
	Tethered with slurry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
	Deep litter, long eating space, solid floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Continued																			
Livestock categories	Stable type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
										pct									
	Deep litter, slatted floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Deep litter, slatted floor, scrapes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Boxes with sloping bedded floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Sheep and goats																			
Sheep	Deep litter (all)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Goats	Deep litter (all)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Swine																			
Sows	Full slatted floor	9	10	10	11	12	12	13	13	14	14	14	13	13	12	12	13	13	12
(incl. 22-25 pigs to 7.5 kg)	Partly slatted floor	56	57	57	57	57	57	57	57	57	57	56	55	54	53	51	70	70	73
	Solid floor	30	27	25	22	20	17	15	12	10	7	7	6	6	6	5	4	4	2
	Deep litter	5	5	5	6	6	7	7	8	9	9	10	10	10	10	11	2	2	2
	Deep litter + slatted floor	0	0	1	1	2	2	3	3	4	4	6	7	8	9	10	8	8	8
	Deep litter + solid floor	0	0	1	1	2	2	3	3	4	4	5	6	7	8	9	1	1	1
	Outdoor sows	0	0	1	1	1	2	2	2	3	3	3	3	2	2	2	2	2	2
Piglets, 7.5-30 kg	Fully slatted floor	54	57	60	57	54	51	49	46	43	40	38	36	35	33	31	23	23	26
	Partly slatted floor	20	20	20	24	27	31	34	38	41	45	47	49	50	52	54	66	66	63
Piglets, 7.5-30 kg	Solid floor	21	18	15	14	12	11	9	8	6	5	5	5	5	5	5	3	3	1
	Deep litter (to-clima stables)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	3
	Deep litter + slatted floor	0	0	0	1	1	2	3	4	4	5	5	5	5	5	5	4	4	0
	Partly slatted and drained floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Slaugther pigs, 30-105 kg	Fully slatted floor	51	56	60	60	60	60	60	60	60	60	58	57	56	55	53	49	49	53
	Partly slatted floor	23	21	20	21	23	24	25	26	28	29	31	33	34	35	38	38	38	34
	Solid floor	22	19	15	14	12	11	9	8	6	5	5	4	4	4	3	7	7	4
	Deep litter	4	4	5	4	4	3	3	2	2	1	1	1	1	1	1	5	5	4
	Partly slatted floor and partly deep litter	0	0	0	1	1	2	3	4	4	5	5	5	5	5	5	1	1	1
	Partly slatted and drained floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4

Continued																			
Livestock categories	Stable type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
										pct									
Poultry																			
Outdoor hens		0	1	2	4	5	6	7	8	9	9	9	9	7	8	7	7	7	7
Ecological hens		0	1	2	4	5	6	7	10	12	14	15	15	15	16	16	16	16	16
Scrabe hens		11	11	12	12	13	13	13	15	17	18	18	17	19	18	20	20	20	23
Battery hens, manure house		54	52	49	47	44	41	39	36	32	29	26	26	23	23	20	20	20	7
Battery hens, manure tank		12	11	11	10	9	8	7	6	6	5	5	5	4	5	4	4	4	36
Battery hens, manure cellar		23	23	24	24	25	25	26	25	25	24	27	27	32	30	33	33	33	11
HPR-hens (egg for hatching)		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Pullet, consumption, net		17	16	15	14	13	12	11	10	8	7	8	7	6	7	5	5	5	7
Pullet, consumption, floor		57	58	60	61	62	63	64	65	66	67	69	67	69	68	69	69	69	68
Pullet, egg for hatching		26	26	26	26	26	26	26	26	26	26	23	25	25	25	26	26	26	25
Broilers, (conv. 30 days)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Broilers, (conv. 32 days)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Broilers, (conv. 35 days)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74
Broilers, (conv. 40 days)		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	99	22
Broilers, (conv. 45 days)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Broilers, skrabe (56 days)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Ecological broilers (81 days)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turkey, male		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Turkey, female		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Ducks		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Geese		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Fur farming																			
Mink	Slurry system	18	20	20	22	23	25	26	28	29	30	42	50	55	60	65	70	70	91
	Solid manure and black liquid	82	80	80	78	77	75	74	73	71	70	58	50	45	40	35	30	30	9
Foxes	Slurry system	0	0	0	0	0	0	0	0	0	0	2	5	10	15	30	0	0	0
	Solid manure and black liquid	100	100	100	100	100	100	100	100	100	100	98	95	90	85	70	100	100	100
Cattle																			
	Tethered in stables	79	78	77	76	74	73	72	66	60	60	46	40	35	26	22	26	26	17
	Loose-housing with beds	18	18	19	20	21	21	22	26	30	30	43	49	54	63	67	66	66	74
	Deep litter	3	4	4	5	5	6	6	8	10	10	11	11	11	11	11	8	8	9

Continued

Livestock categories	Stable type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
										pct									
Swine																			
	Fully slatted floor	51	56	60	60	60	60	60	60	60	60	58	57	56	55	53	49	49	53
	Partly slatted floor	23	21	20	21	23	24	25	26	28	29	31	33	34	35	38	38	38	39
	Solid floor	22	19	15	14	12	11	9	8	6	5	5	4	4	4	3	7	7	4
	Deep litter	4	4	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	4

Reference: 1990 – 2004 = The Danish Agricultural Advisory Centre, 2005-2006 = The Danish Plant Directorate, 2007 = The Faculty of Agricultural Sciences

Table 3D.7 Background data for estimation of N_2O emission from crop residue 2007.

	Stubble	Husks	Top	Leafs	Frequency of ploughing	Nitrogen content in crop residue	
Crop type	kg N pr ha	kg N pr ha	kg N pr ha	kg N pr ha	No. of year before ploughing	kg N pr ha pr yr	Gg N pr yr
Winter wheat	6.3	10.7	-	-	1	17.0	11.62
Spring wheat	6.3	7.4	-	-	1	13.7	0.11
Winter rye	6.3	10.7	-	-	1	17.0	0.51
Triticale	6.3	10.7	-	-	1	17.0	0.71
Winter barley	6.3	5.9	-	-	1	11.3	2.06
Spring barley	6.3	4.1	-	-	1	10.4	4.76
Oats	6.3	4.1	-	-	1	10.4	0.58
Winter rape	4.4	-	-	-	1	4.4	0.79
Spring rape	4.4	-	-	-	1	4.4	0.00
Potatoes (top), non-harvest	-	-	48.7	-	1	48.7	2.01
Beet (top), non-harvest	-	-	56.7[a]	-	1	56.7	2.44
Straw, non-harvest	-	-	-	-	1	7.4[a]	9.31
Pulse	11.3	-	-	-	1	11.3	0.06
Lucerne	32.3	-	-	-	3	10.8	0.04
Maize – for green fodder	6.3	-	-	-	1	6.3	0.91
Cereal – for green fodder	6.3	-	-	-	1	6.3	0.38
Peas for canning	11.3	-	-	-	1	11.3	0.03
Vegetable	11.3	-	-	-	1	11.3	0.08
Grass- and clover fiel in rotation	32.3		-	10.0	2	26.2	6.86
Grass- and clover field out of rotation	38.8		-	20.0	-	20.0	3.79
Aftermath	6.3	-	-	-	1	6.3	0.79
Seeds of grass crops	6.3	10.7	-	-	2	13.9	1.08
Set-a-side	38.8	-	-	15.0	10	18.9	3.48
Total N from crop residue - 2007							52.41

[a] express the yield for 2007 - varies from year to year. Based on yield datta from Statistics Denmark and N-content from the feeding plan.
Reference: Djurhuus and Hansen 2003

Table 3D.8 Background data for reduction in CH_4 and N_2O from manure management by biogas plants.

	Joint biogas plant, TJ	Farm biogas plant, TJ	Total, TJ	Slurry (Estimated amount), Mt	Slurry, Mt[a]	Slurry, Mt	VS Slurry, Mt	VS Slurry, Mt	Reduction in VS, Gg VS	Reduction in VS, Gg VS	CH_4 reduction, Gg	CH_4 reduction, Gg	CH_4 reduction, Gg	N_2O reduction, Gg	N_2O reduction, Gg	N_2O reduction, Gg	CO_2 eqv., Mt
				Total	Cattle	Swine	Cattle	Swine	Cattle	Swine	Cattle	Swine	Total	Cattle	Swine	Total	
1985	NO										NO	NO	NO	NO	NO	NO	NO
1986	NO										NO	NO	NO	NO	NO	NO	NO
1987	NO										NO	NO	NO	NO	NO	NO	NO
1988	NE										NO	NO	NO	NO	NO	NO	NO
1989	NE										NO	NO	NO	NO	NO	NO	NO
1990	211	19	230	0.19	0.09	0.10	0.0070	0.0051	2.1136	2.5498	0.03	0.08	0.111	0.0021	0.0028	0.0049	**0.004**
1991	369	19	388	0.32	0.14	0.18	0.0119	0.0086	3.5597	4.2944	0.06	0.13	0.187	0.0035	0.0048	0.0082	**0.006**
1992	449	24	473	0.39	0.18	0.21	0.0145	0.0105	4.3384	5.2338	0.07	0.16	0.228	0.0042	0.0058	0.0101	**0.008**
1993	529	27	556	0.46	0.21	0.25	0.0171	0.0123	5.1170	6.1732	0.08	0.19	0.268	0.0050	0.0068	0.0119	**0.009**
1994	632	26	658	0.54	0.24	0.30	0.0200	0.0145	6.0070	7.2468	0.10	0.22	0.315	0.0059	0.0080	0.0139	**0.011**
1995	745	27	772	0.64	0.29	0.35	0.0237	0.0172	7.1194	8.5888	0.11	0.26	0.373	0.0070	0.0095	0.0165	**0.013**
1996	803	27	830	0.69	0.31	0.38	0.0256	0.0185	7.6756	9.2598	0.12	0.28	0.403	0.0075	0.0103	0.0178	**0.014**
1997	973	32	1 005	0.83	0.37	0.46	0.0308	0.0223	9.2329	11.1386	0.15	0.34	0.484	0.0090	0.0123	0.0214	**0.017**
1998	1 166	56	1 222	1.01	0.45	0.56	0.0375	0.0271	11.2352	13.5542	0.18	0.41	0.589	0.0110	0.0150	0.0260	**0.020**
1999	1 183	70	1 253	1.04	0.47	0.57	0.0386	0.0279	11.5690	13.9568	0.19	0.42	0.607	0.0113	0.0155	0.0268	**0.021**
2000	1 279	129	1 408	1.16	0.52	0.64	0.0430	0.0311	12.9038	15.5672	0.21	0.47	0.677	0.0126	0.0173	0.0299	**0.023**
2001	1 345	179	1 524	1.26	0.57	0.69	0.0467	0.0338	14.0162	16.9092	0.23	0.51	0.735	0.0137	0.0187	0.0325	**0.026**
2002	1 403	344	1 747	1.44	0.65	0.79	0.0534	0.0386	16.0186	19.3248	0.26	0.58	0.840	0.0157	0.0214	0.0371	**0.029**
2003	1 508	625	2 133	1.76	0.79	0.97	0.0653	0.0472	19.5782	23.6192	0.31	0.71	1.027	0.0192	0.0262	0.0454	**0.036**
2004	1 531	745	2 276	1.9	0.85	1.03	0.0697	0.0505	20.9131	25.2296	0.34	0.76	1.097	0.0205	0.0280	0.0485	**0.038**
2005	1 593	745	2 338	1.9	0.87	1.06	0.0716	0.0518	21.4693	25.9006	0.35	0.78	1.126	0.0210	0.0287	0.0497	**0.039**
2006	1 678	907	2 585	2.1	0.96	1.18	0.0794	0.0574	23.8054	28.7188	0.38	0.87	1.249	0.0233	0.0318	0.0552	**0.043**
2007	1 699	904	2 603	2.2	0.97	1.18	0.0798	0.0578	23.9398	28.8810	0.38	0.87	1.256	0.0234	0.0320	0.0555	**0.044**

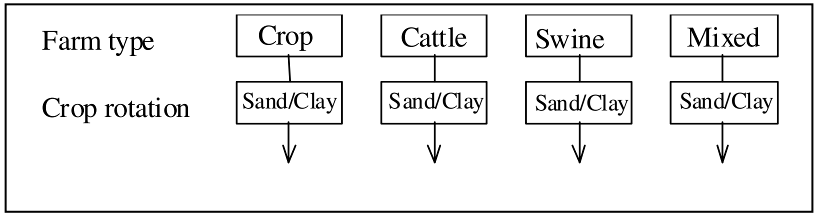
[a] Cattle slurry 45 % of estimated amount slurry, swine 55 %

1.4 Nitrogen leaching and Run-off

Calculations of nitrogen lost by leaching and run-off are based on two models described in Børgesen and Grant (2003) (in Danish). The model SKEP/DAISY is a dynamic model, N-LES is an empirical model and SKEP is an up scaling model. The SKEP/DAISY calculations were done for 10 scenarios (the years 1984, 1989 and 1995-2002) and the N-LES calculations were done for an 11 year period (1990-2000). Both calculations were up scaled nation wide. The key parameters for the models were land use, nitrogen from synthetic fertilizer and manure, application practice for manure and NH_3 evaporation at application of manure (SKEP/DAISY only). The calculations were normalised to an average climate. A schematic overview of the models is seen below.

Model calculation of nitrogen leaching nationwide by SKEP/DAISY and N-LES

Basic DAISY calculations of N-leaching



Each crop rotation calculates for:
6 climate regions
30 fertilizer plan
4 soil type (here 2 w/w.out water)

} 38.000 combinations

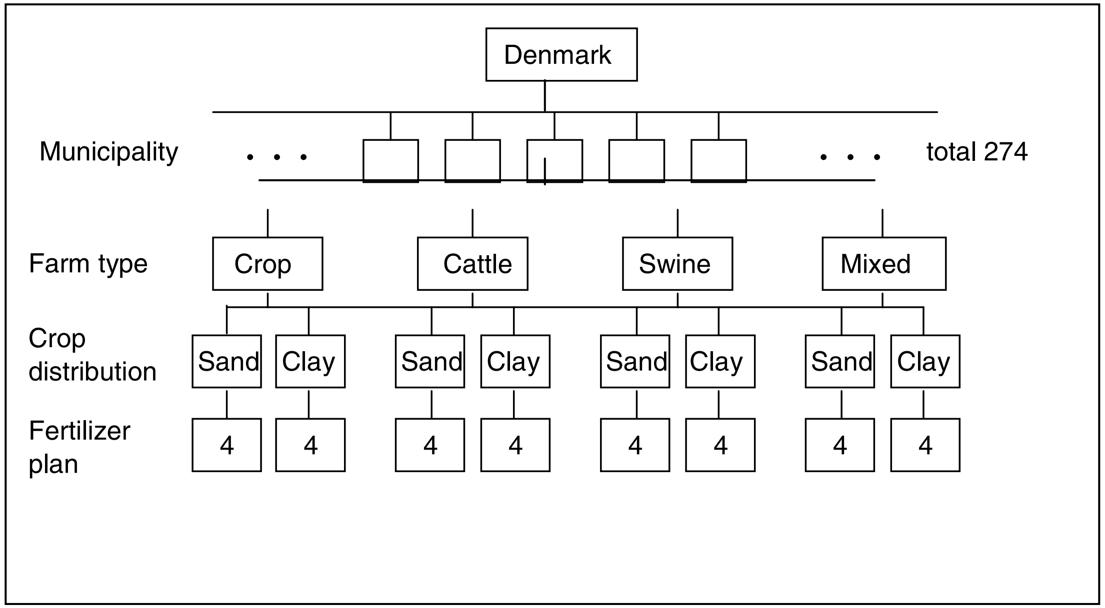
Data base
Calculation for all combinations for each of 4 climate year
Calculation for 12 combinations for each year in a 11 years period (1989-2001).

N-LES calculations

Model calculations for the crop rotations and fertilizer planes in SKEP plus appurtenant percolations from the DAISY calculations. Model calculations for each of the 11 years in the period 1989-2001, mean of the 11 years is up scaled nationwide by SKEP

Up scaling by the SKEP model

In the up scaling of DAISY calculations a climate normalisation and yield correction is made



2 LULUCF

Table A1 Emission from organic soils. Literature data corrected to average Danish climate (Svend E. Olesen, Danish Institute of Agricultural Sciences).

Crop	Country	Peat type	Depth, m	Distance to water table, m	climate corr. factor	Emission, C ha^{-1} y^{-1}	Source
Permanent grass	Finland	Fen/moor	?	not drained		-0.6-0.9	Tolonen & Turonen (1996)
	Holland	Fen/moor	>1.0	0.3-0.4	0.7	0.5-1.0	Shothorst (1977)
	Holland	Fen/moor	>1.0	.0.55-0.6	0.7	1.2-2.1	Shothorst (1977)
	Holland	Fen/moor	>1.0	0.7	0.7	2.4-2.8	Shothorst (1977)
	Germany	Fen/moor	0.5	0.3	0.6	1.7	Mundel (1976)
	Germany	Fen/moor	0.5	0.6	0.6	2.4	Mundel (1976)
	Germany	Fen/moor	0.5	0.9-1.2	0.6	2.5	Mundel (1976)
	Germany	Fen/moor	>1.0	0.3	0.6	1.8	Mundel (1976)
	Germany	Fen/moor	>1.0	0.6	0.6	3.3	Mundel (1976)
	Germany	Fen/moor	>1.0	0.9-1.2	0.6	3.9	Mundel (1976)
	Holland	Fen/moor	>1.0	0.3-0.5	0.7	2.0	Langeveld et al. (1997)
	Denmark	Raised bog	>1.0	drained	1.0	5.6	Pedersen (1978)
	Denmark	Raised bog	>1.0	drained	1.0	4.5	Pedersen (1978)
	Sweden	Fen/moor	>1.0?	drained	1.2	2.0	Staff (2001) e. Berglund (1989)
	Finland	Fen/moor	>1.0	0.2-1.2	2.0	3.6	Nykänen et al. (1995)
	Scotland	Hill blanket	>0.5	drained?	2.0	5.7	Chapman & Thurlow, 1996
	Scotland	Hill blanket	>0.5	drained?	2.0	4.4	Chapman & Thurlow, 1996
Grass in rotation	Finland	Fen/moor	0.2	drained	2.0	15.0	Maljanen et al, (2001)
	Finland	Fen/moor	>1.0	0.2-1.2	2.0	11.8	Nykänen et al. (1995)
	Finland	Fen/moor	?	drained	2.0	1.6	Lohila et al. (2004)
	Finland	Fen/moor	0.3	drained	2.0	6.6	Maljanen et al. 2004
	Finland	Fen/moor	0.7	drained	2.0	9.2	Maljanen et al. 2004
	Sweden	Fen/moor	>1.0?	drained	1.2	3.8	Staff (2001) e. Berglund (1989)
	Sweden	Fen/moor	>1.0?	drained	1.2	5.1-10.4	Kasismir et al.(1997) e. Berglund(1989)
Cereals	Finland	Fen/moor	>0.4	0.8-1.0	2.0	4.2	Lohila et al. (2004)
	Finland	Fen/moor	0.2	drained	2.0	8.0	Maljanen et al. (2001)
	Finland	Fen/moor	0.3	drained	2.0	16.6	Maljanen et al. 2004
	Finland	Fen/moor	0.7	drained	2.0	16.6	Maljanen et al. 2004
	Sweden	Fen/moor	>1.0?	drained	1.2	5.8	Staff (2001) e. Berglund (1989)
	Sweden	Fen/moor	>1.0?	drained	1.2	10.4-20.9	Kasismir et al.(1997) e. Berglund(1989)
Row crops	Sweden	Fen/moor	>1.0?	drained	1.2	9.3	Staff (2001) e. Berglund (1989)
	Sweden	Fen/moor	>1.0?	drained	1.2	20.9-31.0	Kasismir et al.(1997) e. Berglund(1989)

A2 Output of Excel model used for calculation of the amounts of CO_2 sequestered due to afforestation since 1990.

Table A2.1 Main output table giving areas and annual and cumulated uptake of CO_2.

	Afforestation area, ha				Total CO2 uptake		CO2 uptake per cumulated area		
Year	Broadleaves	Conifers	Total	Cumulated area since 1990	Annual, Gg/yr	Cumulated, Gg	Annual CO2 uptake, t/ha	Annual C uptake, t/ha	Running average CO2 uptake since 1990 Gg/ha
1990	320	410	730	730	0	0	0.0	0.00	0.00
1991	527	466	993	1723	1	1	0.7	0.20	0.00
1992	721	534	1255	2978	3	4	1.0	0.28	0.00
1993	738	542	1280	4258	5	10	1.2	0.34	0.00
1994	912	579	1491	5749	8	17	1.3	0.36	0.00
1995	790	536	1326	7075	10	28	1.5	0.40	0.00
1996	833	543	1376	8451	16	44	1.9	0.53	0.00
1997	1614	646	2260	10711	24	68	2.2	0.61	0.00
1998	912	493	1405	12116	34	102	2.8	0.77	0.00
1999	3613	810	4423	16539	43	145	2.6	0.71	0.00
2000	2115	638	2753	19292	59	204	3.1	0.83	0.01
2001	1577	556	2133	21425	74	277	3.4	0.94	0.01
2002	1828	515	2343	23768	88	365	3.7	1.01	0.01
2003	1972	556	2528	26296	108	473	4.1	1.12	0.01
2004	857	468	1325	27621	124	597	4.5	1.22	0.01
2005	2841	500	3341	30962	140	737	4.5	1.23	0.01
2006	3353	483	3836	34798	165	902	4.7	1.62	0.01
2007	546	490	1036	35834	189	1091	5.3	1.8	0.02

TableA2.2 The carbon increment model behind the output tables.

		With products		Without products		With products		Without products		
Year	Age	Increment, t CO2/ha/yr	Storage, t CO2/ha	Increment, t CO2/ha/yr	Storage, t CO2/ha	Increment, t CO2/ha/yr	Storage, t CO2/ha	Increment, t CO2/ha/yr	Storage, t CO2/ha	Stored wood for bioenergy, t CO2/ha
1990	0	0	0	0	0	0	0	0	0	
1991	1	2	2	2	2	1	1	1	1	0
1992	2	2	4	2	4	1	3	1	3	0
1993	3	2	6	2	6	1	4	1	4	0
1994	4	2	9	2	9	1	6	1	6	0
1995	5	2	11	2	11	1	7	1	7	0
1996	6	6	17	6	17	7	14	7	14	0
1997	7	6	24	6	24	7	21	7	21	0
1998	8	6	30	6	30	7	28	7	28	0
1999	9	6	36	6	36	7	35	7	35	0
2000	10	6	43	6	43	7	41	7	41	0
2001	11	9	51	9	51	12	54	12	54	0
2002	12	9	60	9	60	12	66	12	66	0
2003	13	9	68	9	68	12	79	12	79	0
2004	14	9	77	9	77	12	91	12	91	0
2005	15	9	86	9	86	12	104	-14	77	0
2006	16	13	98	13	98	3	106	15	91	0
2007	17	13	111	13	111	8	114	15	106	0

Tables used to calculate total uptake of CO_2 based on annual cohorts of broadleaved and coniferous stands.

Table A2.3 Summation table for cohorts of areas afforested with conifers, t CO_2.

Summation table for cohorts of areas afforested with conifers (t CO2)

	Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	Area (ha)	**410**	**466**	**534**	**542**	**579**	**536**	**543**	**646**	**493**	**810**	**638**	**556**	**515**	**556**	**468**	**500**	**483**	**490**
Year	**Age (yr)**																		
1990	0	0																	
1991	1	566	0																
1992	2	566	643	0															
1993	3	566	643	737	0														
1994	4	566	643	737	748	0													
1995	5	566	643	737	748	799	0												
1996	6	2829	643	737	748	799	740	0											
1997	7	2829	3215	737	748	799	740	749	0										
1998	8	2829	3215	3685	748	799	740	749	891	0									
1999	9	2829	3215	3685	3740	799	740	749	891	680	0								
2000	10	2829	3215	3685	3740	3995	740	749	891	680	1118	0							
2001	11	5092	3215	3685	3740	3995	3698	749	891	680	1118	880	0						
2002	12	5092	5788	3685	3740	3995	3698	3747	891	680	1118	880	767	0					
2003	13	5092	5788	6632	3740	3995	3698	3747	4457	680	1118	880	767	711	0				
2004	14	5092	5788	6632	6732	3995	3698	3747	4457	3402	1118	880	767	711	767	0			
2005	15	-5941	5788	6632	6732	7191	3698	3747	4457	3402	5589	880	767	711	767	646	0		
2006	16	6035	-6752	6632	6732	7191	6657	3747	4457	3402	5589	4402	767	711	767	646	690	0	
2007	17	6145	6859	-7738	6732	7191	6657	6744	4457	3402	5589	4402	3836	711	767	646	690	667	0

Table A2.4 Sumarion table for cohorts of areas afforested with broadleaves, t CO_2.

Summation table for cohorts of areas afforested with broadleaves (t CO2)

	Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	Area (ha)	320	527	721	738	912	790	833	1614	912	3613	2115	1577	1828	1972	857	2841	3353	546
Year	Age (yr)																		
1990	0	0																	
1991	1	685	0																
1992	2	685	1128	0															
1993	3	685	1128	1543	0														
1994	4	685	1128	1543	1579	0													
1995	5	685	1128	1543	1579	1952	0												
1996	6	2054	1128	1543	1579	1952	1691	0											
1997	7	2054	3383	1543	1579	1952	1691	1783	0										
1998	8	2054	3383	4629	1579	1952	1691	1783	3454	0									
1999	9	2054	3383	4629	4738	1952	1691	1783	3454	1952	0								
2000	10	2054	3383	4629	4738	5855	1691	1783	3454	1952	7732	0							
2001	11	2739	3383	4629	4738	5855	5072	1783	3454	1952	7732	4526	0						
2002	12	2739	4511	4629	4738	5855	5072	5348	3454	1952	7732	4526	3375	0					
2003	13	2739	4511	6172	4738	5855	5072	5348	10362	1952	7732	4526	3375	3912	0				
2004	14	2739	4511	6172	6317	5855	5072	5348	10362	5855	7732	4526	3375	3912	4220	0			
2005	15	2739	4511	6172	6317	7807	5072	5348	10362	5855	23195	4526	3375	3912	4220	1834	0		
2006	16	4109	4511	6172	6317	7807	6762	5348	10362	5855	23195	13578	3375	3912	4220	1834	6080	0	
2007	17	4109	6767	6172	6317	7807	6762	7130	10362	5855	23195	13578	10124	3912	4220	1834	6080	7175	0

Annex 3E Waste

Solid Waste Disposal on Land

The starting year for the FOD model used is 1960 for historic data for waste amounts. The record of ISAG registration of waste amounts does not go back in time that far, but for the time-series 1990-2006 to be reported here this does not play a bigger role as regards time-series consistency.

In Table 3E.1 results from the calculations by the model for selected years 1970-1979 to illustrate how the model performs: The left two columns represent the time-series of potential emissions. The actual emissions are in the next column as total. In the "from year"columns are put the contribution of emissions from individual previous years to the actual years emission (the Total). So, the contribution from the deposited waste in 1970 with its potential emission in 1970 (=39.2) to the actual emissions in 1970 was 2.63. In 1971 the contribution from the 1970 deposited waste was 2.45. In 1972 it was 2.29 and so on. Summing up the contribution from the potential of the year 1970 until 1979 equals 19.6 corresponding to a half-life time of 10 years; i.e. half of the potential emission of 39.2 in 1970 is emitted after 10 years. The reason for in this illustration to go back in time to 1970 to 1779 is simply that this is a way in one illustration in a small table to illustrate these behaviours.

Table 3E.1 Results from the FOD model 1970-1979.

Year	Emissions [kt]																					
	Potential	Actual																				
			From year																			
		Total	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1970	39,2	20,9	1,31	1,41	1,51	1,62	1,73	1,86	1,99	2,13	2,29	2,45	2,63									
1971	42,8	22,4	1,23	1,31	1,41	1,51	1,62	1,73	1,86	1,99	2,13	2,29	2,45	2,86								
1972	46,3	24,0	1,14	1,23	1,31	1,41	1,51	1,62	1,73	1,86	1,99	2,13	2,29	2,67	3,10							
1973	49,9	25,7	1,07	1,14	1,23	1,31	1,41	1,51	1,62	1,73	1,86	1,99	2,13	2,49	2,90	3,34						
1974	53,5	27,6	1,00	1,07	1,14	1,23	1,31	1,41	1,51	1,62	1,73	1,86	1,99	2,33	2,70	3,12	3,58					
1975	57,0	29,6	0,93	1,00	1,07	1,14	1,23	1,31	1,41	1,51	1,62	1,73	1,86	2,17	2,52	2,91	3,34	3,82				
1976	60,6	31,6	0,87	0,93	1,00	1,07	1,14	1,23	1,31	1,41	1,51	1,62	1,73	2,03	2,35	2,71	3,12	3,56	4,06			
1977	64,2	33,8	0,81	0,87	0,93	1,00	1,07	1,14	1,23	1,31	1,41	1,51	1,62	1,89	2,19	2,53	2,91	3,33	3,79	4,30		
1978	67,7	36,1	0,75	0,81	0,87	0,93	1,00	1,07	1,14	1,23	1,31	1,41	1,51	1,76	2,05	2,36	2,71	3,10	3,53	4,01	4,54	
1979	71,3	38,4	0,70	0,75	0,81	0,87	0,93	1,00	1,07	1,14	1,23	1,31	1,41	1,65	1,91	2,20	2,53	2,89	3,30	3,74	4,23	4,77
											total	19,6										

The result of summing this table horizontally in the "from years" columns is the total actual emission of that year.

Annex 3F Solvents

National Atmospheric Inventory
http://www.aeat.co.uk/netcen/airqual/naei/annreport/annrep99/app1_28.html

The emission inventory for Great Britain is performed by the National Environmental Technology Centre, June 2000, and covers the following sectors:

Total emission
Energy Production
Comm+ Residn Combusn.
Industrial Combustion
Production Processes
Extr & Distrib of Fossil Fuels
Solvent Use
Road Transport
Other Transp & Mach
Waste Treatment & Disp
Nature (Forests)

For the following substances

1 (1-methylethyl)cyclohexane
2 (1-methylpropyl)cyclohexane
3 (2-methyl-1-propyl)acetate
4 (2-methylbutyl)cyclohexane
5 (2-methylpropyl)cyclohexane
6 1-(2-butoxy-1-methyl-ethoxy)-2-propanol
7 1-(2-ethoxy-1-methyl-ethoxy)-2-propanol
8 1-(2-methoxy-1-methyl-ethoxy)2-propanol
9 1-(butoxyethoxy)-2-propanol
10 1,1,1-trichloroethane
11 1,1,1-trichlorotrifluoroethane
12 1,1,2,2-tetrachloroethane
13 1,1,2-trimethylcyclohexane
14 1,1,2-trimethylcyclopentane
15 1,1,3-trimethylcyclohexane
16 1,1,4,4-tetramethylcyclohexane
17 1,1-dichloroethane
18 1,1-dichloroethene
19 1,1-dichlorotetrafluoroethane
20 1,1-dimethylcyclohexane
21 1,1-dimethylcyclopentane
22 1,2,3,4-tetrahydronaphthalene
23 1,2,3,4-tetramethylbenzene
24 1,2,3,5-tetramethylbenzene
25 1,2,3,5-tetramethylcyclohexane
26 1,2,3-trichlorobenzene
27 1,2,3-trimethylbenzene
28 1,2,3-trimethylcyclohexane

29 1,2,3-trimethylcyclopentane
30 1,2,4,4-tetramethylcyclopentane
31 1,2,4,5-tetramethylbenzene
32 1,2,4-trichlorobenzene
33 1,2,4-trimethlycyclopentane
34 1,2,4-trimethylbenzene
35 1,2,4-trimethylcyclohexane
36 1,2,4-trimethylcyclopentane
37 1,2-diaminoethane
38 1,2-dibromoethane
39 1,2-dichlorobenzene
40 1,2-dichloroethane
41 1,2-dichloroethene
42 1,2-dichlorotetrafluoroethane
43 1,2-dimethyl-3-isopropylcyclopentane
44 1,2-dimethylcyclohexane
45 1,2-dimethylcyclopentane
46 1,2-ethanedioldiacetate
47 1,2-ethylmethylcyclopentane
48 1,2-propanediol
49 1,3,4,5,6-pentahydroxy-2-hexanone
50 1,3,5-trichlorobenzene
51 1,3,5-trimethylbenzene
52 1,3,5-trimethylcyclohexane
53 1,3-butadiene
54 1,3-dichlorobenzene
55 1,3-diethylbenzene
56 1,3-dimethyl-4-ethylbenzene
57 1,3-dimethyl-5-propylbenzene
58 1,3-dimethylcyclohexane
59 1,3-dimethylcyclopentane
60 1,3-dioxolane
61 1,3-ethylmethylcyclopentane
62 1,3-hexadiene
63 1,4-butyrolacetone
64 1,4-dichlorobenzene
65 1,4-diethylbenzene
66 1,4-dimethyl-2-isopropylbenzene
67 1,4-dimethylcyclohexane
68 1,4-dimethylpiperazine
69 1,4-dioxane
70 11-methyl-1-dodecanol
71 1-butanal
72 1-butanol
73 1-butene
74 1-butoxy-2-propanol
75 1-butyne
76 1-chloro-2,3-epoxypropane
77 1-chloro-4-nitrobenzene
78 1-chloropropane
79 1-decene
80 1-ethoxy-2-propanol
81 1-ethoxy-2-propyl acetate
82 1-ethyl-1,4-dimethylcyclohexane
83 1-ethyl-2,2,6-trimethylcyclohexane

84 1-ethyl-2,3-dimethylbenzene
85 1-ethyl-2,3-dimethylcyclohexane
86 1-ethyl-2-propylbenzene
87 1-ethyl-2-propylcyclohexane
88 1-ethyl-3,5-dimethylbenzene
89 1-ethyl-3-methylcyclohexane
90 1-ethyl-4-methylcyclohexane
91 1-ethylpropylbenzene
92 1-heptene
93 1-hexanal
94 1-hexene
95 1-hydrophenol
96 1-methoxy-2-ethanol
97 1-methoxy-2-propanol
98 1-methoxy-2-propyl acetate
99 1-methyl-1-phenylcyclopropane
100 1-methyl-1-propylcyclopentane
101 1-methyl-2-isopropylbenzene
102 1-methyl-2-propylbenzene
103 1-methyl-3-(isopropyl)benzene
104 1-methyl-3-isopropylcyclopentane
105 1-methyl-3-propylbenzene
106 1-methyl-4-isopropylbenzene
107 1-methyl-4-isopropylcyclohexane
108 1-methyl-4-tertbutylbenzene
109 1-methylbutylbenzene
110 1-methylindan
111 1-methylindene
112 1-nonene
113 1-octene
114 1-pentanal
115 1-pentanol
116 1-pentene
117 1-propanal
118 1-propanol
119 2-(2-aminoethylamino)ethanol
120 2-(2-butoxyethoxy)ethanol
121 2-(2-butoxyethoxy)ethyl acetate
122 2-(2-ethoxyethoxy)ethanol
123 2-(2-ethoxyethoxy)ethyl acetate
124 2-(2-hydroxy-ethoxy)ethanol
125 2-(2-hydroxy-propoxy)-1-propanol
126 2-(methoxyethoxy)ethanol
127 2,2,3,3-tetramethylhexane
128 2,2,4,6,6-pentamethylheptane
129 2,2,4-trimethyl-1,3-pentanediol
130 2,2,4-trimethylpentane
131 2,2,5-trimethylhexane
132 2,2-dimethylbutane
133 2,2-dimethylhexane
134 2,2-dimethylpentane
135 2,2-dimethylpropane
136 2,2′-iminodi(ethylamine)
137 2,2′-iminodiethanol
138 2,3,3,4-tetramethylpentane

139 2,3,3-trimethyl-1-butene
140 2,3,4-trimethylhexane
141 2,3,4-trimethylpentane
142 2,3,5-trimethylhexane
143 2,3-dimethylbutane
144 2,3-dimethylfuran
145 2,3-dimethylheptane
146 2,3-dimethylhexane
147 2,3-dimethylnonane
148 2,3-dimethyloctane
149 2,3-dimethylpentane
150 2,3-dimethylundecane
151 2,4,6-trichloro-1,3,5-triazine
152 2,4-difluoroaniline
153 2,4-dimethyl-1-(1-methylethyl)benzene
154 2,4-dimethylfuran
155 2,4-dimethylheptane
156 2,4-dimethylhexane
157 2,4-dimethylpentane
158 2,4-toluene diisocyanate
159 2,5-dimethyldecane
160 2,5-dimethylfuran
161 2,5-dimethylheptane
162 2,5-dimethylhexane
163 2,5-dimethyloctane
164 2,6-dimethyldecane
165 2,6-dimethylheptane
166 2,6-dimethyloctane
167 2,6-dimethylundecane
168 2,6-toluene diisocyanate
169 2,7-dimethyloctane
170 2-[2-(2-ethoxy-ethoxy)-ethoxy]ethanol
171 2-acetoxy-propyl acetate
172 2-aminoethanol
173 2-butanol
174 2-butanone
175 2-butanone oxime
176 2-butene
177 2-butoxyethanol
178 2-butoxyethyl acetate
179 2-chloroethanol
180 2-chloropropane
181 2-chlorotoluene
182 2-ethoxyethanol
183 2-ethoxyethyl acetate
184 2-ethoxypropanol
185 2-ethyl hexanol
186 2-ethyl-1,3-dimethylbenzene
187 2-ethyltoluene
188 2-hexoxyethanol
189 2-hydrophenol
190 2-isopropoxyethanol
191 2-methoxy-2-methylpropane
192 2-methoxyethanol
193 2-methoxyethyl acetate

194 2-methoxypropane
195 2-methyl benzaldehyde
196 2-methyl-1,3-dioxolane
197 2-methyl-1-butene
198 2-methyl-1-butylbenzene
199 2-methyl-1-pentene
200 2-methyl-1-propanol
201 2-methyl-2,4-pentanediol
202 2-methyl-2-butene
203 2-methyl-2-hexene
204 2-methyl-5-ethyloctane
205 2-methylbutanal
206 2-methylbutane
207 2-methyldecalin
208 2-methyldecane
209 2-methylfuran
210 2-methylheptane
211 2-methylhexane
212 2-methylnonane
213 2-methyloctane
214 2-methylpentane
215 2-methylpropanal
216 2-methylpropane
217 2-methylpropenal
218 2-methylpropene
219 2-methylpropyl acetate
220 2-methylpyridine
221 2-methylundecane
222 2-pentanone
223 2-pentene
224 2-phenoxy ethanol
225 2-phenylpropene
226 2-propanol
227 2-propen-1-ol
228 2-propyl acetate
229 3-(2-hydroxy-propoxy)-1-propanol
230 3,3,4-trimethylhexane
231 3,3,5-trimethylheptane
232 3,3-dimethylheptane
233 3,3-dimethyloctane
234 3,3-dimethylpentane
235 3,4-dimethylheptane
236 3,4-dimethylhexane
237 3,5-dimethyloctane
238 3,6-dimethyloctane
239 3,7-dimethylnonane
240 3A,4,7,7A-tetrahydro-4,7-methanoindene
241 3-chloro-4-fluoropicoline
242 3-chloropropene
243 3-chloropyridine
244 3-ethyl-2-methylheptane
245 3-ethyl-2-methylhexane
246 3-ethylheptane
247 3-ethylhexane
248 3-ethyloctane

249 3-ethylpentane
250 3-ethyltoluene
251 3-hydrophenol
252 3-methyl benzaldehyde
253 3-methyl-1-butene
254 3-methylbutanal
255 3-methylbutanol
256 3-methyldecane
257 3-methylfuran
258 3-methylheptane
259 3-methylhexane
260 3-methylnonane
261 3-methyloctane
262 3-methylpentane
263 3-methylundecane
264 3-pentanone
265 4,4-dimethylheptane
266 4,4′-methylenedianiline
267 4,5-dimethylnonane
268 4,6-dimethylindan
269 4,7-dimethylindan
270 4-4′-methylenediphenyl diisocyanate
271 4-bromophenyl acetate
272 4-chlorotoluene
273 4-ethyl morpholine
274 4-ethyl-1,2-dimethylbenzene
275 4-ethyloctane
276 4-ethyltoluene
277 4-methyl benzaldehyde
278 4-methyl-1,3-dioxol-2-one
279 4-methyl-1-pentene
280 4-methyl-2-pentanol
281 4-methyl-2-pentanone
282 4-methyl-4-hydroxy-2-pentanone
283 4-methyldecane
284 4-methylheptane
285 4-methylnonane
286 4-methyloctane
287 4-methylpentene
288 4-propylheptane
289 5-methyl-2-hexanone
290 5-methyldecane
291 5-methylnonane
292 5-methylundecane
293 6-ethyl-2-methyldecane
294 6-ethyl-2-methyloctane
295 6-methylundecane
296 8-methyl-1-nonanol
297 acenaphthene
298 acenaphthylene
299 acetaldehyde
300 acetic acid
301 acetic anhydride
302 acetone
303 acetonitrile

304 acetyl chloride
305 acetylene
306 acrolein
307 acrylamide
308 acrylic acid
309 acrylonitrile
310 aniline
311 anthanthrene
312 anthracene
313 atrazine
314 benzaldehyde
315 benzene
316 benzene-1,2,4-tricarboxylic acid 1,2-
317 benzo (a) anthracene
318 benzo (a) pyrene
319 benzo (b) fluoranthene
320 benzo (c) phenanthrene
321 benzo (e) pyrene
322 benzo (g,h,i) fluoranthene
323 benzo (g,h,i) perylene
324 benzo (k) fluoranthene
325 benzophenone
326 benzopyrenes
327 benzyl alcohol
328 benzyl chloride
329 biphenyl
330 bis(2-hydroxyethyl)ether
331 bis(chloromethyl)ether
332 bis(tributyltin) oxide
333 bromoethane
334 bromoethene
335 bromomethane
336 butane
337 butanethiols
338 butene
339 butoxyl
340 butyl acetate
341 butyl acrylate
342 butyl glycolate
343 butyl lactate
344 butylbenzene
345 butylcyclohexane
346 butyrolactone
347 C10 alkanes
348 C10 alkenes
349 C10 aromatic hydrocarbons
350 C10 cycloalkanes
351 C11 alkanes
352 C11 alkenes
353 C11 aromatic hydrocarbons
354 C11 cycloalkanes
355 C12 alkanes
356 C12 cycloalkanes
357 C13 alkanes
358 C13+ alkanes

359 C13+ aromatic hydrocarbons
360 C14 alkanes
361 C15 alkanes
362 C16 alkanes
363 C2-alkyl-anthracenes
364 C2-alkyl-benzanthracenes
365 C2-alkyl-benzophenanthrenes
366 C2-alkyl-chrysenes
367 C2-alkyl-phenanthrenes
368 C5 alkenes
369 C6 alkenes
370 C7 alkanes
371 C7 alkenes
372 C7 cycloalkanes
373 C8 alkanes
374 C8 alkenes
375 C8 cycloalkanes
376 C9 alkanes
377 C9 alkenes
378 C9 aromatic hydrocarbons
379 C9 cycloalkanes
380 camphor/fenchone
381 carbon disulphide
382 carbon tetrachloride
383 carbonyl sulphide
384 chlorobenzene
385 chlorobutane
386 chlorocyclohexane
387 chlorodifluoromethane
388 chloroethane
389 chloroethene
390 chloroethylene
391 chlorofluoromethane
392 chloromethane
393 chrysene
394 cis-1,3-dimethylcyclopentane
395 cis-2-butene
396 cis-2-hexene
397 cis-2-pentene
398 coronene
399 crotonaldehyde
400 cycloheptane
401 cyclohexanamine
402 cyclohexane
403 cyclohexanol
404 cyclohexanone
405 cyclopenta (c,d) pyrene
406 cyclopenta-anthracenes
407 cyclopentane
408 cyclopenta-phenanthrenes
409 cyclopentene
410 decalin
411 decane
412 diacetoneketogulonic acid
413 diazinon

414 dibenzanthracenes
415 dibenzo (a,h) anthracene
416 dibenzopyrenes
417 dichlorobutenes
418 dichlorodifluoromethane
419 dichlorofluoromethane
420 dichloromethane
421 dichlorvos
422 diethyl disulphide
423 diethyl ether
424 diethyl sulphate
425 diethylamine
426 diethylbenzene
427 difluoromethane
428 dihydroxyacetone
429 diisopropyl ether
430 diisopropylbenzene
431 dimethoxymethane
432 dimethyl disulphide
433 dimethyl esters
434 dimethyl ether
435 dimethyl sulphate
436 dimethyl sulphide
437 dimethylamine
438 dimethylbutene
439 dimethylcyclopentane
440 dimethylformamide
441 dimethylhexene
442 dimethylnonane
443 dimethylpentane
444 dipentene
445 dipropyl ether
446 dodecane
447 ethane
448 ethanethiol
449 ethanol
450 ethofumesate
451 ethyl acetate
452 ethyl acrylate
453 ethyl butanoate
454 ethyl chloroformate
455 ethyl hexanol
456 ethyl lactate
457 ethyl pentanoate
458 ethyl propionate
459 ethylamine
460 ethylbenzene
461 ethylcyclohexane
462 ethylcyclopentane
463 ethyldimethylbenzene
464 ethylene
465 ethylene glycol
466 ethylene oxide
467 ethylisopropylbenzene
468 fenitrothion

469 fluoranthene
470 fluorene
471 formaldehyde
472 formanilide
473 formic acid
474 fumaric acid
475 glycerol
476 glyoxal
477 heptadecane
478 heptane
479 hexachlorocyclohexane
480 hexachloroethane
481 hexadecane
482 hexafluoropropene
483 hexamethylcyclotrisiloxane
484 hexamethyldisilane
485 hexamethyldisiloxane
486 hexamethylenediamine
487 hexane
488 hexylcyclohexane
489 indan
490 indeno (1,2,3-c,d) pyrene
491 iodomethane
492 isobutylbenzene
493 isobutylcyclohexane
494 isopentylbenzene
495 isophorone
496 isoprene
497 isoprene + BVOC (1)
498 isopropylbenzene
499 isopropylcyclohexane
500 limonene
501 malathion
502 maleic anhydride
503 m-cresol
504 menthene
505 methacrylic acid
506 methanethiol
507 methanol
508 methyl acetate
509 methyl acrylate
510 methyl butanoate
511 methyl ethyl ether
512 methyl formate
513 methyl glyoxal
514 methyl methacrylate
515 methyl naphthalenes
516 methyl pentanoate
517 methyl styrene
518 methylamine
519 methyl-anthracenes
520 methyl-benzanthracenes
521 methyl-benzphenanthrenes
522 methylcyclodecane
523 methylcyclohexane

524 methylcyclopentane
525 methylethylbenzene
526 methyl-fluoranthenes
527 methylhexane
528 methylindane
529 methyl-phenanthrenes
530 methylpropene
531 methylpropylbenzene
532 methyltetralin
533 m-xylene
534 N-(hydroxymethyl) acrylamide
535 N,N-diethyl benzenamine
536 N,N-dimethyl benzenamine
537 naphthalene
538 naphthol
539 Nedocromil Sodium
540 nitrobenzene
541 nitromethane
542 nitropentane
543 nitropropane
544 N-methyl pyrrolidone
545 nonane
546 o-cresol
547 octahydroindan
548 octamethylcyclotetrasiloxane
549 octane
550 octylamine
551 o-xylene
552 palmitic acid
553 p-benzoquinone
554 p-cresol
555 pentadecane
556 pentafluoroethane
557 pentane
558 pentanethiols
559 pentylbenzene
560 pentylcyclohexane
561 permethrin
562 perylene
563 phenol
564 phenoxyacetic acid (phenoxy acid)
565 phenylacetic acid
566 phenylacetonitrile
567 phthalic anhydride
568 pine oil
569 polyethylene glycol
570 polyisobutene
571 polyvinyl chloride
572 potassium phenylacetate
573 propadiene
574 propane
575 propanetriol
576 propanoic acid
577 propionitrile
578 propyl acetate

579 propyl butanoate
580 propyl propionate
581 propylamine
582 propylbenzene
583 propylcyclohexane
584 propylcyclopentane
585 propylene
586 propylene oxide
587 propyne
588 p-xylene
589 pyrene
590 pyridine
591 salicylic acid
592 sec-butylbenzene
593 sec-butylcyclohexane
594 simazine
595 sodium 2-ethylhexanoate
596 sodium acetate
597 sodium phenylacetate
598 styrene
599 sulphanilamide
600 terpenes
601 tert-butylamine
602 tert-butylbenzene
603 tert-butylcyclohexane
604 tert-butylcyclopropane
605 tert-pentylbenzene
606 tetrachloroethene
607 tetradecane
608 tetrafluoroethene
609 tetrahydrofuran
611 tetramethylcyclohexane
612 toluene
613 toluene-2,3-diamine
614 toluene-2,4-diamine
615 toluene-2,4-diisocyanate
616 toluene-2,5-diamine
617 toluene-2,6-diamine
618 toluene-2,6-diisocyanate
619 toluene-3,4-diamine
620 toluene-3,5-diamine
621 trans-2-butene
622 trans-2-hexene
623 trans-2-pentene
624 trans-3-hexene
625 trialkyl phosphate
626 trichloroethene
627 trichlorofluoromethane
628 trichloromethane
629 tridecane
630 triethanolamine
631 triethylamine
632 trifluoroethene
633 trifluoromethane
634 trifluralin

635 trimethylamine
636 trimethylfluorosilane
637 tri-n-butyl phosphate
638 undecane
639 unspeciated alcohols
640 unspeciated aliphatic hydrocarbons
641 unspeciated alkanes
642 unspeciated alkenes
643 unspeciated amines
644 unspeciated aromatic hydrocarbons
645 unspeciated carboxylic acids
646 unspeciated cycloalkanes
647 unspeciated hydrocarbons
648 unspeciated ketones
649 urea
650 vinyl acetate
(1) BVOC- biogenic VOCs, such as alpha-pinene and other terpenes

Annex 4 CO_2 reference approach and comparison with sectoral approach, and relevant information on the national energy balance

Please refer to Annex 3

Annex 5 Assessment of completeness and (potential) sources and sinks of greenhouse gas emissions and removals excluded

The Danish greenhouse gas emission inventories for 1990-2007 include all sources identified by the Revised 2006 IPCC Guidelines and the 2000 IPCC Good Practice Guidance except the following:

In the Agriculture sector methane emissions from enteric fermentation for poultry and fur farming is not estimated, because the methane conversion factor is not estimated. There is no default value recommended in IPCC GPG (Table A-4). However, these emissions are seen as non-significant compared with the total emission from enteric fermentation.

In the LULUCF sector emissions/removals from settlements are currently not estimated due to the lack of available data. The lack of data availability is also an issue for other aspects of LULUCF, e.g. harvested wood products. However a major research project is currently running to provide data, see chapter 7.

Direct and indirect CH_4 emissions from agricultural soils are not estimated. Direct and indirect soil emissions are considered of minor importance for CH_4. No methodology is recommended in IPCC-GPG.

In the Industrial processes sector CO_2 emissions from CRF category 2D2 Food and Drink are not estimated, work is ongoing to collect activity data and estimate appropriate emission factors. Estimates are expected to be included in the 2010 reporting.

CO_2 emissions from iron foundries have not yet been estimated. Denmark is currently working on determining the technologies applied at Danish iron foundries. Estimates are expected to be included in the 2010 reporting.

In the Solvent and other product use sector currently only N_2O emissions from anaesthesia are included in CRF category 3D, Denmark will try to obtain activity data for other uses of N_2O.

In the Waste sector CO_2 emissions from managed waste disposal on land are not estimated. According to the 1996 IPCC Guidelines: "Decomposition of organic material derived from biomass sources (e.g., crops, forests), which are regrown on an annual basis is the primary source of CO_2 released from waste. Hence, these CO_2 emissions are not treated as net emissions from waste in the IPCC Methodology."

For wastewater handling, the methane emission will in the future be reported under sludge in Table 6.Bs1 under 6B2b. sludge, with no differentiation between wastewater and sludge. Emissions of methane form treatment of industrial wastewater are included to the extent that this fraction is treated at the centralised WWTPs; i.e. the emission of methane originating from separate industries is not included. The direct emission (emissions from treatment processes at the plant) of N_2O will be reported under 6B2b as well, whereas the indirect N_2O emission, i.e. emission originating from the effluent wastewater, will be reported under 6B2a. waste water. The indirect emission of N_2O has until now been reported under 'N2O form human sewage' in Table 6.Bs1. Regarding separate industries, only indirect emissions from separate industries have been included in the inventory, whereas the direct emissions are still to be included. In addition to separate industries, the indirect emission estimate includes: Rainwater conditioned effluent, Scattered houses, Mariculture and fish farming and Municipal and private WWTPs as provided in Table 8.23 in the main report.

Annex 6.1 Additional information to be considered as part of the NIR submission (where relevant) or other useful reference information

Annual emission inventories 1990-2007 CRF Table 10 for the Kingdom of Denmark and for Denmark + Greenland

In NIR reports up until the NIR 2004 we included the full CRF tables in the NIR report itself as well as we submitted the CRF as spreadsheet files. Due to size constraints the CRF tables will no longer be presented here. The full CRF tables 1990-2007 as spreadsheets are submitted separately as well as the files in the new CRF reporter tools. Notice that this tool defines base year in the sense of the Climate Change Convention (not as in the Kyoto protocol) which is the emissions in 1990.

Annex 6.2 Additional information to be considered as part of the NIR submission (where relevant) or other useful reference information – Greenland/Faroe islands

CO_2 emissions in Greenland and the Faroe Islands

In the Faroe Islands a major work was made in 2002 to produce a revised and more comprehensive greenhouse gas inventory as required by the IPCC guidelines (Lastein et al., 2003). The work comprised emission estimates of CO_2, CH_4 and N_2O for the years 1990-2001.

Since 2008 updates of this work has been made (Umhvørvisstovan, 2009), and the Faroese inventories now include time series of CO_2, CH_4 and N_2O as well as HFC and SF_6 emissions for the years 1990-2007.

The emission factors behind the inventories come from NERI. According to Umhvørvisstovan (Pers. comm. Hansen, 2009) the following changes have been made since last year's submission:

- Emissions from the use of heavy fuel oil in navigation is now included.
- Small errors in the road transport emission calculations have been corrected.
- N_2O emissions from grassing animals (agricultural soils) is now included.
- Small changes have been made to activity data (and hence associated emissions) for the usage of gasoline and kerosene.
- Due to an error the emissions of CH_4 from "Manufacture of Solid fuels and Other Energy Industries" was not included in last year's submission. This error has now been corrected.
- A thorough investigation has shown that the fuel consumption by Atlantic Airways, the Norrøna ferry company and navigation fuel supplied by tank vessels at sea must be excluded from the inventory. Fuel consumption for these categories is bought from oil companies outside the Faroe Islands, and hence these fuel sales (and associated emissions) are accounted for by other countries.

Looking at the general emission trends for the Faroe Islands, the significant increase in CO_2 emissions from 1998 to 2001 is mainly due to more fuel use in the fishery, public electricity and manufacturing industry sectors.

For Greenland the inventory has since the NIR 2007 been expanded to include emissions from agriculture and consumption of F-gases and the pollutants CH_4, N_2O and HFCs. However, fossil fuels are still the most important sources of greenhouse gases in this region. Figures for CO_2, CH_4, and N_2O emissions from 1990 to 2007 and for HFCs for 1995-2007 are given in the table below. The greenhouse gas inventory submitted in March 2009 is completed by Statistics Greenland and The Greenland

Climate and Infrastructure. The methodology applied is described in Annex 6.2.1.

The reporting of the inventories for Greenland and Faroe Islands was discussed during the in-country review in April 2007. One main issue in the discussion was how to include these inventories in the CRF format. At the stage of the review the inventories was included in the sector "7. Other" of the CRF format only, while the inventory was detailed as in this Annex. The conclusion of the discussion was to continue with the reporting in the sector "7. Other", and add to the reporting inventories for Greenland and for Faroe Islands in the "Summary 2" table of the CRF format. This "Summary 2" table reporting is included in the Annex 6.2.1 (Greenland) and Annex 6.2.3 (Faroe Islands) below.

Table 1 Estimation of greenhouse gas emissions in Greenland and the Faroe Is-lands 1990-2006.

	Greenland				Faroe Islands			
	Gg CO_2	Mg CH_4	Mg N_2O	F-gasses Gg CO_2-eq.	Gg CO_2	Mg CH_4	Mg N_2O	F-gasses Gg CO_2-eq.
1990	625	839	27.8		661	849	76	0.00
1991	610	848	27.6		642	815	74	0.00
1992	596	806	26.0		631	822	75	0.12
1993[1]	546	763	23.7		521	824	70	0.13
1994	496	795	23.5		526	866	71	0.16
1995	533	831	25.4	0.060	530	866	72	0.18
1996	596	843	26.4	0.080	550	860	72	0.22
1997	617	885	28.4	0.39	544	860	72	0.83
1998	579	832	26.0	0.71	586	852	74	1.41
1999	593	778	26.8	1.27	615	856	75	3.38
2000	666	718	27.3	1.85	652	864	76	4.42
2001	616	720	26.5	2.93	742	876	79	7.00
2002	578	686	25.3	3.86	714	876	79	8.78
2003	647	712	26.7	4.70	730	875	79	10.28
2004	635	715	27.4	5.36	729	868	79	11.58
2005	634	731	27.8	5.44	709	852	78	11.34
2006	657	724	28.3	5.51	717	842	78	11.79
2007	649	732	28.3	6.02	717	844	79	12.13

1. The CO_2 emission for Greenland 1993 is interpolated.

References

Umhvørvisstovan, 2009: Unpublished data material, Maria Gunnleivsdóttir Hansen (mariagh@lmr.fo).

Lastein, L. & Winther, M. 2003: Emission of greenhouse gases and long-range transboundary air pollutants in the Faroe Islands 1990-2001. National Environmental Research Institute. - NERI Technical Report 477 (electronic): 62 pp. Available at: http://www.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR477.PDF

Annex 6.2.1 Methodology applied for the GHG inventory for Greenland

Introduction

The following sections contain a report of Greenland's part of the National Inventory Report (NIR) 2009. The structure of the report partly follows the UNFCCC guidelines on reporting and review (UNFCCC, 2002).

The report initiates an introduction followed by a summary on trends in greenhouse gas emissions.

Previously the greenhouse gas inventory and this annex were completed exclusively by The Danish National Environmental Research Institute with input from the Environmental and Nature Agency, Ministry of Infrastructure and Environment.

In 2008 an energy statistic was officially initiated at Statistics Greenland with the intention to "… create an important tool, which in regard to political and economical priorities, can contribute to the identification of efforts on energy matters…" and which "… in regard to environmental aspects will create a basis for assessing the development in regard to Greenland's meetings of the Kyoto protocol …". The first results on the new energy statistics, covering the period 2004-2007, were published in November 2008.

The greenhouse gas inventory submitted in March 2009 is completed by Statistics Greenland and The Greenland Climate and Infrastructure Agency with technical support from The Danish National Environmental Research Institute. This report on methodology is written by Statistics Greenland with assistance from The Greenland Climate and Infrastructure Agency, and documental support by The Danish National Environmental Research Institute.

The annual emission inventories for Greenland, for the years 1990-2007, are reported in the form *Summary 2 – Summary report for CO_2 equivalent emissions*. Emissions for each greenhouse gas are given in CO_2 equivalents.

The greenhouse gases reported are:

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

A description of the institutional arrangement for inventory preparation

The Climate and Infrastructure Agency is responsible for the annual preparation and submission to the UNFCCC of the Greenlandic contribution to the National Inventory Report and the GHG inventories in the Common Reporting Format in accordance with the UNFCCC Guidelines.

The work concerning the annual greenhouse gas emission inventory is carried out in co-operation with other Greenlandic ministries, research institutes, organisations and companies:

Statistics Greenland (Ministry of Finances and Foreign Affairs)
Annual energy statistics in a format suitable for the emission inventory work and fuel-use data for the large combustion plants. Statistical Yearbook.

Agricultural Advisory Service (Ministry of Fisheries, Hunting and Agriculture)
Background data on cropland and grassland, and statistics on livestock (sheep and reindeer).

Agency of Environment and Nature (Ministry of Infrastructure and Environment)
Data on waste and emissions of F-gases.

Ministry of Fisheries, Hunting and Agriculture
Background data for Forestry.

Greenland Airport Authority (Ministry of Infrastructure and Environment)
Statistics on domestic flights and foreign flights to and from Greenland.

Formerly, the provision of data was on a voluntary basis, but a more formal agreement is now in place for the 2009 GHG inventory report.

Brief description of the process of inventory preparation - data collection, data processing, data storage

The background data (activity data and emission factors) for estimation of the Greenlandic emission inventories is collected and stored in central databases at Statistics Greenland. The databases are in SAS format and handled with software from the SAS Institute Inc. The SAS programs are designed by Statistics Greenland.

The material is placed on servers at Statistics Greenland. The servers are subject to routine backup services. Material, which have been backed up is archived safely.

General description of methodologies and data sources used

The GHG inventory for Greenland includes the following sectors:

- Energy sector
- Industrial processes (consumption of F-gasses)
- Agriculture (sheep and reindeer)
- Land Use, Land-use Change and Forestry
- Solid waste management

The applied methodology do to a large degree follow the methodology applied in the Danish inventory, however, the availability of data – especially site specific data – do allow the same equations to be used for all the sectors. The actual methodology is described below for the different sectors.

Energy sector

The Greenlandic emission inventory for fuel combustion has been performed according to the IPCC tier 1 methodology. The inventory is based on activity data from the Greenlandic energy statistics and on emission factors for different fuels, plants and sectors.

Total fuel combustion is based on data from Polaroil, Statoil and Malik Supply A/S. Polaroil imports fuel and distributes fuel in all parts of Greenland. Statoil imports and distributes fuel in Kangerlussuaq. Malik Supply A/S, a Danish company, re-distributes fuel bought from Polaroil to Greenlandic trawlers, ships etc. By using detailed data from Polaroil, Statoil and Malik Supply A/S it is possible to determine total import, total export, total international bunkers and total domestic fuel combustion.

Total domestic fuel combustion is then divided into sectors and private households by using data from a survey on energy consumption, company specific sales data from Polaroil and local fuel distributors, company tax accountings, municipality and Greenland Home Rule Government accountings, and by estimation.

In 2008 Statistics Greenland conducted a survey among the greater companies. By completing a questionnaire each company returned detailed information on the consumption of specific types of fuel in 2004-2007. The survey covers 39.5 % of total GHG emission from energy combustion in 2007, see Table 1.

By using detailed information on sales from Polaroil and local fuel distributors it is possible to determine fuel combustion in private companies and public offices with an automatic deal on supply. The sales data covers 6.0 % of total GHG emission from energy combustion in 2007, see Table 1.

Tax accountings in DKK are used to determine annual consumption of fuel in private companies, in municipalities, and within the Greenland Home Rule Government. At the moment tax accountings are primarily used for determining fuel combustion in municipalities and public offices in settlements. Accountings cover 15.0 % of total GHG emission from energy combustion in 2007, see Table 1.

The remaining amount of total inland fuel combustion is divided into sectors and private households by estimation. This work is carried out by involving statistical material on population, housing, public finances, fisheries and hunting, and national accountings. The Greenlandic Business Register (GER) is used to divide remaining companies into sectors. Information on employees, operating units, vehicles etc. is used to determine the activity in each company.

Fuel combustion in private households is estimated using detailed information from a number of local fuel distributors. Fuel deliveries are registered by buildings. In Greenland each building has a unique number registered in the Greenlandic Area Register (NIN). By combining the NIN-register and the GER-register (see above) with statistics on housing and population each building is labelled *private household* or located to a sector describing the main activity in the building. This new building-sector register, completed annually, is used extensively to determine the buyer of fuel delivered by Polaroil or local fuel distributors.

Fuel combustion in road traffic is based on a model designed by Statistics Greenland. The model contains data on the vehicle stock obtained from the Greenland Police Department's register on engine data. The vehicles are divided into broad categories of type i.e. personal car, lorry, taxi, truck, ambulance, motorbike etc. Each category is assigned with ratios on fuel type and mileage. Input data on mileage is derived from a survey among businesses and private road traffic in 2008. Each vehicle is divided in business categories or labelled *private vehicle* according to the owner. For each group the emissions are estimated by combining vehicle and annual mileage numbers with standard emission factors according to the type of fuel. The model does not take cold start or hot engines into account.

For air traffic annual emissions are based on activity data from Air Greenland A/S and sales data from the Greenland Airport Authority. For navigation, ferries and freight, annual emissions are based on activity data from Royal Arctic Line A/S (freight), Royal Arctic Tankers A/S (freight), Royal Arctic Bygdeservice A/S (freight/passengers), and Arctic Umiaq Line A/S (passengers) and the liquidated Assartuivik A/S (passengers).

Table 1 shows the part of total CO_2 emission by using survey results, specific sales data, tax accountings, and estimation.

Table 1 CO_2 emission from fuel combustion by sources to sectoral division (2004-2007).

	2004	2005	2006	2007
			pct.	
Total	100.0	100.0	100.0	100.0
Survey	40.0	38.9	38.9	39.5
Sales data from Polaroil	6.6	6.4	6.5	6.0
Accountings	14.2	14.0	15.3	15.0
Estimation	39.2	40.7	39.3	39.5

The procedure described above is used to divide total fuel combustion into sectors and private households during the period 2004-2007. Formerly, the period 1990-2003, activity data on sectors and private households were estimated using aggregated statistics on population, housing, companies, data on sales from Polaroil, and data on energy consumption in larger companies.

Table 2 shows the activity data on fuel combustion for the period 1990-2007.

Table 2 Activity data on fuel combustion (SINK categories).

	1990	1991	1992	1993	1994	1995	1996	1997	1998
					TJ				
Total	8.471	8.271	8.075	…	6.710	7.232	8.083	8.366	7.843
Energy industries	2.455	2.383	2.324	…	1.873	1.609	1.618	1.713	1.619
Manufacturing and construction	358	348	339	…	273	596	605	627	544
Domestic aviation	535	550	541	…	493	574	629	653	766
Road transport	499	486	474	…	396	369	368	386	335
National navigation	287	279	272	…	223	284	284	298	262
Commercial/Institutional	679	659	643	…	518	712	721	745	582
Residential	2.112	2.054	2.006	…	1.644	1.703	1.724	1.780	1.509
AFF	1.434	1.403	1.369	…	1.204	1.286	2.035	2.066	2.128
Other	112	109	106	…	85	99	99	99	99
continued	1999	2000	2001	2002	2003	2004	2005	2006	2007
					TJ				
Total	8.041	9.029	8.351	7.822	8.772	8.510	8.568	8.870	8.799
Energy industries	1.703	1.734	1.748	1.751	1.751	1.795	1.776	1.867	1.800
Manufacturing and construction	624	656	622	588	678	424	444	433	499
Domestic aviation	739	729	624	595	637	612	629	739	737
Road transport	399	416	398	387	431	378	407	434	442
National navigation	306	320	307	297	333	380	346	324	317
Commercial/Institutional	741	771	714	688	784	1.190	1.224	1.255	1.220
Residential	1.770	1.844	1.741	1.664	1.888	1.776	1.761	1.792	1.734
AFF	1.660	2.461	2.098	1.753	2.171	1.872	1.894	1.934	1.953
Other	99	99	99	99	99	82	89	92	96

Sources: Statistics Greenland. Notes: Data on fuel combustion in 1993 are unavailable.

The CO_2 emission has been calculated by using the same methodology as described in the IPCC1996 guidelines (IPCC, 1997). This methodology implies use of C content pr fuel type (default) and fraction of carbon oxidised (default); see the equation below.

$$E_{CO_2} = \sum Act_a \times EF_{C,a} \times Ox \times 44/12$$

where:

Act_{fuel} = activity; consumption of fuel a

$EF_{C,fuel}$ = C emission factor for fuel a

Ox = oxidation factor

The emissions of CH_4, N_2O, NO_X, CO and NMVOC have been calculated at sector/fuel level by using IPCC default emission factors combined with measured/Danish EF waste incineration (with energy recovery). The equation applied for each pollutant is:

$$E = \sum (EF_{ab} \times Act_{ab})$$

where:

EF = emission factor

Act = activity; fuel input

a = fuel type

b = sector activity

Fugitive emission
Greenland has no off-shore activities, no oil refineries, no natural gas transmission or distribution. For that reason there is no fugitive emission from such activities.

However, some fugitive emission occurs in the distribution of fuel e.g. when refuelling from ships to on-shore tanks, onshore loading of fuel to ships and offshore loading of ships. The fugitive emission from loading/unloading of ships is currently not estimated.

Industrial processes

Energy consumption associated with industrial processes and emissions thereof are included in the Energy sector of the inventory.

Mineral products
Road paving with asphalt is the only contributor to emission of greenhouse gasses from mineral products. However the use of asphalt is currently not estimated.

Chemical industry
Greenland has no chemical industry.

Metal production
Greenland has no metal production.

Other production
There are several manufacturers of fish products and one tannery. The activity on these plants and the emission on greenhouse gasses thereof are currently not estimated.

F-gasses
Greenland has no production of halocarbons or SF_6. Data on consumption of F-gasses (HFCs and SF_6) are obtained from the Agency of Environment and Nature. The Agency conducts an annual survey on consumption of halocarbons and SF_6. Information on emission of industrial gasses is available from 1995 onwards. Greenland has no consumption of PFCs.

Solvent and other product use

The use of solvents and other products are currently not estimated.

Agriculture

Enteric Fermentation Manure Management
Agriculture is sparse in Greenland due to climatic conditions. However sheep and reindeer are considered to contribute to emission of greenhouse gasses. Enteric fermentation and manure management is assumed

to contribute to emission of CH_4, and nitrogen excretion is assumed to contribute to emission of N_2O.

The equations used are presented below.

$$E_{CH_4} = N_{animal} \times (EF_{ent.ferm.} + EF_{m.m.})$$

$$E_{N_2O} = N_{animal} \times N_{ex.} \times EF_{N_2O} \times 44/28$$

The applied emission factors are presented in Table 3.

Table 3 Applied emission factors for agriculture.

Animal	Enteric fermentation kg CH_4 pr head pr year	Manure management kg CH_4 pr head pr year	Nitrogen excretion kg N pr head pr year
Sheep	17.17	0.32	16.87
Reindeer	11.00	0.36	6.00

The emission factors for sheep are adopted from the Danish inventory (Illerup et al. 2006). The emission factors for reindeer are based on Norwegian emission factors.

The IPCC default for EFN_2O: 0.02 kg N_2O-N pr kg N has been chosen.

Table 4 shows the number of livestock (sheep and reindeer) in Greenland.

Table 4 Livestock (sheep and reindeer).

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Sheep	19.929	20.134	17.900	16.256	17.818	19.464	20.163	23.134	19.929
Reindeer	6.000	6.000	5.600	4.300	4.600	4.600	4.600	3.800	6.000
continued	1999	2000	2001	2002	2003	2004	2005	2006	2007
Sheep	21.007	20.444	20.394	18.967	19.259	20.383	21.317	21.289	21.704
Reindeer	2.106	2.000	2.480	3.100	3.100	3.100	3.100	2.318	2.441

Sources: Agricultural Advisory Service (Ministry of Fisheries, Hunting and Agriculture).

Greenland has no activities related to rice cultivation, prescribed burning of savannas, or field burning of agricultural residues. These categories are therefore omitted from the GHG inventory. The consumption of agricultural soils is currently not estimated.

Land use, land-use change and forestry

Data on land use, land-use change and forestry is introduced to the GHG inventory for Greenland in the 2009 submission.

Emission estimates for the LULUCF sector

These GHG emission estimates for the Greenlandic LULUCF sector are preliminary estimates calculated by Dep. of Policy Analysis, National Environmental Research Institute, Denmark. The estimation is based on data received from Greenland, expert judgment and default IPCC emission factors (IPCC 2006).

The GHG estimates are the first estimates and more data collection, validation and verification is needed. These first estimates include Forest land, Cropland and Grassland were as Wetlands, Settlements and Other land has not been estimated yet.

A land use matrix for Greenland has not been established. As a consequence hereof the effect on the GHG emission due to land use changes has not been estimated. However this emission must be assumed as very limited.

The estimations are based on area and species data.

Greenland has polar climate according to the IPCC guidelines with an average annual temperature for Nuuk (the Capital) of -1.4 C, a maximum of 9.9 C in July and a minimum of -10.7 °C in February (Based on 1961-1990). The more southern part of Greenland were the forest and agricultural activities are taking place has a higher average indicating a boreal zone. Qaqortoq in the southern Greenland has as an average of 0.6 C and a maximum in July of 11.1 C as an average for 1961 to 1990. The recent global warming has increased temperatures over the years making it possible to grow some vegetables as well as the area with grassland has increased and probably a higher growth rate in the Greenlandic forests.

In total Greenland had 54 ha of forest land in 2007, 5 ha of cropland, 973 ha of improved grassland and 242.000 ha of mountainous grassland. The mountainous grassland is only used for grazing sheep in the short summer period of 3-4 months. The major part of the mountainous grassland is bare rock and mountains.

There are currently no data on how the forests are maintained as well as how the cropland is cultivated.

Since 1990 the increase in grassland has often taken place together with draining and ditching. The drained area today is app. 250 ha. Approx. 75 % of the cropland and grassland is light sandy soils with a varying content of organic matter. The remaining area is fens with high organic matter content although there is no information on the organic matter content. Subsequently these areas are assumed to be histosols (>20 % organic matter).

There is currently no information on fertilizer and lime consumption.

Forest land

Greenland has four forests which may qualify to the FAO criteria of forest definitions, e.g. larger than 0.5 ha, a width larger than 20 meters, a minimum height higher than 5 meters at maturity and a minimum crown cover of 10 %. It is assumed that no cuttings or wind felling have taken place in the period 1990 to 2007.

No information is available on afforestation and deforestation – according to the Kyoto Protocol art. 3.3 – since 1990. However, it is assumed to be very limited with very low growth rates.

The four forests are:

A natural forest in the Qinngua valley of 45 ha consisting mainly of Betula Nana which in the period 1990 to 2007 has had an average height of six meters and app. 100 trees pr ha. It is thus assumed that it has had the same biomass for the whole period.

A planted forest in Qanassiassat of one ha (Picea Abies) which in 1990 had an average height of five meters increasing to 10 meters in 2007 with an average of 800 trees pr ha.

A planted forest in Kuussuaq of five ha (Abies Lasiocarpa) which in 1990 had an average height of three meters increasing to nine meters in 2007 with app. 900 trees pr ha.

A planted forest in Orpiutegarfia of three ha (Larix Sibirica) which in 1990 had an average height of four meters increasing to seven meters in 2007 with approx. 400 trees pr ha.

There is no information on forest area on organic soils and drainage status.

For the carbon stock and carbon stock changes calculations for forests a combination of data from Greenland and default values on density, carbon content, BCEFs and shoot-root-ratio from IPCC Guidelines for National Green House Gas Inventories (IPPC 2006) for living biomass for the boreal zone are used. No estimations are made for carbon stock and carbon stock changes in dead organic matter and forest soils as well as CH_4 and N_2O emissions.

Carbon stock change for 1990 is not estimated since no data is available for 1989.

Cropland

In 1990 it was assumed that no annual crops were grown in Greenland. In 2007 five ha of cropland was used for annual crops. The primary production is potatoes. Potato fields are mainly managed by hand and primarily fens with a high content of organic matter which is used for this purpose. It is thus assumed that the IPCC standard emission factor for boreal/cold areas of five tonnes C pr ha can be used although it is probably an overestimation due to the cold climate and the current management practice.

The N_2O emission from cropland has not been estimated.

Grassland

The total area with grassland has increased from 490 ha in 1990 to 973 ha in 2007. The grassland is improved grassland which occasionally is reseeded with grass to increase the yield. At the moment no information is available on how often the grass sward is broken. Approx. 25 % of the grassland is organics soils as well as 250 ha is assumed to be drained. For grassland on mineral/varying soils an emission of zero (steady state) is assumed although there has been an increase in the area since 1990. For the area on histosols it is assumed that the IPCC standard emission factor for boreal/cold areas of 0.25 tonnes C pr ha is applicable although it is probably an overestimation due to the cold climate. For the whole period it is assumed that 25 % of the grassland is on histosols leading to an increased emission from this source.

It is well known that the frequent freezing/thawing situation may lead to high peaks of N_2O emission. However has this emission not been estimated yet.

Wetlands

No emission estimates has been made since no data is available.

Settlements

No emission estimates has been made since no data is available.

Other land

No emission estimates has been made since no data is available.

Data on land-use and forestry are presented in Table 5.

Table 5 Land-use and Forestry (ha)

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Forest Land	54	54	54	54	54	54	54	54	54
Cropland	-	-	-	-	-	-	-	-	-
Grassland	490	516	542	568	594	620	646	672	698
Continued	1999	2000	2001	2002	2003	2004	2005	2006	2007
Forest Land	54	54	54	54	54	54	54	54	54
Cropland	-	-	5	5	5	5	5	5	5
Grassland	724	750	776	851	874	888	922	961	973

Sources: Agricultural Advisory Service (cropland, grassland), Ministry of Fisheries, Hunting and Agriculture (forestry)

Data on carbon stock, living biomass in forests are presented in Table 6.

Table 6 Preliminary emission estimated for Forestland, Cropland and Grassland

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Forestry									
Carbon stock, living biomass (tonne C)	182,2	182,7	184,9	187,6	190,8	194,4	198,7	203,5	209,0
Carbon stock, total (tonne CO_2)	667,9	669,7	678,0	687,9	699,5	713,0	728,5	746,2	766,3
Carbon stock change (tonne CO_2 pr year) [a]	NEb	-1,8	-8,3	-9,9	-11,6	-13,5	-15,5	-17,7	-20,1
Cropland									
CO_2 emission (tonne pr year)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Grassland									
CO_2 emission (tonne pr year)	112,4	118,3	124,3	130,2	136,1	142,1	148,0	154,0	159,9
Continued	1999	2000	2001	2002	2003	2004	2005	2006	2007
Forestry									
Carbon stock, living biomass (tonne C)	215,1	222,0	229,7	238,1	247,5	257,7	268,8	281,0	294,1
Carbon stock, total (tonne CO_2)	788,9	814,1	842,2	873,2	907,4	944,8	985,7	1.030,2	1.078,4
Carbon stock change (tonne CO_2 pr year)	-22,6	-25,2	-28,1	-31,0	-34,2	-37,4	-40,9	-44,5	-48,2
Cropland									
CO_2 emission (ton pr year)	0,0	0,0	91,7	91,7	91,7	91,7	91,7	91,7	91,7
Grassland									
CO_2 emission (tonne pr year)	165,9	171,8	177,7	195,0	200,3	203,5	211,3	220,3	223,0

Notes: a) negative values indicate that the source is a sink (carbon sequestration), positive values indicates that the source emit CO_2. b) NE = Not estimated. Carbon stock change in 1990 is not estimated since there is no data available yet for 1989.

Source: Calculations made by Dep. of Policy Analysis, National Environmental Research Institute, Denmark on forestry data from Ministry of Fisheries, Hunting and Agriculture.

Solid waste management

The solid waste management in Greenland can be divided in the following processes:

- Waste incineration with energy recovery
- Waste incineration without energy recovery
- Managed waste disposal combined with open burning
- Unmanaged waste disposal combined with open burning

Information on amount of waste produced pr year, amount of waste treated in the different processes, distribution between household and commercial waste, composition of the household waste and commercial waste, respectively, were provided by the Environmental and Nature Agency, Ministry of Infrastructure and Environment; see Table 7. The distribution of waste between different treatment options after correction for open burning is presented in Table 8. The amount of household waste generated in 2007 is assumed to be the same as in 2006.

Table 7 Composition of municipal waste before and after open burning.

Fraction	Household waste[2]	Commercial waste[2]	Weighted	After open burning	Weighted (after open burning)	DOC[3]	DOC weighted (after open burning)
				pct.			
Paper/cardboard, dry	8.00[1]	20.00	11.84	2.37	7.66	0.4	3.06
Paper/cardboard, wet	10.00[1]	7.00	9.04	1.81	5.85	0.2	1.17
Plastics	7.00[1]	9.00	7.64	1.53	4.94	-	-
Organic waste	44.00[1]	34.00	40.80	8.16	26.40	0.2	5.28
Other combustible	17.50[1]	16.00	17.02	3.40	11.00	0.2	2.20
Glass	7.50[1]	3.00[1]	6.06	6.06	19.60	-	-
Metal	3.50[1]	3.00[1]	3.34	3.34	10.80	-	-
Other, non combustible	1.00[1]	5.00	2.28	2.28	7.37	-	-
Hazardous waste	1.50[1]	3.00[1]	1.98	1.98	6.40	-	-
Total	100.00	100.00	100.00	30.93	100.00		0.12
Per cent (%)	0.68[4]	0.32[4]		0.80[5]			

Notes:

[1] Measured values.

[2] Source: Environmental and Nature Agency, Ministry of Infrastructure and Environment.

[3] Source: Illerup et al. (2006).

[4] Distribution of household and commercial waste.

[5] Share of combustible waste burned at waste disposal sites.

Table 8 Waste management in Greenland. Waste disposal is corrected for open burning

	1990	1991	1992	1993	1994	1995	1996	1997	1998
					ktonnes				
6A1 Managed waste disposal corrected for open burning	5.61	5.70	5.74	5.78	5.85	5.95	5.93	5.92	5.66
6A2 Unmanaged waste disposal corrected for open burning	1.34	1.37	1.36	1.36	1.35	1.29	1.21	1.16	1.06
Waste incineration, energy recovery	6.90	6.99	7.05	7.09	7.34	7.55	7.73	7.82	7.97
Waste incineration	-	-	-	-	0.06	0.22	0.79	1.24	2.67
Open burning	15.5	15.80	15.90	16.00	16.10	16.20	15.90	15.80	15.00
Total	29.38	29.83	30.02	30.19	30.68	31.21	31.60	31.98	32.37
continued	1999	2000	2001	2002	2003	2004	2005	2006	2007
					ktonnes				
6A1 Managed waste disposal corrected for open burning	5.19	4.35	4.38	4.16	4.45	4.19	4.19	4.19	4.19
6A2 Unmanaged waste disposal corrected for open burning	1.00	0.91	0.87	0.85	0.84	0.83	0.83	0.83	0.83
Waste incineration, energy recovery	9.78	12.90	13.20	14.50	14.00	15.30	15.30	15.30	15.30
Waste incineration	2.92	3.14	3.31	3.40	3.42	3.45	3.45	3.45	3.45
Open burning	13.80	11.70	11.70	11.20	11.80	11.20	11.20	11.20	11.20
Total	32.71	33.09	33.52	34.07	34.53	35.01	35.01	35.01	35.01

Waste-water handling

Data on waste-water is not available. Waste-water is labelled *sanitary sewage* or *grey water*. Grey waste-water is lead out to sea or in the terrain. Sanitary sewage or black sewage is lead out through the same pipes as grey waste-water or collected in bags. The bags are emptied into the sea. In addition, wastewater is discharged out from industries i.e. fish factories. These discharges are under controlled by each factory as part of its environmental operational permit (EOP). Currently there are no wastewater treatment plants.

The calculation of anaerobe degradation at the waste disposal sites is done by use of the tier 1 methodology i.e. by using the following equation:

$$E_{CH_4} = MSW \times MCF \times DOC \times F \times 16/12 \times (1 - OX)$$

where:

MSW = amount of waste disposed of at managed/un-managed disposal sites

MCF = methane correction factor

DOC = degradable organic carbon

F = fraction of methane in landfill gas

OX = oxidation factor

The emission factors applied in the calculation of emission from incineration of waste with and without energy recovery and open burning are based on measured emissions combined with IPCC default emission factors and Danish emission factors; see Table 9.

Table 9 Emission factors for incineration of waste.

	CO_2-fossil	CO_2-biogenic	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	kg		g					
Emission factors DK[1]								
/GJ	17.6	94.5	6.0	4.0	164	10	9.0	67
/t wet	185	992	63	42	1 722	105	94.5	704
IPCC2006								
Continuous / semi-cont.				50				
Batch, stoker			60	60				
Open burning /t dry				150				
Open burning /t wet				106				
Measured, incineration[2]								
Medium plants /t wet					3 210	224		693
Small plants /t wet					3 074	31 880		
Applied emission factors								
Waste incineration /t wet	185	992	60	50	3 210	224		693
Waste incineration /GJ	17.6	94.5	5.7	4.8	305.7	21.4	9.0	66
Waste incineration, village plant /t wet	185	992	60	60	3 074	31 880	94.5	693
Open burning /t wet	185	992	60	213	3 074	31 880	94.5	693

Sources: [1] Illerup et al. (2006). [2] Environmental and Nature Agency, Ministry of Infrastructure and Environment.

Memo Items

International Aviation Bunkers

Emissions from international aviation bunkers are considered to be of neglible importance. The Greenland Airport Authority has reported the annual amount of jet fuel loaded into foreign aircrafts including Danish aircrafts. However, it is not possible to distinguish between Danish aircrafts and other aircrafts. Since most foreign aircrafts by far are Danish the annual amount of jet fuel loaded into foreign aircrafts are therefore included as part of the IPCC category 1A3a Civil aviation.

International Marine Bunkers

Emissions from international marine bunkers are included from 2004 and onwards. Before 2004 international marine bunkers are considered to be of neglible importance.

Future improvements

The greenhouse gas inventory reported in March 2009 is completed by Statistics Greenland and The Greenland Climate and Infrastructure Agency with technical support from The Danish National Environmental Research Institute. Formerly both inventory and methodology were completed exclusively by The Danish National Environmental Research Institute with input from the Greenland Ministry of Environment and Nature.

This section briefly describes planned future improvements in the gathering of data for the greenhouse gas emission inventories.

Energy sector

The Greenland energy statistics is still under development. At this moment quality control regarding the energy sector therefore focuses equally on processing, handling, documenting, archiving and reporting procedures. Total domestic fuel combustion is documented since 1990. The 2004-2007 division of domestic fuel combustion into sectors and private households is based on a survey on energy consumption and other statistical inputs (see Section 1.3.1). The prospect is to expand the annual survey in order to retain greater certainty concerning the division of domestic fuel combustion into sectors and private households.

Industrial processes

In order to estimate emissions from road paving with asphalt information on the consumption of asphalt is required. This information can be obtained directly from the asphalt plants or indirectly from the statistics on import of asphalt.

Solvent and other product use

In order to estimate emissions from solvents and other product use information on the consumption of solvents and other products is required. This information will be obtained indirectly from the statistics on import of solvents and other products.

Land use

Background data on "settlements" and "other land" is currently not available. The information might be available in a couple of years. At that time the information will be implemented in the GHG inventory.

Waste

An annual report on waste management is needed in order to estimate the emission of greenhouse gasses from solid waste disposal on land and waste incineration.

References

Agency of Environment and Nature: Data on waste and ozone depleting substances and greenhouse gasses HFCs, PFCs and SF_6.

Agricultural Advisory Service: Statistics on livestock (sheep and reindeer) and background data on land use (cropland and grassland).

Department of Fisheries, Hunting and Agriculture: Background data for Forestry.

Statistics Greenland: Energy Consumption in Greenland 2004-2007 published in Danish. Available at : http://www.stat.gl/Statistik/MiljøEnergi/tabid/92/language/da-DK/Default.aspx as "Grønlands energiforbrug 2004-2007" (13-11-2008).

IPCC, 1997: Revised 1996 IPCC Guidelines for National Greenhouse Gas inventories. Available at: http://www.ipcc-nggip.iges.or.jp/public/gl/invs6.htm (15-04-2007).

IPCC, 2000: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Available at: http://www.ipcc-nggip.iges.or.jp/public/gp/english/ (15-04-2007).

Trends in Greenhouse Gas Emissions

Description and interpretation of emission trends for aggregated greenhouse gas emission

The GHG emissions are estimated according to the IPCC guidelines and are aggregated into six main sectors; Energy excl. Transport, Transport, Industrial Processes, Agriculture, LULUCF, and Waste. In Figure 3 and Figure 4 CO_2 emissions from fuel combustion in the Energy Sector is split into several sub-categories i.e. Energy Industries, Manufacturing Industries and Construction, Commercial and Institutional, Residential, Agriculture and Fishing.

The greenhouse gases include CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. However, Greenland has no consumption of PFC. Figure 1 shows the estimated total greenhouse gas emission in CO_2 equivalents from 1990 to 2007. The emissions are not corrected for temperature variations. CO_2 is the most important greenhouse gas. In 2007 CO_2 contributed to the total emission in CO_2 equivalent excluding LULUCF (Land Use and Land-Use Change and Forestry) with 95.6 %, followed by CH_4 with 2.3 %, N_2O 1.3 % and f-gases (HFCs and SF_6) with 0.9 %. Since 1990 these percentages have been increasing for f-gases, almost constant for N_2O and falling for CO_2 and CH_4.

Stationary combustion plants and transport represent the largest categories. Energy excluding transport contributed to the total emission in CO_2 equivalents excluding LULUCF with 80.1 % in 2007, see Figure 2. Transport contributed with 15.9 %. Industrial processes, agriculture and waste contributed to the total emission in CO_2 equivalents with 4 %.

The net CO_2 removal by forestry is 0.01 % of the total emission in CO_2 equivalents in 2007. The total GHG emission in CO_2 equivalents excluding LULUCF has increased by 4.26 % from 1990 to 2007 and increased 4.28 % including LULUCF. Comments on the overall trends etc. seen in Figure 1 and Figure 2 are given in the sections below on the individual greenhouse gases.

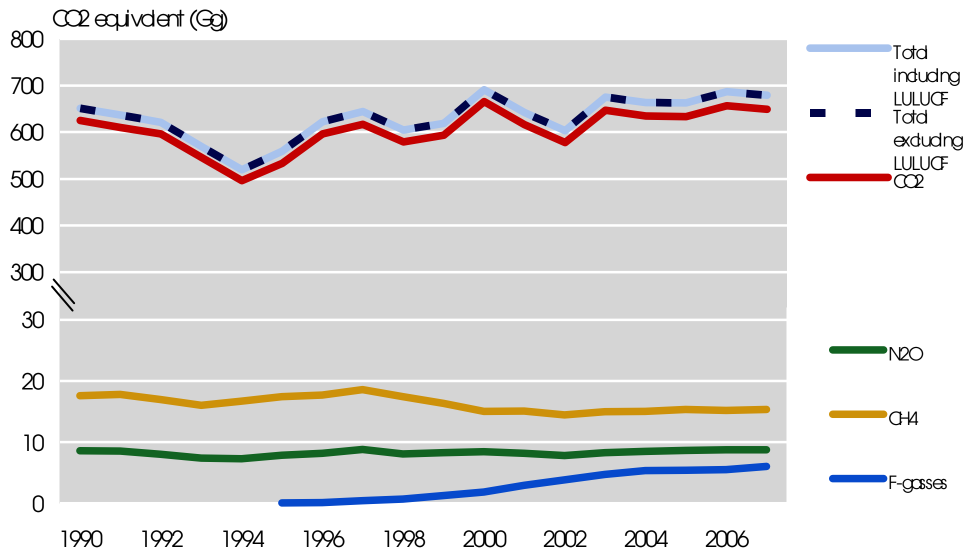


Figure 1 Greenhouse gas emission in CO_2 equivalents, time-series for 1990 to 2007.

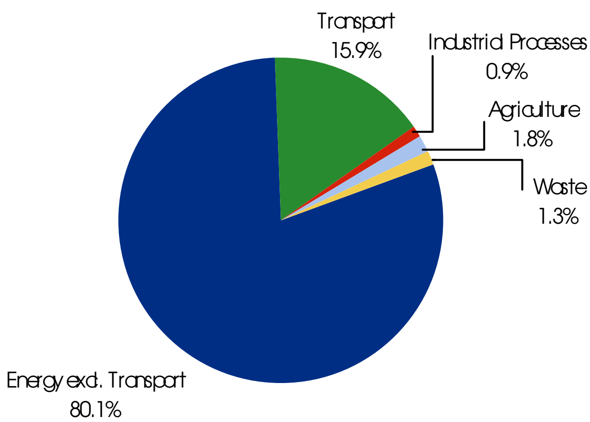


Figure 2 Greenhouse gas emission in CO_2 equivalents distributed on main sectors for 2007

Description and interpretation of emission trends by gas

Carbon Dioxide

The largest source to the emission of CO_2 is the energy sector. This sector includes combustion of fossil fuels like gas oil, gasoline, jet kerosene etc. From this sector Agriculture and Fishing contributes with 21.9 % of the total CO_2 emission followed by Energy Industries with 20.9 % and Residential with 19.6 % in 2007.

Transport contributes with 16.5 % of the total CO_2 emission. Manufacturing Industries and Construction with 7.9 %. Commercial and Institutions with 11.6 %. The category *Other* contributes with 1.5 % of the emissions.

The CO_2 emission excluding LULUCF decreased by approximately 1 % from 2006 to 2007. The main reason for this decrease was a relatively warm 2007-spring, which caused less fuel combustion in power plants. In 2007, the actual CO_2 emission was 3.8 % higher than the emission in 1990.

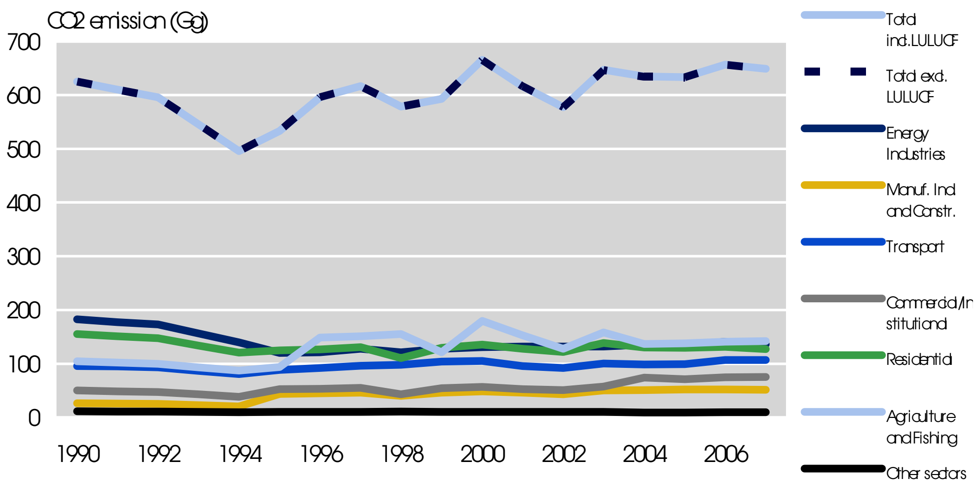


Figure 3 CO_2 emissions, time-series for 1990 to 2007.

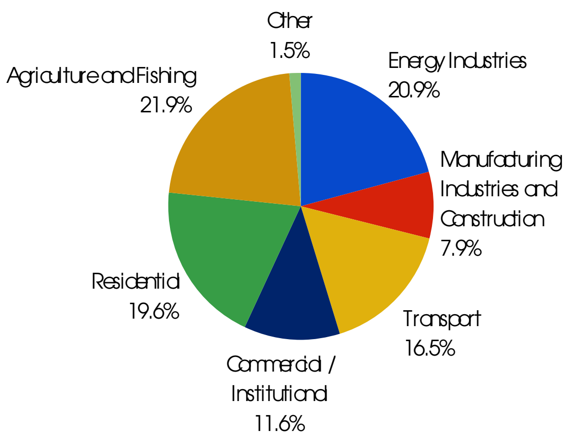


Figure 4 CO_2 emissions, distribution according to the main sectors for 2007.

Nitrous oxide

Agriculture is the most important N_2O emission source in 2007 contributing 42.3 % to the total N_2O emissions, see Figure 6. Emission from agricultural soil is currently not estimated. The estimated emission of N_2O derives only from manure management (sheep and reindeer). Since 1990 the emissions from manure management has been almost constant.

Combustion of fossil fuels in Energy Industries contributes 15.5 %. Combustion of fuel in other energy sectors, both stationary and mobile sources, contributes 37.3 %. Residential and Fisheries are the largest contributors of the other energy sectors.

The N_2O emission has decreases during the early nineties because of a decrease in reindeer livestock from 1990 to 1994. Since 1995 the emission of N_2O has increased and decreased for shorter periods depending on changes in the livestock. Since 2002 the N_2O emission has increased. In 2007, the actual N_2O emission was 1.9 % lower than the emission in 1990, see Figure 5.

Total N_2O emission including LULUCF is identical to total N_2O emission excluding LULUCF due to missing estimation of emission from emission from LULUCF, see Section 1.3.5.

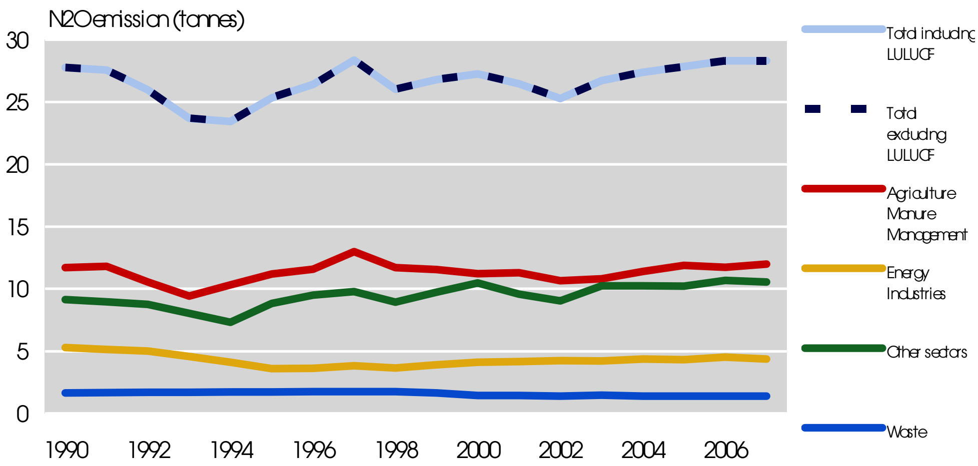


Figure 5 N_2O emissions, time-series for 1990 to 2007.

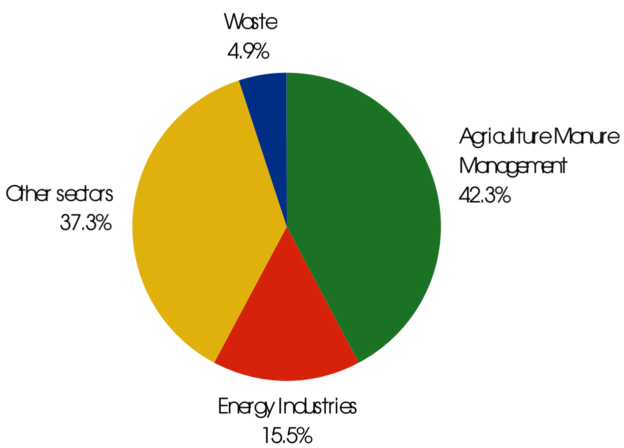


Figure 6 N_2O emissions, distribution according to the main sectors in 2007.

Methane

The largest sources of anthropogenic CH_4 emissions are agricultural activities contributing in 2007 with a total of 55.7 % of total CH_4 emissions (see Figure 8). The energy sector contributes with 5.7 %, while waste, primarily solid waste disposal on land, contributes with 38.7 %. The emission from agriculture derives from enteric fermentation (54.6 %) and management of animal manure (1.1 %).

Since 1990 the overall number of sheep has increased, while the overall number of reindeer has decreased. From 1990 to 2007 the emission of CH_4 from enteric fermentation had decreased by 2.1 %, while the emission from manure management has decreased by 8.4 %. The larger fall in emission from manure management is caused by the fact that the annual emission factor on manure management is larger for reindeer (0.36 kg CH_4 pr head) than for sheep (0.32 kg CH_4 pr head), while the annual emission factor on enteric fermentation is larger for sheep (17.17 kg CH_4 pr head) than for reindeer (11.00 kg CH_4 pr head).

Altogether, the emission of CH_4 from the agriculture sector has decreased 2.3 % from 1990 to 2007. The emission of CH_4 from waste disposal has decreased due to a decrease in the amount of solid waste disposal on land.

Total CH_4 emission including LULUCF is identical to total CH_4 emission excluding LULUCF due to missing estimation of emission from emission from LULUCF, see Section 1.3.5.

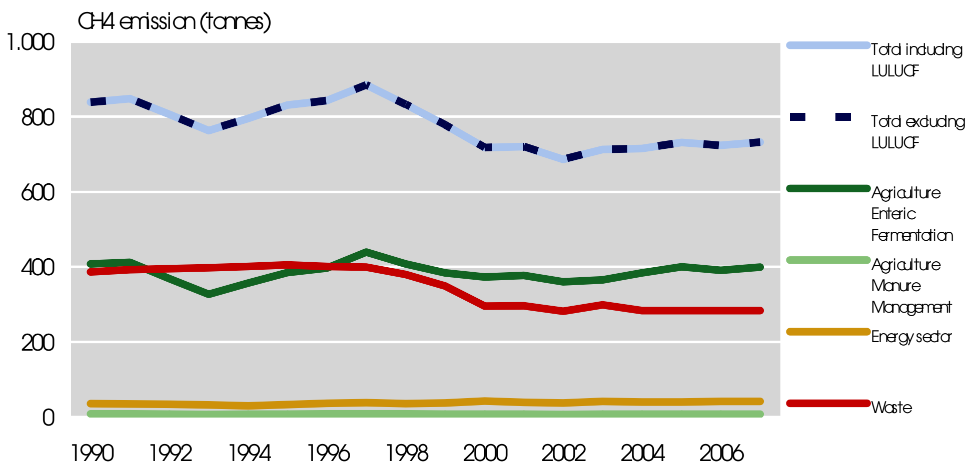


Figure 7 CH_4 emissions, time-series for 1990 to 2007.

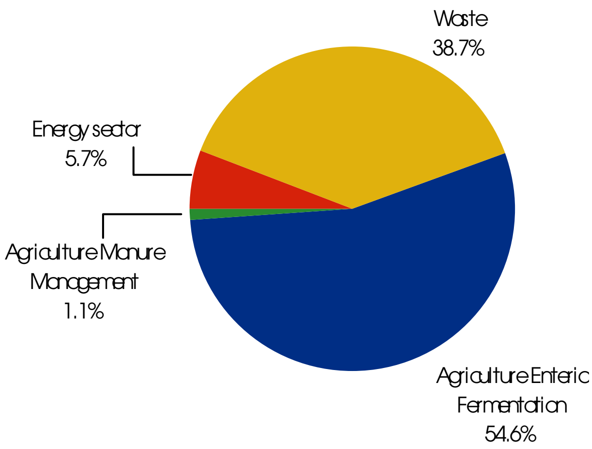


Figure 8 CH_4 emissions, distribution according to the main sectors in 2007.

HFCs, PFCs and SF_6

This part of the Greenland inventory only comprises a full data set for HFCs and SF_6 from 1995. Greenland has no consumption that leads to emission of PFCs. From 1995 to 2007 there has been a continuous and substantial increase in the contribution from f-gasses calculated as the sum of emissions in CO_2 equivalents, see figure 9. This increased is caused by and simultaneous with an increase in the emission of HFCs. For the time-series 2004-2007 the increase is lower than for the years 1995 to 2004. The increase from 1995 to 2004 is 8,783 %. From 2004 to 2007 total emission increased by 12.2 %. SF_6 contributed to the f-gas sum in 1995 with 59.4 %. Environmental awareness and regulation of this gas under Danish law has reduced its use considerably since 1995. In 2007 the contribution from SF_6 to f-gasses was only 0.1 %.

The use of HFCs has increased to a great extent. Today HFCs are by far the dominant f-gas, comprising 40.6 % in 1995, but 99.9 % in 2007. HFCs are mainly used as a refrigerant.

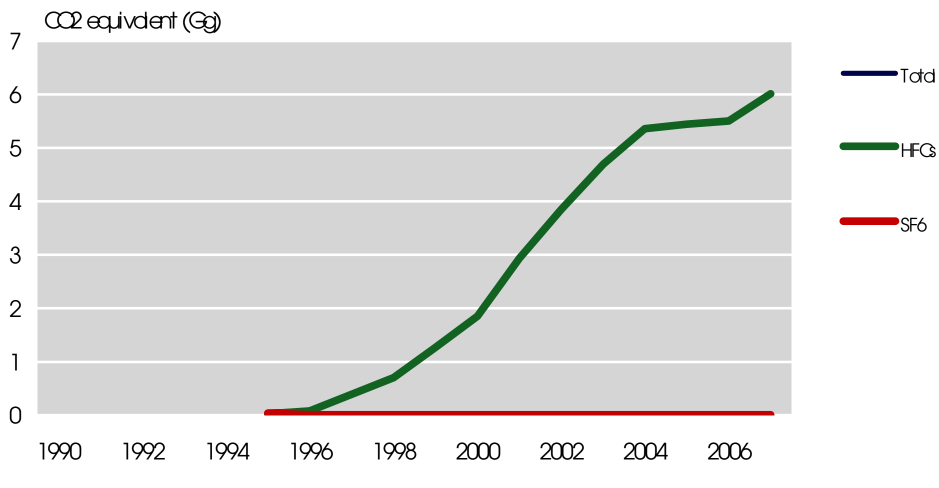


Figure 9   F-gas emissions, time-series for 1990 to 2007.

Description and interpretation of emission trends by category

Energy

The emission of CO_2 from fuel combustion has increased by 3.9 % from 1990 to 2007. Combustion of fuel was decreasing from 1990 until 1994 due to the implementation of the first water power plant. However, since 1994 combustion of fuel has increased continuously. The reason for this increase is primarily higher demand for transportation and heating. Combustion of fuel may decrease certain years due to milder temperatures.

Emission of CH_4 has increased by 17.4 % from 1990 to 2007 primarily due to an increase in the use of fuel for transportation. The CO_2 emission from the transport sector has increased by 11.9 % from 1990 to 2007, mainly due to increasing domestic aviation.

Emission of N_2O has increased by 3.6 % from 1990 to 2007.

Industrial processes

Emissions from industrial processes (consumption of halocarbons and SF_6) other than fuel combustion amount to 0.9 % of the total emission in CO_2 equivalents excluding LULUCF in 2007. The main source is consumptions of HFCs. Emission of f-gasses have increased considerable since 1990.

Agriculture

The agricultural sector contributes with 1.8 % of the total greenhouse gas emissions in 2007, 55.7 % of the total CH_4 emission and 42.3 % of the total N_2O emission. The total emission from the sector has decreased by 0.9 % from 1990 to 2007. This decrease is due to a decrease in the CH_4 emission from reindeer. The number of reindeer has decreased from 6,000 heads in 1990 to 2,500 heads in 2007. The N_2O emission increased by 2.3 % from 1990 to 2007, while the CH_4 emission decreased by 2.3 % during the same period.

LULUCF

Emissions from the LULUCF sector amount to just 0.04 % of the total emission in CO_2 equivalents in 2007. The forests are assumed to be a sink for the whole period increasing from app. zero in 1990 to 48.3 tonnes CO_2 in 2007. The emission from cropland is assumed to be zero in 1990 and a net source in 2007 of 91.7 tonnes CO_2 pr year. The emission from grassland has been estimated to 112.4 tonnes CO_2 in 1990 increasing to 223 tonnes CO_2 in 2007.

Waste

The waste sector contributes with 1.3 % of the total greenhouse gas emissions in 2007, 38.7 % of the total CH_4 emission and 4.9 % of the total N_2O emission. The total emission from the sector has decreased by 21 % from 1990 to 2007. This decrease is mainly a result of a decrease in the CH_4

emission from solid waste disposal sites by 26.8 % due to the increasing use of waste for heat production. Emission from incinerated waste used for heat production is included in the 1A1 IPCC category *Energy Industries*.

Summary

The Summary report for CO_2 equivalents for 1990-2007 (CRF: Summary 2) is presented in Table 12 – Table 29.

Times series for emission of greenhouse gasses is shown in Table 10. Times series for emission of greenhouse gasses in different sectors is shown in Table 11. CO_2 is accounting for more than 95 % of the emission of greenhouse gasses in 2007. The emission of greenhouse gasses is mainly related to the energy sector.

Table 10 Emission of greenhouse gasses 1990-2007 (Gg-CO_2-eq).

	1990	1991	1992	1993	1994	1995	1996	1997	1998
					Gg-CO_2-eq				
CO_2	625,2	610,4	596,1	545,9	495,7	533,5	596,2	616,9	578,8
CH_4	17,6	17,8	16,9	16,0	16,7	17,5	17,7	18,6	17,5
N_2O	8,6	8,5	8,1	7,4	7,3	7,9	8,2	8,8	8,1
HFC	NE	NE	NE	NE	NE	0,0	0,1	0,4	0,7
SF_6	NE	NE	NE	NE	NE	0,0	0,0	0,0	0,0
Total	651,4	636,8	621,1	569,2	519,6	558,8	622,2	644,7	605,1
continued	1999	2000	2001	2002	2003	2004	2005	2006	2007
					Gg-CO_2-eq				
CO_2	593,0	665,7	616,3	577,6	647,3	634,8	633,6	657,0	649,2
CH_4	16,3	15,1	15,1	14,4	15,0	15,0	15,3	15,2	15,4
N_2O	8,3	8,4	8,2	7,8	8,3	8,5	8,6	8,8	8,8
HFC	1,3	1,9	2,9	3,9	4,7	5,4	5,4	5,5	6,0
SF_6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Total	618,9	691,1	642,6	603,7	675,3	663,6	663,0	686,5	679,3

Table 11 Emission of greenhouse gasses within different sectors 1990-2007 (Gg-CO_2-eq).

	1990	1991	1992	1993	1994	1995	1996	1997	1998
					Gg-CO_2-eq				
Energy	627,4	612,5	598,1	547,4	496,7	534,9	597,8	618,7	580,1
Industry	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,4	0,7
Agriculture	12,4	12,5	11,2	9,9	10,8	11,7	12,1	13,4	12,4
LULUCF	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Waste management	11,5	11,7	11,8	11,8	11,9	12,1	12,1	12,1	11,8
Total	651,4	636,8	621,1	569,2	519,6	558,8	622,2	644,7	605,1
Continued	1999	2000	2001	2002	2003	2004	2005	2006	2007
					Gg-CO_2-eq				
Energy	594,8	668,3	618,4	579,5	649,6	637,2	636,0	659,6	651,7
Industry	1,3	1,9	2,9	3,9	4,7	5,4	5,4	5,5	6,0
Agriculture	11,8	11,5	11,6	11,0	11,2	11,8	12,2	12,0	12,3
LULUCF	0,1	0,1	0,2	0,3	0,3	0,3	0,3	0,3	0,3
Waste management	10,9	9,4	9,4	9,0	9,5	9,1	9,1	9,1	9,1
Total	618,9	691,1	642,6	603,7	675,3	663,6	663,0	686,5	679,3

Table 12 SUMMARY 2: Summary report for CO_2 equivalent emissions 1990.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1990
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**625,18**	**17,62**	**8,61**	**0,00**	**0,00**	**0,00**	**651,41**
1. Energy	**622,20**	**0,75**	**4,47**				**627,42**
A. Fuel Combustion (Sectoral Approach)	622,20	0,75	4,47				627,42
1. Energy Industries	182,52	0,16	1,64				184,32
2. Manufacturing Industries and Construction	26,36	0,02	0,22				26,61
3. Transport	95,73	0,13	0,53				96,39
4. Other Sectors	309,35	0,43	2,01				311,78
5. Other	8,24	0,01	0,07				8,31
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 (2)				NE	NO	NE	0,00
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**8,75**	**3,63**				**12,38**
A. Enteric Fermentation		8,57					8,57
B. Manure Management		0,18	3,63				3,81
C. Rice Cultivation		NO					0,00
D. Agricultural Soils(3)		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry(1)	**0,11**	**0,00**	**0,00**				**0,11**
A. Forest Land	NE	NA	NA				0,00
B. Cropland	0,00	NA	NE				0,00
C. Grassland	0,11	NA	NE				0,11
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,87**	**8,12**	**0,51**				**11,50**
A. Solid Waste Disposal on Land	NE	8,10					8,10
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,00	0,00	0,00				0,00
D. Other	2,87	0,02	0,51				3,40
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	651,29
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	651,41

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 13 SUMMARY 2: Summary report for CO_2 equivalent emissions 1991.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 1991

(Sheet 1 of 1) Submission 2009 v2.1

GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**610,44**	**17,81**	**8,54**	**0,00**	**0,00**	**0,00**	**636,79**
1. Energy	**607,40**	**0,73**	**4,37**				**612,50**
A. Fuel Combustion (Sectoral Approach)	607,40	0,73	4,37				612,50
1. Energy Industries	177,26	0,16	1,59				179,02
2. Manufacturing Industries and Construction	25,59	0,02	0,22				25,83
3. Transport	95,22	0,12	0,54				95,88
4. Other Sectors	301,33	0,42	1,95				303,70
5. Other	8,00	0,01	0,07				8,07
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [(2)]				NE	NO	NE	0,00
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**8,83**	**3,66**				**12,49**
A. Enteric Fermentation		8,65					8,65
B. Manure Management		0,18	3,66				3,84
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,12**	**0,00**	**0,00**				**0,12**
A. Forest Land	0,00	NA	NA				0,00
B. Cropland	0,00	NA	NE				0,00
C. Grassland	0,12	NA	NE				0,12
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,92**	**8,25**	**0,52**				**11,68**
A. Solid Waste Disposal on Land	NE	8,23					8,23
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,00	0,00	0,00				0,00
D. Other	2,92	0,02	0,52				3,45
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	636,67
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	636,79

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 14 SUMMARY 2: Summary report for CO_2 equivalent emissions 1992.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 1992

(Sheet 1 of 1) Submission 2009 v2.1

GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**596,13**	**16,92**	**8,06**	**0,00**	**0,00**	**0,00**	**621,11**
1. Energy	**593,08**	**0,71**	**4,27**				**598,06**
A. Fuel Combustion (Sectoral Approach)	593,08	0,71	4,27				598,06
1. Energy Industries	172,94	0,16	1,56				174,66
2. Manufacturing Industries and Construction	24,96	0,02	0,21				25,19
3. Transport	93,22	0,12	0,53				93,87
4. Other Sectors	294,15	0,41	1,91				296,47
5. Other	7,80	0,01	0,07				7,87
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [(2)]				NE	NO	NE	0,00
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**7,91**	**3,27**				**11,18**
A. Enteric Fermentation		7,75					7,75
B. Manure Management		0,16	3,27				3,43
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,12**	**0,00**	**0,00**				**0,12**
A. Forest Land	-0,01	NA	NA				-0,01
B. Cropland	0,00	NA	NE				0,00
C. Grassland	0,12	NA	NE				0,12
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,93**	**8,30**	**0,52**				**11,75**
A. Solid Waste Disposal on Land	NE	8,28					8,28
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,00	0,00	0,00				0,00
D. Other	2,93	0,02	0,52				3,47
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	620,99
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	621,11

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 15 SUMMARY 2: Summary report for CO_2 equivalent emissions 1993.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 1993

(Sheet 1 of 1) Submission 2009 v2.1

GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**545,86**	**16,02**	**7,35**	**0,00**	**0,00**	**0,00**	**569,23**
1. Energy	**542,79**	**0,67**	**3,91**				**547,37**
A. Fuel Combustion (Sectoral Approach)	542,79	0,67	3,91				547,37
1. Energy Industries	156,34	0,14	1,42				157,90
2. Manufacturing Industries and Construction	22,53	0,02	0,19				22,74
3. Transport	86,81	0,12	0,50				87,42
4. Other Sectors	270,07	0,39	1,74				272,20
5. Other	7,04	0,01	0,06				7,11
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 (2)				NE	NO	NE	0,00
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**7,00**	**2,92**				**9,92**
A. Enteric Fermentation		6,85					6,85
B. Manure Management		0,14	2,92				3,06
C. Rice Cultivation		NO					0,00
D. Agricultural Soils(3)		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry(1)	**0,12**	**0,00**	**0,00**				**0,12**
A. Forest Land	-0,01	NA	NA				-0,01
B. Cropland	0,00	NA	NE				0,00
C. Grassland	0,13	NA	NE				0,13
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,95**	**8,35**	**0,52**				**11,82**
A. Solid Waste Disposal on Land	NE	8,33					8,33
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,00	0,00	0,00				0,00
D. Other	2,95	0,02	0,52				3,49
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	569,11
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	569,23

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 16 SUMMARY 2: Summary report for CO_2 equivalent emissions 1994.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

(Sheet 1 of 1)

Inventory 1994

Submission 2009 v2.1

GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**495,66**	**16,71**	**7,27**	**0,00**	**0,00**	**0,00**	**519,63**
1. Energy	**492,55**	**0,64**	**3,55**				**496,73**
A. Fuel Combustion (Sectoral Approach)	492,55	0,64	3,55				496,73
1. Energy Industries	139,78	0,13	1,28				141,19
2. Manufacturing Industries and Construction	20,11	0,02	0,17				20,29
3. Transport	80,40	0,11	0,47				80,97
4. Other Sectors	245,98	0,38	1,57				247,93
5. Other	6,28	0,01	0,05				6,34
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				NE	NO	NE	0,00
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**7,64**	**3,20**				**10,84**
A. Enteric Fermentation		7,49					7,49
B. Manure Management		0,15	3,20				3,35
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[3]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry[1]	**0,12**	**0,00**	**0,00**				**0,12**
A. Forest Land	-0,01	NA	NA				-0,01
B. Cropland	0,00	NA	NE				0,00
C. Grassland	0,14	NA	NE				0,14
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,98**	**8,43**	**0,53**				**11,94**
A. Solid Waste Disposal on Land	NE	8,41					8,41
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,01	0,00	0,00				0,01
D. Other	2,97	0,02	0,53				3,52
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: [4]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [5]	519,51
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [5]	519,63

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 17 SUMMARY 2: Summary report for CO_2 equivalent emissions 1995.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 1995
(Sheet 1 of 1) Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**533,47**	**17,45**	**7,86**	**0,02**	**0,00**	**0,04**	**558,84**
1. Energy	**530,31**	**0,69**	**3,86**				**534,86**
A. Fuel Combustion (Sectoral Approach)	530,31	0,69	3,86				534,86
1. Energy Industries	120,28	0,12	1,12				121,51
2. Manufacturing Industries and Construction	43,84	0,04	0,37				44,25
3. Transport	88,15	0,15	0,55				88,85
4. Other Sectors	270,79	0,38	1,75				272,91
5. Other	7,26	0,01	0,07				7,34
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,02**	**0,00**	**0,04**	**0,06**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 (2)				0,02	NO	0,04	0,06
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**8,25**	**3,47**				**11,71**
A. Enteric Fermentation		8,08					8,08
B. Manure Management		0,17	3,47				3,63
C. Rice Cultivation		NO					0,00
D. Agricultural Soils(3)		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry(1)	**0,13**	**0,00**	**0,00**				**0,13**
A. Forest Land	-0,01	NA	NA				-0,01
B. Cropland	0,00	NA	NE				0,00
C. Grassland	0,14	NA	NE				0,14
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**3,03**	**8,52**	**0,53**				**12,08**
A. Solid Waste Disposal on Land	NE	8,49					8,49
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,04	0,00	0,00				0,05
D. Other	2,99	0,02	0,53				3,54
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	558,72
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	558,84

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 18 SUMMARY 2: Summary report for CO_2 equivalent emissions 1996.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 1996
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**596,23**	**17,69**	**8,19**	**0,08**	**0,00**	**0,00**	**622,20**
1. Energy	**593,01**	**0,77**	**4,07**				**597,85**
A. Fuel Combustion (Sectoral Approach)	593,01	0,77	4,07				597,85
1. Energy Industries	121,04	0,12	1,13				122,28
2. Manufacturing Industries and Construction	44,51	0,04	0,38				44,93
3. Transport	92,06	0,15	0,59				92,80
4. Other Sectors	328,14	0,46	1,91				330,50
5. Other	7,26	0,01	0,07				7,34
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,08**	**0,00**	**0,00**	**0,08**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [(2)]				0,08	NO	0,00	0,08
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**8,50**	**3,58**				**12,09**
A. Enteric Fermentation		8,33					8,33
B. Manure Management		0,17	3,58				3,75
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [(3)]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [(1)]	**0,13**	**0,00**	**0,00**				**0,13**
A. Forest Land	-0,02	NA	NA				-0,02
B. Cropland	0,00	NA	NE				0,00
C. Grassland	0,15	NA	NE				0,15
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**3,09**	**8,42**	**0,54**				**12,05**
A. Solid Waste Disposal on Land	NE	8,40					8,40
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,15	0,00	0,01				0,16
D. Other	2,95	0,02	0,52				3,49
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	622,06
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	622,20

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 19 SUMMARY 2: Summary report for CO_2 equivalent emissions 1997.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 1997
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**616,93**	**18,59**	**8,79**	**0,39**	**0,00**	**0,00**	**644,69**
1. Energy	**613,64**	**0,80**	**4,22**				**618,66**
A. Fuel Combustion (Sectoral Approach)	613,64	0,80	4,22				618,66
1. Energy Industries	128,00	0,12	1,19				129,31
2. Manufacturing Industries and Construction	46,17	0,04	0,39				46,60
3. Transport	96,01	0,16	0,61				96,78
4. Other Sectors	336,20	0,47	1,96				338,63
5. Other	7,26	0,01	0,07				7,34
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,39**	**0,00**	**0,00**	**0,39**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				0,39	NO	0,00	0,39
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**9,40**	**4,02**				**13,43**
A. Enteric Fermentation		9,22					9,22
B. Manure Management		0,18	4,02				4,21
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**0,14**	**0,00**	**0,00**				**0,14**
A. Forest Land	-0,02	NA	NA				-0,02
B. Cropland	0,00	NA	NE				0,00
C. Grassland	0,15	NA	NE				0,15
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**3,15**	**8,38**	**0,54**				**12,08**
A. Solid Waste Disposal on Land	NE	8,36					8,36
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,23	0,00	0,02				0,25
D. Other	2,93	0,02	0,52				3,46
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: [4]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [5]	644,55
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [5]	644,69

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

[5] These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 20 SUMMARY 2: Summary report for CO_2 equivalent emissions 1998.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1998
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**578,83**	**17,48**	**8,07**	**0,71**	**0,00**	**0,00**	**605,09**
1. Energy	**575,42**	**0,76**	**3,91**				**580,09**
A. Fuel Combustion (Sectoral Approach)	575,42	0,76	3,91				580,09
1. Energy Industries	121,32	0,11	1,13				122,57
2. Manufacturing Industries and Construction	40,00	0,03	0,34				40,38
3. Transport	97,70	0,16	0,66				98,52
4. Other Sectors	309,13	0,45	1,70				311,28
5. Other	7,26	0,01	0,07				7,34
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,71**	**0,00**	**0,00**	**0,71**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 (2)				0,71	NO	0,00	0,71
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**8,75**	**3,63**				**12,38**
A. Enteric Fermentation		8,57					8,57
B. Manure Management		0,18	3,63				3,81
C. Rice Cultivation		NO					0,00
D. Agricultural Soils(3)		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry(1)	**0,14**	**0,00**	**0,00**				**0,14**
A. Forest Land	-0,02	NA	NA				-0,02
B. Cropland	0,00	NA	NE				0,00
C. Grassland	0,16	NA	NE				0,16
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**3,27**	**7,97**	**0,54**				**11,78**
A. Solid Waste Disposal on Land	NE	7,95					7,95
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,49	0,00	0,05				0,55
D. Other	2,77	0,02	0,49				3,28
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	604,95
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	605,09

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 21 SUMMARY 2: Summary report for CO_2 equivalent emissions 1999.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 1999
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**593,04**	**16,33**	**8,31**	**1,26**	**0,00**	**0,00**	**618,95**
1. Energy	**589,80**	**0,79**	**4,23**				**594,81**
A. Fuel Combustion (Sectoral Approach)	589,80	0,79	4,23				594,81
1. Energy Industries	127,70	0,13	1,21				129,03
2. Manufacturing Industries and Construction	45,91	0,04	0,39				46,34
3. Transport	103,70	0,17	0,68				104,55
4. Other Sectors	305,22	0,44	1,88				307,54
5. Other	7,26	0,01	0,07				7,34
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**1,26**	**0,00**	**0,00**	**1,27**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [(2)]				1,26	NO	0,00	1,27
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**8,22**	**3,58**				**11,79**
A. Enteric Fermentation		8,06					8,06
B. Manure Management		0,16	3,58				3,73
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,14**	**0,00**	**0,00**				**0,14**
A. Forest Land	-0,02	NA	NA				-0,02
B. Cropland	0,00	NA	NE				0,00
C. Grassland	0,17	NA	NE				0,17
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**3,09**	**7,33**	**0,51**				**10,93**
A. Solid Waste Disposal on Land	NE	7,31					7,31
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,54	0,00	0,05				0,60
D. Other	2,55	0,02	0,45				3,03
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	618,80
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	618,95

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 22 SUMMARY 2: Summary report for CO_2 equivalent emissions 2000.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 2000
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**665,73**	**15,07**	**8,45**	**1,85**	**0,00**	**0,00**	**691,11**
1. Energy	**662,83**	**0,89**	**4,53**				**668,25**
A. Fuel Combustion (Sectoral Approach)	662,83	0,89	4,53				668,25
1. Energy Industries	130,57	0,13	1,28				131,98
2. Manufacturing Industries and Construction	48,25	0,04	0,41				48,70
3. Transport	105,09	0,18	0,67				105,94
4. Other Sectors	371,66	0,54	2,09				374,29
5. Other	7,26	0,01	0,07				7,34
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**1,85**	**0,00**	**0,00**	**1,85**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [(2)]				1,85	NO	0,00	1,85
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**7,99**	**3,48**				**11,46**
A. Enteric Fermentation		7,83					7,83
B. Manure Management		0,15	3,48				3,63
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,15**	**0,00**	**0,00**				**0,15**
A. Forest Land	-0,03	NA	NA				-0,03
B. Cropland	0,00	NA	NE				0,00
C. Grassland	0,17	NA	NE				0,17
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,75**	**6,20**	**0,44**				**9,39**
A. Solid Waste Disposal on Land	NE	6,18					6,18
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,58	0,00	0,06				0,64
D. Other	2,17	0,01	0,39				2,57
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	690,96
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	691,11

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 23 SUMMARY 2: Summary report for CO_2 equivalent emissions 2001.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 2001
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**616,35**	**15,13**	**8,21**	**2,93**	**0,00**	**0,00**	**642,62**
1. Energy	**613,33**	**0,83**	**4,27**				**618,43**
A. Fuel Combustion (Sectoral Approach)	613,33	0,83	4,27				618,43
1. Energy Industries	131,71	0,13	1,29				133,14
2. Manufacturing Industries and Construction	45,77	0,04	0,39				46,20
3. Transport	95,36	0,17	0,59				96,11
4. Other Sectors	333,23	0,49	1,92				335,64
5. Other	7,26	0,01	0,07				7,34
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**2,93**	**0,00**	**0,00**	**2,93**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [(2)]				2,93	NO	0,00	2,93
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**8,08**	**3,50**				**11,58**
A. Enteric Fermentation		7,93					7,93
B. Manure Management		0,16	3,50				3,65
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [(3)]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [(1)]	**0,24**	**0,00**	**0,00**				**0,24**
A. Forest Land	-0,03	NA	NA				-0,03
B. Cropland	0,09	NA	NE				0,09
C. Grassland	0,18	NA	NE				0,18
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,78**	**6,21**	**0,45**				**9,44**
A. Solid Waste Disposal on Land	NE	6,19					6,19
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,61	0,00	0,06				0,68
D. Other	2,17	0,01	0,38				2,57
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	642,38
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	642,62

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 24 SUMMARY 2: Summary report for CO_2 equivalent emissions 2002.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2002
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**577,57**	**14,41**	**7,84**	**3,85**	**0,00**	**0,00**	**603,68**
1. Energy	**574,62**	**0,79**	**4,11**				**579,52**
A. Fuel Combustion (Sectoral Approach)	574,62	0,79	4,11				579,52
1. Energy Industries	132,14	0,13	1,32				133,59
2. Manufacturing Industries and Construction	43,27	0,04	0,37				43,67
3. Transport	91,70	0,17	0,57				92,44
4. Other Sectors	300,24	0,45	1,79				302,48
5. Other	7,26	0,01	0,07				7,34
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**3,85**	**0,00**	**0,00**	**3,86**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [(2)]				3,85	NO	0,00	3,86
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**7,71**	**3,30**				**11,00**
A. Enteric Fermentation		7,56					7,56
B. Manure Management		0,15	3,30				3,45
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,26**	**0,00**	**0,00**				**0,26**
A. Forest Land	-0,03	NA	NA				-0,03
B. Cropland	0,09	NA	NE				0,09
C. Grassland	0,19	NA	NE				0,19
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,70**	**5,92**	**0,43**				**9,05**
A. Solid Waste Disposal on Land	NE	5,90					5,90
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,63	0,00	0,06				0,70
D. Other	2,07	0,01	0,37				2,45
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	603,43
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	603,68

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 25 SUMMARY 2: Summary report for CO_2 equivalent emissions 2003.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2003
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**647,34**	**14,96**	**8,28**	**4,69**	**0,00**	**0,00**	**675,27**
1. Energy	**644,27**	**0,88**	**4,49**				**649,63**
A. Fuel Combustion (Sectoral Approach)	644,27	0,88	4,49				649,63
1. Energy Industries	132,06	0,13	1,31				133,50
2. Manufacturing Industries and Construction	49,90	0,04	0,42				50,36
3. Transport	100,58	0,18	0,61				101,38
4. Other Sectors	354,46	0,51	2,07				357,05
5. Other	7,26	0,01	0,07				7,34
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**4,69**	**0,00**	**0,00**	**4,70**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [(2)]				4,69	NO	0,00	4,70
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**7,81**	**3,35**				**11,16**
A. Enteric Fermentation		7,66					7,66
B. Manure Management		0,15	3,35				3,50
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [(3)]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [(1)]	**0,26**	**0,00**	**0,00**				**0,26**
A. Forest Land	-0,03	NA	NA				-0,03
B. Cropland	0,09	NA	NE				0,09
C. Grassland	0,20	NA	NE				0,20
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,81**	**6,27**	**0,45**				**9,53**
A. Solid Waste Disposal on Land	NE	6,25					6,25
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,63	0,00	0,06				0,70
D. Other	2,18	0,01	0,39				2,58
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**
Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	675,02
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	675,27

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 26 SUMMARY 2: Summary report for CO_2 equivalent emissions 2004.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 2004
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**634,78**	**15,01**	**8,49**	**5,36**	**0,00**	**0,00**	**663,65**
1. Energy	**631,81**	**0,84**	**4,53**				**637,18**
A. Fuel Combustion (Sectoral Approach)	631,81	0,84	4,53				637,18
1. Energy Industries	135,56	0,14	1,36				137,05
2. Manufacturing Industries and Construction	51,00	0,04	0,43				51,47
3. Transport	98,29	0,18	0,59				99,06
4. Other Sectors	340,94	0,48	2,09				343,51
5. Other	6,02	0,01	0,06				6,09
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**5,36**	**0,00**	**0,00**	**5,36**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 (2)				5,36	NO	0,00	5,36
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**8,23**	**3,53**				**11,76**
A. Enteric Fermentation		8,07					8,07
B. Manure Management		0,16	3,53				3,69
C. Rice Cultivation		NO					0,00
D. Agricultural Soils(3)		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry(1)	**0,26**	**0,00**	**0,00**				**0,26**
A. Forest Land	-0,04	NA	NA				-0,04
B. Cropland	0,09	NA	NE				0,09
C. Grassland	0,20	NA	NE				0,20
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,71**	**5,94**	**0,43**				**9,09**
A. Solid Waste Disposal on Land	NE	5,92					5,92
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,64	0,00	0,06				0,71
D. Other	2,07	0,01	0,37				2,46
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: (4)							
International Bunkers	1,81	0,00	0,00				1,82
Aviation	NO	NO	NO				0,00
Marine	1,81	0,00	0,00				1,82
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	663,39
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	663,65

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 27 SUMMARY 2: Summary report for CO_2 equivalent emissions 2005.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2005
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**633,62**	**15,35**	**8,63**	**5,44**	**0,00**	**0,00**	**663,04**
1. Energy	**630,65**	**0,85**	**4,51**				**636,01**
A. Fuel Combustion (Sectoral Approach)	630,65	0,85	4,51				636,01
1. Energy Industries	134,14	0,13	1,34				135,62
2. Manufacturing Industries and Construction	52,19	0,05	0,44				52,68
3. Transport	99,05	0,18	0,61				99,84
4. Other Sectors	338,75	0,48	2,06				341,29
5. Other	6,51	0,01	0,06				6,58
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**5,44**	**0,00**	**0,00**	**5,44**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [(2)]				5,44	NO	0,00	5,44
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**8,56**	**3,68**				**12,25**
A. Enteric Fermentation		8,40					8,40
B. Manure Management		0,16	3,68				3,85
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [(3)]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [(1)]	**0,26**	**0,00**	**0,00**				**0,26**
A. Forest Land	-0,04	NA	NA				-0,04
B. Cropland	0,09	NA	NE				0,09
C. Grassland	0,21	NA	NE				0,21
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,71**	**5,94**	**0,43**				**9,09**
A. Solid Waste Disposal on Land	NE	5,92					5,92
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,64	0,00	0,06				0,71
D. Other	2,07	0,01	0,37				2,46
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	4,62	0,01	0,01				4,64
Aviation	NO	NO	NO				0,00
Marine	4,62	0,01	0,01				4,64
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	662,78
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	663,04

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 28 SUMMARY 2: Summary report for CO_2 equivalent emissions 2006.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2006
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**657,01**	**15,19**	**8,77**	**5,50**	**0,00**	**0,00**	**686,49**
1. Energy	**654,04**	**0,88**	**4,71**				**659,62**
A. Fuel Combustion (Sectoral Approach)	654,04	0,88	4,71				659,62
1. Energy Industries	140,81	0,14	1,40				142,36
2. Manufacturing Industries and Construction	51,78	0,05	0,44				52,26
3. Transport	107,16	0,20	0,69				108,04
4. Other Sectors	347,50	0,49	2,12				350,11
5. Other	6,78	0,01	0,07				6,86
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**5,50**	**0,00**	**0,00**	**5,51**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 (2)				5,50	NO	0,00	5,51
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**8,37**	**3,63**				**12,01**
A. Enteric Fermentation		8,21					8,21
B. Manure Management		0,16	3,63				3,80
C. Rice Cultivation		NO					0,00
D. Agricultural Soils (3)		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry (1)	**0,27**	**0,00**	**0,00**				**0,27**
A. Forest Land	-0,04	NA	NA				-0,04
B. Cropland	0,09	NA	NE				0,09
C. Grassland	0,22	NA	NE				0,22
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,71**	**5,94**	**0,43**				**9,09**
A. Solid Waste Disposal on Land	NE	5,92					5,92
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,64	0,00	0,06				0,71
D. Other	2,07	0,01	0,37				2,46
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: (4)							
International Bunkers	7,74	0,01	0,02				7,77
Aviation	NO	NO	NO				0,00
Marine	7,74	0,01	0,02				7,77
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	686,22
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	686,49

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 29 SUMMARY 2: Summary report for CO_2 equivalent emissions 2007.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 2007
Submission 2009 v2.1
GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**649,15**	**15,37**	**8,77**	**6,01**	**0,00**	**0,00**	**679,31**
1. Energy	**646,18**	**0,88**	**4,63**				**651,68**
A. Fuel Combustion (Sectoral Approach)	646,18	0,88	4,63				651,68
1. Energy Industries	135,90	0,14	1,36				137,39
2. Manufacturing Industries and Construction	51,13	0,04	0,43				51,61
3. Transport	107,10	0,20	0,68				107,98
4. Other Sectors	345,04	0,49	2,09				347,61
5. Other	7,01	0,01	0,07				7,09
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels	NO	NO	NO				0,00
2. Oil and Natural Gas	NO	NO	NO				0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**6,01**	**0,00**	**0,00**	**6,02**
A. Mineral Products	NE	NE	NE				0,00
B. Chemical Industry	NO	NO	NO				0,00
C. Metal Production	NO	NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NO	NO	0,00
F. Consumption of Halocarbons and SF_6 [2]				6,01	NO	0,00	6,02
G. Other	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	**NE**		**NE**				**0,00**
4. Agriculture		**8,55**	**3,71**				**12,26**
A. Enteric Fermentation		8,39					8,39
B. Manure Management		0,16	3,71				3,87
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		NE	NE				0,00
E. Prescribed Burning of Savannas		NO	NO				0,00
F. Field Burning of Agricultural Residues		NO	NO				0,00
G. Other		NO	NO				0,00
5. Land Use, Land-Use Change and Forestry [1]	**0,27**	**0,00**	**0,00**				**0,27**
A. Forest Land	-0,05	NA	NA				-0,05
B. Cropland	0,09	NA	NE				0,09
C. Grassland	0,22	NA	NE				0,22
D. Wetlands	NE	NE	NE				0,00
E. Settlements	NE	NE	NE				0,00
F. Other Land	NE	NE	NE				0,00
G. Other	NE	NE	NE				0,00
6. Waste	**2,71**	**5,94**	**0,43**				**9,09**
A. Solid Waste Disposal on Land	NE	5,92					5,92
B. Waste-water Handling		NE	NE				0,00
C. Waste Incineration	0,64	0,00	0,06				0,71
D. Other	2,07	0,01	0,37				2,46
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0,00**

Memo Items: [4]							
International Bunkers	9,59	0,01	0,02				9,63
Aviation	NO	NO	NO				0,00
Marine	9,59	0,01	0,02				9,63
Multilateral Operations	**NO**	**NO**	**NO**				**0,00**
CO_2 Emissions from Biomass	**NO**						**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [5]	679,05
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [5]	679,31

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Annex 6.2.2 Denmark + Greenland

Greenhouse gas emissions - Denmark + Greenland

The present annex presents the total emissions for Denmark and Greenland. Figure 1 present the trend for the different greenhouse gasses and Figure 2 present the trend for the different sectors.

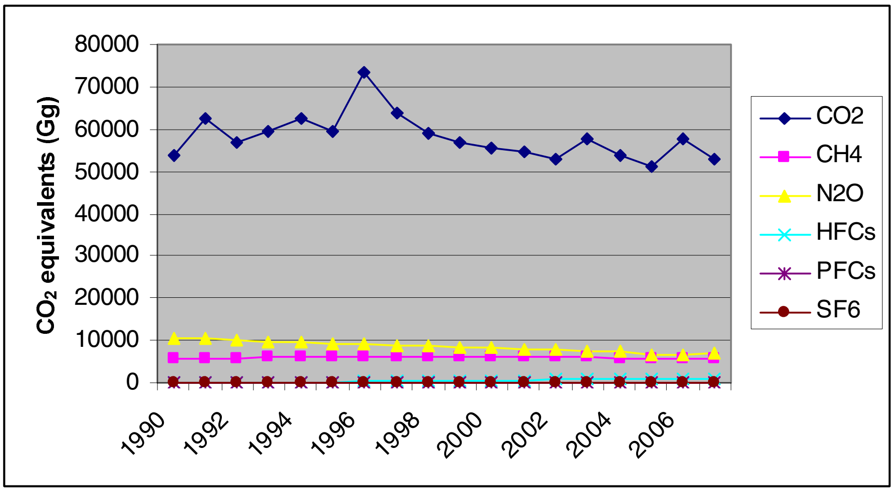


Figure 1 GHG emission trends for Denmark + Greenland.

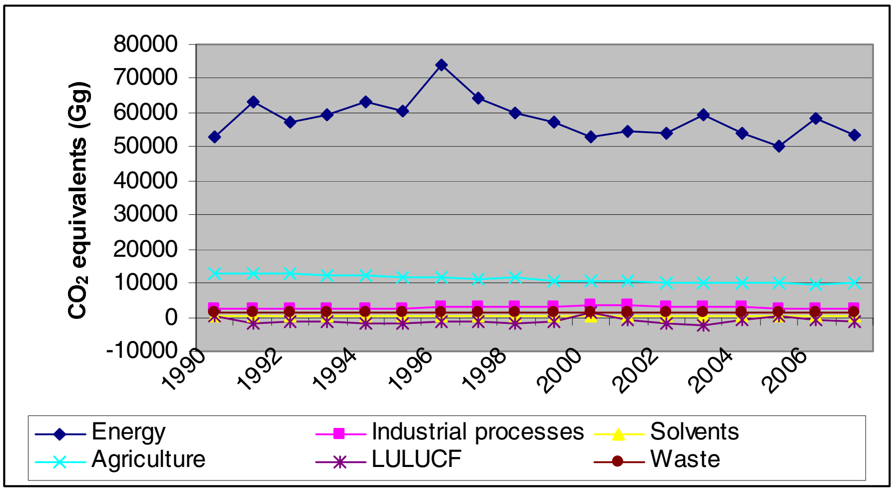


Figure 2 GHG emission trends for Denmark + Greenland.

Table 1 and Table 2 present the emission trends as CRF Table 10 and the following tables 3-20 presents summary reports as CRF Summary 2.

Table 1

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
CO_2 emissions including net CO_2 from LULUCF	53.970,18	62.394,78	56.726,25	59.379,41	62.506,75	59.438,47	73.419,23	63.961,40	58.915,81	56.936,28
CO_2 emissions excluding net CO_2 from LULUCF	53.418,39	64.082,82	58.274,67	60.536,28	64.123,63	61.107,57	74.636,20	65.140,57	60.869,81	58.170,96
CH_4 emissions including CH_4 from LULUCF	5.712,51	5.801,16	5.828,21	5.987,98	5.909,98	6.005,44	6.119,87	6.011,66	6.036,82	5.913,10
CH_4 emissions excluding CH_4 from LULUCF	5.713,11	5.801,76	5.828,81	5.988,58	5.910,57	6.006,02	6.120,46	6.012,25	6.037,40	5.913,60
N_2O emissions including N_2O from LULUCF	10.535,34	10.326,22	9.893,33	9.652,36	9.471,78	9.365,82	9.003,99	8.910,18	8.822,09	8.509,74
N_2O emissions excluding N_2O from LULUCF	10.535,25	10.326,13	9.893,24	9.652,27	9.471,69	9.365,73	9.003,90	8.910,09	8.822,00	8.509,66
HFCs	0,00	0,00	3,44	93,93	134,53	217,75	329,38	324,14	411,89	504,25
PFCs	0,00	0,00	0,00	0,00	0,05	0,50	1,66	4,12	9,10	12,48
SF_6	44,45	63,50	89,15	101,17	122,06	107,37	60,96	73,07	59,42	65,36
Total (including LULUCF)	**70.262,49**	**78.585,66**	**72.540,39**	**75.214,85**	**78.145,15**	**75.135,35**	**88.935,10**	**79.284,57**	**74.255,13**	**71.941,21**
Total (excluding LULUCF)	**69.711,21**	**80.274,21**	**74.089,32**	**76.372,24**	**79.762,53**	**76.804,95**	**90.152,57**	**80.464,23**	**76.209,62**	**73.176,31**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
1. Energy	52.710,50	63.277,67	57.350,02	59.660,10	63.313,97	60.446,38	74.013,92	64.338,93	60.149,97	57.477,39
2. Industrial Processes	2.239,52	2.342,60	2.379,13	2.452,18	2.550,48	2.724,27	2.827,38	3.017,85	2.994,76	3.218,36
3. Solvent and Other Product Use	179,38	174,21	169,05	163,88	158,71	140,96	154,36	139,45	128,40	126,88
4. Agriculture	13.021,92	12.902,88	12.615,50	12.482,78	12.138,05	11.917,91	11.581,91	11.411,50	11.416,65	10.829,19
5. Land Use, Land-Use Change and Forestry[(5)]	551,28	-1.688,55	-1.548,93	-1.157,38	-1.617,38	-1.669,60	-1.217,47	-1.179,66	-1.954,49	-1.235,11
6. Waste	1.559,90	1.576,84	1.575,62	1.613,31	1.601,33	1.575,42	1.574,99	1.556,51	1.519,84	1.524,49
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)[(5)]	**70.262,49**	**78.585,66**	**72.540,39**	**75.214,85**	**78.145,15**	**75.135,35**	**88.935,10**	**79.284,57**	**74.255,13**	**71.941,21**

[(1)] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[(2)] Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[(3)] Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equivalent emissions.

[(4)] In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is Gg of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

[(5)] Includes net CO_2, CH_4 and N_2O from LULUCF.

Table 2

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
CO_2 emissions including net CO_2 from LULUCF	55.386,86	54.501,83	52.857,07	57.785,94	53.689,15	51.023,43	57.850,83	52.749,83	-2,26
CO_2 emissions excluding net CO_2 from LULUCF	53.756,07	55.270,79	54.835,55	60.075,96	54.513,25	50.862,02	58.725,43	53.876,69	0,86
CH_4 emissions including CH_4 from LULUCF	5.904,44	6.037,45	6.008,01	5.989,80	5.800,35	5.693,31	5.639,84	5.762,97	0,88
CH_4 emissions excluding CH_4 from LULUCF	5.904,94	6.037,95	6.008,50	5.990,29	5.800,85	5.693,80	5.640,34	5.763,46	0,88
N_2O emissions including N_2O from LULUCF	8.296,61	8.025,21	7.680,83	7.570,98	7.304,98	6.747,98	6.491,10	6.788,63	-35,56
N_2O emissions excluding N_2O from LULUCF	8.296,53	8.025,14	7.680,76	7.570,90	7.304,91	6.747,90	6.491,03	6.788,55	-35,56
HFCs	606,49	650,25	675,91	700,17	754,32	800,44	820,40	846,01	100,00
PFCs	17,89	22,13	22,17	19,34	15,90	13,90	15,68	15,36	100,00
SF_6	59,23	30,40	25,01	31,38	33,15	21,76	36,00	30,35	-31,73
Total (including LULUCF)	**70.271,52**	**69.267,27**	**67.269,01**	**72.097,60**	**67.597,85**	**64.300,82**	**70.853,86**	**66.193,14**	**-5,79**
Total (excluding LULUCF)	**68.641,15**	**70.036,65**	**69.247,91**	**74.388,04**	**68.422,37**	**64.139,83**	**71.728,88**	**67.320,43**	**-3,43**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
1. Energy	53.025,80	54.595,43	54.157,67	59.558,95	53.864,75	50.246,69	58.091,09	53.197,76	0,92
2. Industrial Processes	3.388,37	3.290,73	3.197,91	3.214,85	3.022,57	2.440,44	2.521,32	2.538,75	13,36
3. Solvent and Other Product Use	126,61	112,54	115,01	103,70	99,17	113,39	129,94	124,00	-30,88
4. Agriculture	10.593,00	10.530,75	10.244,92	9.973,16	10.015,15	9.941,41	9.597,98	10.084,61	-22,56
5. Land Use, Land-Use Change and Forestry(5)	1.630,37	-769,38	-1.978,90	-2.290,45	-824,52	160,99	-875,02	-1.127,28	-304,49
6. Waste	1.507,37	1.507,21	1.532,40	1.537,38	1.420,74	1.397,89	1.388,55	1.375,31	-11,83
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
Total (including LULUCF)(5)	**70.271,52**	**69.267,27**	**67.269,01**	**72.097,60**	**67.597,85**	**64.300,82**	**70.853,86**	**66.193,14**	**-5,79**

(1) The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

(2) Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(3) Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equivalent emissions.

(4) In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is Gg of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.
(5) Includes net CO_2, CH_4 and N_2O from LULUCF.

Documentation box:
- Parties should provide detailed explanations on emissions trends in Chapter 2: Trends in Greenhouse Gas Emissions and, as appropriate, in the corresponding Chapters 3 - 9 of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.
- Use the documentation box to provide explanations if potential emissions are reported.

Table 3 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 1990.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1990
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**53.970,18**	**5.712,51**	**10.535,34**	**0,00**	**0,00**	**44,45**	**70.262,49**
1. Energy	**52.083,98**	**225,22**	**401,29**				**52.710,50**
A. Fuel Combustion (Sectoral Approach)	51.820,54	185,61	399,86				52.406,01
1. Energy Industries	26.355,71	23,54	120,47				26.499,72
2. Manufacturing Industries and Construction	5.450,05	14,85	54,70				5.519,60
3. Transport	10.623,82	56,18	116,28				10.796,28
4. Other Sectors	9.263,70	90,92	107,20				9.461,82
5. Other	127,25	0,12	1,22				128,59
B. Fugitive Emissions from Fuels	263,44	39,61	1,44				304,48
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	263,44	39,61	1,44				304,48
2. Industrial Processes	**1.152,16**	**0,00**	**1.042,90**	**0,00**	**0,00**	**44,45**	**2.239,52**
A. Mineral Products	1.073,21	IE,NA,NE	IE,NA,NE				1.073,21
B. Chemical Industry	0,80	NA,NO	1.042,90				1.043,70
C. Metal Production	28,45	NA,NO	NO		NO	31,07	59,52
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				NA,NE,NO	NA,NE,NO	13,38	13,38
G. Other	49,71	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	49,71
3. Solvent and Other Product Use	**179,38**		**0,00**				**179,38**
4. Agriculture		**4.018,99**	**9.002,92**				**13.021,92**
A. Enteric Fermentation		3.267,60					3.267,60
B. Manure Management		751,39	688,56				1.439,95
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE,NO	8.314,36				8.314,36
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry[(1)]	**551,78**	**-0,60**	**0,09**				**551,28**
A. Forest Land	-2.830,67	NA,NO	NA,NO				-2.830,67
B. Cropland	3.287,48	NA	NA				3.287,48
C. Grassland	93,01	NA	NA				93,01
D. Wetlands	1,96	-0,60	0,09				1,45
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,87**	**1.468,90**	**88,14**				**1.559,90**
A. Solid Waste Disposal on Land	NA,NE,NO	1.343,26					1.343,26
B. Waste-water Handling		125,62	87,63				213,25
C. Waste Incineration	IE	IE	IE				IE
D. Other	2,87	0,02	0,51				3,40
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	4.823,30	2,03	78,46				4.903,79
Aviation	1.736,10	0,65	18,30				1.755,06
Marine	3.087,20	1,37	60,16				3.148,73
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	4.640,89						**4.640,89**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	69.711,21
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	70.262,49

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 4 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 1991.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1991
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**62.394,78**	**5.801,16**	**10.326,22**	**0,00**	**0,00**	**63,50**	**78.585,66**
1. Energy	**62.581,43**	**251,16**	**445,09**				**63.277,67**
A. Fuel Combustion (Sectoral Approach)	62.063,41	203,24	442,27				62.708,92
1. Energy Industries	35.290,49	32,54	146,80				35.469,83
2. Manufacturing Industries and Construction	5.969,78	15,61	58,87				6.044,25
3. Transport	10.999,27	57,00	123,20				11.179,47
4. Other Sectors	9.509,19	97,69	110,78				9.717,66
5. Other	294,69	0,40	2,62				297,70
B. Fugitive Emissions from Fuels	518,02	47,92	2,82				568,76
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	518,02	47,92	2,82				568,76
2. Industrial Processes	**1.324,26**	**0,00**	**954,83**	**0,00**	**0,00**	**63,50**	**2.342,60**
A. Mineral Products	1.246,16	IE,NA,NE	IE,NA,NE				1.246,16
B. Chemical Industry	0,80	NA,NO	954,83				955,63
C. Metal Production	28,45	NA,NO	NO		NO	31,07	59,52
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [2]				NA,NE,NO	NA,NE,NO	32,43	32,43
G. Other	48,86	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	48,86
3. Solvent and Other Product Use	**174,21**		**0,00**				**174,21**
4. Agriculture		**4.060,68**	**8.842,20**				**12.902,88**
A. Enteric Fermentation		3.270,47					3.270,47
B. Manure Management		790,21	684,37				1.474,57
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		NE,NO	8.157,84				8.157,84
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry [1]	**-1.688,05**	**-0,60**	**0,09**				**-1.688,55**
A. Forest Land	-3.009,20	NA,NO	NA,NO				-3.009,20
B. Cropland	1.228,40	NA	NA				1.228,40
C. Grassland	90,79	NA	NA				90,79
D. Wetlands	1,96	-0,60	0,09				1,45
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,92**	**1.489,92**	**84,01**				**1.576,84**
A. Solid Waste Disposal on Land	NA,NE,NO	1.367,31					1.367,31
B. Waste-water Handling		122,59	83,49				206,08
C. Waste Incineration	IE	IE	IE				IE
D. Other	2,92	0,02	0,52				3,45
7. Other ***(as specified in Summary 1.A)***	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [4]							
International Bunkers	4.394,45	1,84	71,10				4.467,39
Aviation	1.632,12	0,61	17,24				1.649,97
Marine	2.762,33	1,23	53,86				2.817,42
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	5.032,95						**5.032,95**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [5]	80.274,21
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [5]	78.585,66

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

[5] These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 5 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 1992.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1992
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**56.726,25**	**5.828,21**	**9.893,33**	**3,44**	**0,00**	**89,15**	**72.540,39**
1. Energy	**56.659,75**	**260,99**	**429,29**				**57.350,02**
A. Fuel Combustion (Sectoral Approach)	56.125,54	215,37	426,38				56.767,29
1. Energy Industries	30.255,19	39,18	135,31				30.429,68
2. Manufacturing Industries and Construction	5.793,82	15,09	57,32				5.866,24
3. Transport	11.194,90	56,36	128,81				11.380,07
4. Other Sectors	8.733,03	104,51	103,66				8.941,20
5. Other	148,59	0,22	1,28				150,09
B. Fugitive Emissions from Fuels	534,21	45,62	2,91				582,74
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	534,21	45,62	2,91				582,74
2. Industrial Processes	**1.442,95**	**0,00**	**843,59**	**3,44**	**0,00**	**89,15**	**2.379,13**
A. Mineral Products	1.365,58	IE,NA,NE	IE,NA,NE				1.365,58
B. Chemical Industry	0,80	NA,NO	843,59				844,39
C. Metal Production	28,45	NA,NO	NO		NO	31,07	59,52
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 (2)				3,44	NA,NE,NO	58,08	61,52
G. Other	48,12	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	48,12
3. Solvent and Other Product Use	**169,05**		**0,00**				**169,05**
4. Agriculture		**4.069,04**	**8.546,46**				**12.615,50**
A. Enteric Fermentation		3.223,32					3.223,32
B. Manure Management		845,72	687,44				1.533,16
C. Rice Cultivation		NO					0,00
D. Agricultural Soils(3)		NE,NO	7.859,02				7.859,02
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry(1)	**-1.548,42**	**-0,60**	**0,09**				**-1.548,93**
A. Forest Land	-3.000,81	NA,NO	NA,NO				-3.000,81
B. Cropland	1.361,37	NA	NA				1.361,37
C. Grassland	89,05	NA	NA				89,05
D. Wetlands	1,96	-0,60	0,09				1,45
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,93**	**1.498,79**	**73,90**				**1.575,62**
A. Solid Waste Disposal on Land	NA,NE,NO	1.377,49					1.377,49
B. Waste-water Handling		121,28	73,38				194,66
C. Waste Incineration	IE	IE	IE				IE
D. Other	2,93	0,02	0,52				3,47
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: (4)							
International Bunkers	4.580,16	1,92	74,27				4.656,35
Aviation	1.693,19	0,63	17,93				1.711,75
Marine	2.886,97	1,29	56,34				2.944,60
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	5.321,34						**5.321,34**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	74.089,32
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	72.540,39

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 6 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 1993.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1993
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**59.379,41**	**5.987,98**	**9.652,36**	**93,93**	**0,00**	**101,17**	**75.214,85**
1. Energy	**58.907,30**	**310,23**	**442,56**				**59.660,10**
A. Fuel Combustion (Sectoral Approach)	58.438,97	260,00	440,01				59.138,98
1. Energy Industries	31.783,63	72,71	139,63				31.995,97
2. Manufacturing Industries and Construction	5.631,66	15,39	56,09				5.703,14
3. Transport	11.311,53	55,66	132,59				11.499,77
4. Other Sectors	9.467,98	115,95	109,46				9.693,39
5. Other	244,17	0,28	2,24				246,69
B. Fugitive Emissions from Fuels	468,34	50,23	2,55				521,12
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	468,34	50,23	2,55				521,12
2. Industrial Processes	**1.462,16**	**0,00**	**794,92**	**93,93**	**0,00**	**101,17**	**2.452,18**
A. Mineral Products	1.382,84	IE,NA,NE	IE,NA,NE				1.382,84
B. Chemical Industry	0,80	NA,NO	794,92				795,72
C. Metal Production	30,97	NA,NO	NO		NO	35,85	66,82
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				93,93	NA,NE,NO	65,32	159,25
G. Other	47,55	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	47,55
3. Solvent and Other Product Use	**163,88**		**0,00**				**163,88**
4. Agriculture		**4.159,40**	**8.323,38**				**12.482,78**
A. Enteric Fermentation		3.260,25					3.260,25
B. Manure Management		899,15	685,72				1.584,87
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE,NO	7.637,66				7.637,66
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry[(1)]	**-1.156,88**	**-0,59**	**0,09**				**-1.157,38**
A. Forest Land	-3.213,00	NA,NO	NA,NO				-3.213,00
B. Cropland	1.969,70	NA	NA				1.969,70
C. Grassland	84,48	NA	NA				84,48
D. Wetlands	1,95	-0,59	0,09				1,44
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,95**	**1.518,95**	**91,41**				**1.613,31**
A. Solid Waste Disposal on Land	NA,NE,NO	1.391,43					1.391,43
B. Waste-water Handling		127,50	90,89				218,38
C. Waste Incineration	IE	IE	IE				IE
D. Other	2,95	0,02	0,52				3,49
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	5.958,34	2,55	101,57				6.062,47
Aviation	1.658,84	0,61	17,75				1.677,20
Marine	4.299,50	1,94	83,82				4.385,27
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	5.574,45						**5.574,45**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	76.372,24
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	75.214,85

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 7 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 1994.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1994
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**62.506,75**	**5.909,98**	**9.471,78**	**134,53**	**0,05**	**122,06**	**78.145,15**
1. Energy	**62.474,61**	**379,61**	**459,75**				**63.313,97**
A. Fuel Combustion (Sectoral Approach)	62.007,01	326,11	457,23				62.790,35
1. Energy Industries	35.491,55	137,19	154,61				35.783,35
2. Manufacturing Industries and Construction	5.788,74	15,53	55,50				5.859,77
3. Transport	11.792,65	53,77	142,81				11.989,23
4. Other Sectors	8.675,76	119,35	101,90				8.897,02
5. Other	258,29	0,28	2,41				260,98
B. Fugitive Emissions from Fuels	467,60	53,49	2,52				523,62
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	467,60	53,49	2,52				523,62
2. Industrial Processes	**1.487,33**	**0,00**	**806,51**	**134,53**	**0,05**	**122,06**	**2.550,48**
A. Mineral Products	1.406,08	IE,NA,NE	IE,NA,NE				1.406,08
B. Chemical Industry	0,80	NA,NO	806,51				807,31
C. Metal Production	33,50	NA,NO	NO		NO	45,41	78,91
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				134,53	0,05	76,65	211,23
G. Other	46,95	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	46,95
3. Solvent and Other Product Use	**158,71**		**0,00**				**158,71**
4. Agriculture		**4.025,35**	**8.112,70**				**12.138,05**
A. Enteric Fermentation		3.155,64					3.155,64
B. Manure Management		869,70	666,59				1.536,30
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE,NO	7.446,11				7.446,11
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry[(1)]	**-1.616,88**	**-0,59**	**0,09**				**-1.617,38**
A. Forest Land	-3.102,56	NA,NO	NA,NO				-3.102,56
B. Cropland	1.401,93	NA	NA				1.401,93
C. Grassland	81,82	NA	NA				81,82
D. Wetlands	1,94	-0,59	0,09				1,43
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,98**	**1.505,62**	**92,73**				**1.601,33**
A. Solid Waste Disposal on Land	NA,NE,NO	1.353,47					1.353,47
B. Waste-water Handling		152,13	92,20				244,33
C. Waste Incineration	0,01	0,00	0,00				0,01
D. Other	2,97	0,02	0,53				3,52
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	6.646,69	2,85	113,57				6.763,12
Aviation	1.817,70	0,66	19,39				1.837,75
Marine	4.828,99	2,19	94,18				4.925,37
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	5.533,46						**5.533,46**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	79.762,53
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	78.145,15

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 8 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 1995.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1995
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**59.438,47**	**6.005,44**	**9.365,82**	**217,75**	**0,50**	**107,37**	**75.135,35**
1. Energy	**59.468,78**	**510,49**	**467,11**				**60.446,38**
A. Fuel Combustion (Sectoral Approach)	59.105,98	448,78	465,14				60.019,90
1. Energy Industries	32.054,44	248,83	154,83				32.458,10
2. Manufacturing Industries and Construction	5.935,19	17,63	56,11				6.008,93
3. Transport	11.940,17	51,07	148,67				12.139,91
4. Other Sectors	8.917,02	130,87	103,23				9.151,12
5. Other	259,15	0,38	2,30				261,83
B. Fugitive Emissions from Fuels	362,80	61,71	1,98				426,49
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	362,80	61,71	1,98				426,49
2. Industrial Processes	**1.494,80**	**0,00**	**903,85**	**217,75**	**0,50**	**107,37**	**2.724,27**
A. Mineral Products	1.406,59	IE,NA,NE	IE,NA,NE				1.406,59
B. Chemical Industry	0,80	NA,NO	903,85				904,65
C. Metal Production	38,56	NA,NO	NO		NO	35,85	74,41
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				217,75	0,50	71,52	289,78
G. Other	48,84	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	48,84
3. Solvent and Other Product Use	**140,96**		**0,00**				**140,96**
4. Agriculture		**4.008,83**	**7.909,08**				**11.917,91**
A. Enteric Fermentation		3.141,22					3.141,22
B. Manure Management		867,61	645,32				1.512,93
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE,NO	7.263,76				7.263,76
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry[(1)]	**-1.669,10**	**-0,59**	**0,09**				**-1.669,60**
A. Forest Land	-2.992,53	NA,NO	NA,NO				-2.992,53
B. Cropland	1.232,78	NA	NA				1.232,78
C. Grassland	88,72	NA	NA				88,72
D. Wetlands	1,93	-0,59	0,09				1,43
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**3,03**	**1.486,71**	**85,69**				**1.575,42**
A. Solid Waste Disposal on Land	NA,NE,NO	1.309,71					1.309,71
B. Waste-water Handling		176,97	85,15				262,12
C. Waste Incineration	0,04	0,00	0,00				0,05
D. Other	2,99	0,02	0,53				3,54
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	6.927,68	3,05	118,70				7.049,42
Aviation	1.867,05	0,74	19,98				1.887,76
Marine	5.060,63	2,31	98,72				5.161,67
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	5.868,80						**5.868,80**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	76.804,95
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	75.135,35

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 9 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 1996.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1996
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**73.419,23**	**6.119,87**	**9.003,99**	**329,38**	**1,66**	**60,96**	**88.935,10**
1. Energy	**72.877,69**	**607,61**	**528,62**				**74.013,92**
A. Fuel Combustion (Sectoral Approach)	72.478,99	548,28	526,45				73.553,73
1. Energy Industries	44.441,92	323,82	203,87				44.969,61
2. Manufacturing Industries and Construction	6.125,19	26,93	58,49				6.210,61
3. Transport	12.201,36	48,88	155,57				12.405,81
4. Other Sectors	9.527,34	148,44	106,80				9.782,58
5. Other	183,18	0,22	1,72				185,12
B. Fugitive Emissions from Fuels	398,70	59,33	2,17				460,19
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	398,70	59,33	2,17				460,19
2. Industrial Processes	**1.601,06**	**0,00**	**834,32**	**329,38**	**1,66**	**60,96**	**2.827,38**
A. Mineral Products	1.515,54	IE,NA,NE	IE,NA,NE				1.515,54
B. Chemical Industry	1,45	NA,NO	834,32				835,77
C. Metal Production	35,19	NA,NO	NO		NO	9,56	44,75
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 (2)				329,38	1,66	51,40	382,44
G. Other	48,89	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	48,89
3. Solvent and Other Product Use	**154,36**		**0,00**				**154,36**
4. Agriculture		**4.010,91**	**7.571,00**				**11.581,91**
A. Enteric Fermentation		3.129,58					3.129,58
B. Manure Management		881,34	646,06				1.527,39
C. Rice Cultivation		NO					0,00
D. Agricultural Soils(3)		NE,NO	6.924,94				6.924,94
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry(1)	**-1.216,97**	**-0,59**	**0,09**				**-1.217,47**
A. Forest Land	-3.069,16	NA,NO	NA,NO				-3.069,16
B. Cropland	1.767,65	NA	NA				1.767,65
C. Grassland	82,62	NA	NA				82,62
D. Wetlands	1,92	-0,59	0,09				1,42
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**3,09**	**1.501,94**	**69,96**				**1.574,99**
A. Solid Waste Disposal on Land	NA,NE,NO	1.299,90					1.299,90
B. Waste-water Handling		202,02	69,42				271,44
C. Waste Incineration	0,15	0,00	0,01				0,16
D. Other	2,95	0,02	0,53				3,49
7. Other ***(as specified in Summary 1.A)***	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: (4)							
International Bunkers	6.773,80	2,99	114,98				6.891,77
Aviation	1.971,08	0,78	21,27				1.993,13
Marine	4.802,71	2,21	93,72				4.898,64
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	6.295,78						**6.295,78**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	90.152,57
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	88.935,10

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 10 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 1997.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1997
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**63.961,40**	**6.011,66**	**8.910,18**	**324,14**	**4,12**	**73,07**	**79.284,57**
1. Energy	**63.229,67**	**609,08**	**500,18**				**64.338,93**
A. Fuel Combustion (Sectoral Approach)	62.666,62	543,62	497,11				63.707,35
1. Energy Industries	35.212,13	313,48	177,68				35.703,29
2. Manufacturing Industries and Construction	6.169,69	26,98	58,86				6.255,53
3. Transport	12.398,60	47,00	158,98				12.604,58
4. Other Sectors	8.708,12	155,89	99,97				8.963,99
5. Other	178,09	0,26	1,61				179,96
B. Fugitive Emissions from Fuels	563,04	65,46	3,07				631,57
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	563,04	65,46	3,07				631,57
2. Industrial Processes	**1.768,30**	**0,00**	**848,23**	**324,14**	**4,12**	**73,07**	**3.017,85**
A. Mineral Products	1.685,28	IE,NA,NE	IE,NA,NE				1.685,28
B. Chemical Industry	0,87	NA,NO	848,23				849,09
C. Metal Production	35,01	NA,NO	NO		NO	14,34	49,35
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				324,14	4,12	58,73	386,98
G. Other	47,15	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	47,15
3. Solvent and Other Product Use	**139,45**		**0,00**				**139,45**
4. Agriculture		**3.915,53**	**7.495,96**				**11.411,50**
A. Enteric Fermentation		3.020,72					3.020,72
B. Manure Management		894,81	646,92				1.541,73
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE,NO	6.849,05				6.849,05
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry[(1)]	**-1.179,17**	**-0,59**	**0,09**				**-1.179,66**
A. Forest Land	-3.162,11	NA,NO	NA,NO				-3.162,11
B. Cropland	1.909,20	NA	NA				1.909,20
C. Grassland	71,83	NA	NA				71,83
D. Wetlands	1,92	-0,59	0,09				1,42
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**3,15**	**1.487,63**	**65,72**				**1.556,51**
A. Solid Waste Disposal on Land	NA,NE,NO	1.239,50					1.239,50
B. Waste-water Handling		248,11	65,17				313,28
C. Waste Incineration	0,23	0,00	0,02				0,25
D. Other	2,93	0,02	0,52				3,47
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	6.413,77	2,83	107,73				6.524,34
Aviation	2.010,44	0,79	21,81				2.033,04
Marine	4.403,33	2,04	85,93				4.491,29
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	6.542,43						**6.542,43**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	80.464,23
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	79.284,57

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 11 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 1998.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1998
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**58.915,81**	**6.036,82**	**8.822,09**	**411,89**	**9,10**	**59,42**	**74.255,13**
1. Energy	**59.030,30**	**638,10**	**481,57**				**60.149,97**
A. Fuel Combustion (Sectoral Approach)	58.609,69	572,59	479,28				59.661,56
1. Energy Industries	31.398,23	339,44	166,32				31.903,99
2. Manufacturing Industries and Construction	6.193,78	28,75	59,34				6.281,86
3. Transport	12.372,28	45,09	156,53				12.573,90
4. Other Sectors	8.434,11	159,01	95,16				8.688,28
5. Other	211,29	0,30	1,94				213,53
B. Fugitive Emissions from Fuels	420,62	65,50	2,29				488,41
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	420,62	65,50	2,29				488,41
2. Industrial Processes	**1.707,84**	**0,00**	**806,51**	**411,89**	**9,10**	**59,42**	**2.994,76**
A. Mineral Products	1.620,24	IE,NA,NE	IE,NA,NE				1.620,24
B. Chemical Industry	0,56	NA,NO	806,51				807,07
C. Metal Production	42,19	NA,NO	NO		NO	16,73	58,92
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [2]				411,89	9,10	42,69	463,68
G. Other	44,85	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	44,85
3. Solvent and Other Product Use	**128,40**		**0,00**				**128,40**
4. Agriculture		**3.949,24**	**7.467,41**				**11.416,65**
A. Enteric Fermentation		3.016,52					3.016,52
B. Manure Management		932,71	655,56				1.588,27
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[3]		NE,NO	6.811,86				6.811,86
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry[1]	**-1.954,00**	**-0,59**	**0,09**				**-1.954,49**
A. Forest Land	-3.320,00	NA,NO	NA,NO				-3.320,00
B. Cropland	1.297,25	NA	NA				1.297,25
C. Grassland	66,99	NA	NA				66,99
D. Wetlands	1,77	-0,59	0,09				1,27
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**3,27**	**1.450,07**	**66,51**				**1.519,84**
A. Solid Waste Disposal on Land	NA,NE,NO	1.197,45					1.197,45
B. Waste-water Handling		252,59	65,94				318,54
C. Waste Incineration	0,49	0,00	0,05				0,55
D. Other	2,77	0,02	0,51				3,31
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [4]							
International Bunkers	6.573,23	2,89	109,56				6.685,68
Aviation	2.158,98	0,84	23,34				2.183,15
Marine	4.414,25	2,05	86,22				4.502,52
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	6.491,97						**6.491,97**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [5]	76.209,62
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [5]	74.255,13

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

[5] These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 12 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 1999.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1999
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**56.936,28**	**5.913,10**	**8.509,74**	**504,25**	**12,48**	**65,36**	**71.941,21**
1. Energy	**56.354,92**	**644,14**	**478,33**				**57.477,39**
A. Fuel Combustion (Sectoral Approach)	55.458,93	569,33	473,45				56.501,71
1. Energy Industries	28.358,82	338,02	161,04				28.857,87
2. Manufacturing Industries and Construction	6.267,67	28,86	59,92				6.356,45
3. Transport	12.374,48	42,75	154,80				12.572,03
4. Other Sectors	8.268,35	159,46	95,88				8.523,69
5. Other	189,61	0,25	1,81				191,67
B. Fugitive Emissions from Fuels	895,99	74,81	4,88				975,68
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	895,99	74,81	4,88				975,68
2. Industrial Processes	**1.686,07**	**0,00**	**950,20**	**504,25**	**12,48**	**65,36**	**3.218,36**
A. Mineral Products	1.599,73	IE,NA,NE	IE,NA,NE				1.599,73
B. Chemical Industry	0,58	NA,NO	950,20				950,78
C. Metal Production	43,04	NA,NO	NO		NO	16,73	59,77
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 (2)				504,25	12,48	48,63	565,36
G. Other	42,72	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	42,72
3. Solvent and Other Product Use	**126,88**		**0,00**				**126,88**
4. Agriculture		**3.810,53**	**7.018,66**				**10.829,19**
A. Enteric Fermentation		2.891,24					2.891,24
B. Manure Management		919,29	633,94				1.553,23
C. Rice Cultivation		NO					0,00
D. Agricultural Soils(3)		NE,NO	6.384,72				6.384,72
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry(1)	**-1.234,68**	**-0,50**	**0,07**				**-1.235,11**
A. Forest Land	-3.319,93	NA,NO	NA,NO				-3.319,93
B. Cropland	2.015,81	NA	NA				2.015,81
C. Grassland	68,39	NA	NA				68,39
D. Wetlands	1,05	-0,50	0,07				0,63
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**3,09**	**1.458,92**	**62,48**				**1.524,49**
A. Solid Waste Disposal on Land	NA,NE,NO	1.222,04					1.222,04
B. Waste-water Handling		236,86	61,94				298,80
C. Waste Incineration	0,54	0,00	0,05				0,60
D. Other	2,55	0,02	0,48				3,06
7. Other ***(as specified in Summary 1.A)***	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: (4)							
International Bunkers	6.445,41	2,81	105,94				6.554,16
Aviation	2.290,07	0,86	24,82				2.315,75
Marine	4.155,35	1,95	81,12				4.238,42
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	6.857,21						**6.857,21**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	73.176,31
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	71.941,21

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 13 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 2000.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2000
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**55.386,86**	**5.904,44**	**8.296,61**	**606,49**	**17,89**	**59,23**	**70.271,52**
1. Energy	**51.925,45**	**640,27**	**460,09**				**53.025,80**
A. Fuel Combustion (Sectoral Approach)	51.332,90	560,32	456,87				52.350,09
1. Energy Industries	25.260,38	321,06	151,49				25.732,93
2. Manufacturing Industries and Construction	6.052,89	32,95	59,47				6.145,31
3. Transport	12.165,68	40,20	150,95				12.356,83
4. Other Sectors	7.736,16	165,99	93,81				7.995,96
5. Other	117,79	0,13	1,14				119,05
B. Fugitive Emissions from Fuels	592,55	79,94	3,22				675,71
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	592,55	79,94	3,22				675,71
2. Industrial Processes	**1.701,26**	**0,00**	**1.003,50**	**606,49**	**17,89**	**59,23**	**3.388,37**
A. Mineral Products	1.620,19	IE,NA,NE	IE,NA,NE				1.620,19
B. Chemical Industry	0,65	NA,NO	1.003,50				1.004,16
C. Metal Production	40,73	NA,NO	NO		NO	21,29	62,02
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 (2)				606,49	17,89	37,93	662,31
G. Other	39,70	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	39,70
3. Solvent and Other Product Use	**126,61**		**0,00**				**126,61**
4. Agriculture		**3.825,93**	**6.767,07**				**10.593,00**
A. Enteric Fermentation		2.871,52					2.871,52
B. Manure Management		954,41	605,09				1.559,50
C. Rice Cultivation		NO					0,00
D. Agricultural Soils(3)		NE,NO	6.161,98				6.161,98
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry(1)	**1.630,79**	**-0,50**	**0,07**				**1.630,37**
A. Forest Land	-664,28	NA,NO	NA,NO				-664,28
B. Cropland	2.227,07	NA	NA				2.227,07
C. Grassland	71,27	NA	NA				71,27
D. Wetlands	-3,28	-0,50	0,07				-3,70
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,75**	**1.438,75**	**65,87**				**1.507,37**
A. Solid Waste Disposal on Land	NA,NE,NO	1.221,53					1.221,53
B. Waste-water Handling		217,19	65,40				282,59
C. Waste Incineration	0,58	0,00	0,06				0,64
D. Other	2,17	0,02	0,41				2,60
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: (4)							
International Bunkers	6.629,22	2,92	108,95				6.741,09
Aviation	2.349,78	0,89	25,46				2.376,13
Marine	4.279,45	2,03	83,49				4.364,96
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	7.169,29						**7.169,29**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	68.641,15
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	70.271,52

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 14 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 2001.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2001
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**54.501,83**	**6.037,45**	**8.025,21**	**650,25**	**22,13**	**30,40**	**69.267,27**
1. Energy	**53.452,82**	**674,93**	**467,67**				**54.595,43**
A. Fuel Combustion (Sectoral Approach)	52.821,58	594,80	464,25				53.880,63
1. Energy Industries	26.546,58	347,62	159,01				27.053,21
2. Manufacturing Industries and Construction	6.116,94	34,38	60,66				6.211,98
3. Transport	12.152,53	37,65	146,06				12.336,24
4. Other Sectors	7.901,40	174,99	97,55				8.173,94
5. Other	104,13	0,15	0,97				105,26
B. Fugitive Emissions from Fuels	631,24	80,13	3,42				714,79
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	631,24	80,13	3,42				714,79
2. Industrial Processes	**1.702,65**	**0,00**	**885,31**	**650,25**	**22,13**	**30,40**	**3.290,73**
A. Mineral Products	1.616,66	IE,NA,NE	IE,NA,NE				1.616,66
B. Chemical Industry	0,83	NA,NO	885,31				886,13
C. Metal Production	46,68	NA,NO	NO		NO	NO	46,68
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				650,25	22,13	30,40	702,78
G. Other	38,49	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	38,49
3. Solvent and Other Product Use	**112,54**		**0,00**				**112,54**
4. Agriculture		**3.916,31**	**6.614,43**				**10.530,75**
A. Enteric Fermentation		2.925,72					2.925,72
B. Manure Management		990,59	606,06				1.596,65
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE,NO	6.008,37				6.008,37
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry[(1)]	**-768,96**	**-0,50**	**0,07**				**-769,38**
A. Forest Land	-3.551,16	NA,NO	NA,NO				-3.551,16
B. Cropland	2.712,70	NA	NA				2.712,70
C. Grassland	74,46	NA	NA				74,46
D. Wetlands	-4,97	-0,50	0,07				-5,39
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,78**	**1.446,70**	**57,72**				**1.507,21**
A. Solid Waste Disposal on Land	NA,NE,NO	1.215,23					1.215,23
B. Waste-water Handling		231,45	57,26				288,71
C. Waste Incineration	0,61	0,00	0,06				0,68
D. Other	2,17	0,02	0,40				2,59
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	5.989,77	2,61	95,89				6.088,27
Aviation	2.384,94	0,89	25,53				2.411,36
Marine	3.604,83	1,72	70,35				3.676,91
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	7.902,41						**7.902,41**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	70.036,65
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	69.267,27

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 15 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 2002.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2002
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**52.857,07**	**6.008,01**	**7.680,83**	**675,91**	**22,17**	**25,01**	**67.269,01**
1. Energy	**53.017,10**	**676,25**	**464,32**				**54.157,67**
A. Fuel Combustion (Sectoral Approach)	52.484,23	593,48	461,44				53.539,15
1. Energy Industries	26.716,49	346,20	163,27				27.225,96
2. Manufacturing Industries and Construction	5.831,37	31,48	57,58				5.920,43
3. Transport	12.250,92	35,45	143,21				12.429,59
4. Other Sectors	7.589,41	180,23	96,45				7.866,09
5. Other	96,04	0,11	0,93				97,08
B. Fugitive Emissions from Fuels	532,86	82,77	2,88				618,51
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	532,86	82,77	2,88				618,51
2. Industrial Processes	**1.700,75**	**0,00**	**774,07**	**675,91**	**22,17**	**25,01**	**3.197,91**
A. Mineral Products	1.660,33	IE,NA,NE	IE,NA,NE				1.660,33
B. Chemical Industry	0,55	NA,NO	774,07				774,62
C. Metal Production	0,00	NA,NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 (2)				675,91	22,17	25,01	723,09
G. Other	39,86	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	39,86
3. Solvent and Other Product Use	**115,01**		**0,00**				**115,01**
4. Agriculture		**3.861,23**	**6.383,69**				**10.244,92**
A. Enteric Fermentation		2.855,01					2.855,01
B. Manure Management		1.006,23	592,38				1.598,61
C. Rice Cultivation		NO					0,00
D. Agricultural Soils(3)		NE,NO	5.791,31				5.791,31
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry(1)	**-1.978,48**	**-0,50**	**0,07**				**-1.978,90**
A. Forest Land	-3.827,04	NA,NO	NA,NO				-3.827,04
B. Cropland	1.779,43	NA	NA				1.779,43
C. Grassland	76,12	NA	NA				76,12
D. Wetlands	-6,99	-0,50	0,07				-7,41
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,70**	**1.471,03**	**58,68**				**1.532,40**
A. Solid Waste Disposal on Land	NA,NE,NO	1.160,71					1.160,71
B. Waste-water Handling		310,29	58,23				368,52
C. Waste Incineration	0,63	0,00	0,06				0,70
D. Other	2,07	0,02	0,39				2,47
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: (4)							
International Bunkers	5.024,93	2,27	80,20				5.107,40
Aviation	2.059,41	0,85	22,27				2.082,53
Marine	2.965,52	1,42	57,93				3.024,87
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	8.429,61						**8.429,61**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	69.247,91
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	67.269,01

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 16 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 2003.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2003
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**57.785,94**	**5.989,80**	**7.570,98**	**700,17**	**19,34**	**31,38**	**72.097,60**
1. Energy	**58.400,14**	**681,24**	**477,56**				**59.558,95**
A. Fuel Combustion (Sectoral Approach)	57.852,19	596,91	474,59				58.923,69
1. Energy Industries	31.533,96	339,68	172,00				32.045,64
2. Manufacturing Industries and Construction	5.801,33	31,53	57,16				5.890,02
3. Transport	12.721,97	34,11	143,17				12.899,25
4. Other Sectors	7.695,69	191,47	101,29				7.988,45
5. Other	99,24	0,12	0,96				100,33
B. Fugitive Emissions from Fuels	547,95	84,33	2,97				635,26
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	547,95	84,33	2,97				635,26
2. Industrial Processes	**1.569,31**	**0,00**	**894,66**	**700,17**	**19,34**	**31,38**	**3.214,85**
A. Mineral Products	1.531,22	IE,NA,NE	IE,NA,NE				1.531,22
B. Chemical Industry	1,05	NA,NO	894,66				895,71
C. Metal Production	0,00	NA,NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [2]				700,17	19,34	31,38	750,89
G. Other	37,03	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	37,03
3. Solvent and Other Product Use	**103,70**		**0,00**				**103,70**
4. Agriculture		**3.824,73**	**6.148,44**				**9.973,16**
A. Enteric Fermentation		2.811,75					2.811,75
B. Manure Management		1.012,98	569,87				1.582,84
C. Rice Cultivation		NO					0,00
D. Agricultural Soils [3]		NE,NO	5.578,57				5.578,57
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry [1]	**-2.290,03**	**-0,49**	**0,07**				**-2.290,45**
A. Forest Land	-3.547,24	NA,NO	NA,NO				-3.547,24
B. Cropland	1.191,05	NA	NA				1.191,05
C. Grassland	76,17	NA	NA				76,17
D. Wetlands	-10,00	-0,49	0,07				-10,42
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,81**	**1.484,32**	**50,24**				**1.537,38**
A. Solid Waste Disposal on Land	0,00	1.183,94					1.183,94
B. Waste-water Handling		300,36	49,77				350,13
C. Waste Incineration	0,63	0,00	0,06				0,70
D. Other	2,18	0,02	0,41				2,61
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [4]							
International Bunkers	5.272,10	2,39	84,31				5.358,80
Aviation	2.142,08	0,87	23,19				2.166,14
Marine	3.130,03	1,52	61,12				3.192,66
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	9.452,90						**9.452,90**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [5]	74.388,04
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [5]	72.097,60

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 17 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 2004.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2004
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**53.689,15**	**5.800,35**	**7.304,98**	**754,32**	**15,90**	**33,15**	**67.597,85**
1. Energy	**52.722,89**	**679,25**	**462,61**				**53.864,75**
A. Fuel Combustion (Sectoral Approach)	52.116,46	577,67	459,32				53.153,45
1. Energy Industries	25.541,59	318,88	155,89				26.016,36
2. Manufacturing Industries and Construction	5.848,52	31,30	58,58				5.938,39
3. Transport	13.030,90	32,22	143,69				13.206,82
4. Other Sectors	7.450,41	194,99	98,74				7.744,14
5. Other	245,04	0,28	2,42				247,74
B. Fugitive Emissions from Fuels	606,43	101,58	3,29				711,30
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	606,43	101,58	3,29				711,30
2. Industrial Processes	**1.688,48**	**0,00**	**530,72**	**754,32**	**15,90**	**33,15**	**3.022,57**
A. Mineral Products	1.647,74	IE,NA,NE	IE,NA,NE				1.647,74
B. Chemical Industry	3,01	NA,NO	530,72				533,73
C. Metal Production	0,00	NA,NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [2]				754,32	15,90	33,15	803,37
G. Other	37,73	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	37,73
3. Solvent and Other Product Use	**99,17**		**0,00**				**99,17**
4. Agriculture		**3.757,23**	**6.257,92**				**10.015,15**
A. Enteric Fermentation		2.718,10					2.718,10
B. Manure Management		1.039,13	581,44				1.620,57
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[3]		NE,NO	5.676,48				5.676,48
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry[1]	**-824,10**	**-0,49**	**0,07**				**-824,52**
A. Forest Land	-3.465,26	NA,NO	NA,NO				-3.465,26
B. Cropland	2.579,66	NA	NA				2.579,66
C. Grassland	73,99	NA	NA				73,99
D. Wetlands	-12,50	-0,49	0,07				-12,92
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,71**	**1.364,37**	**53,65**				**1.420,74**
A. Solid Waste Disposal on Land	NA,NE,NO	1.089,58					1.089,58
B. Waste-water Handling		274,77	53,20				327,97
C. Waste Incineration	0,64	0,00	0,06				0,71
D. Other	2,07	0,02	0,39				2,48
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [4]							
International Bunkers	4.995,17	2,23	75,98				5.073,39
Aviation	2.448,86	0,99	26,30				2.476,15
Marine	2.546,32	1,25	49,68				2.597,24
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	10.142,31						**10.142,31**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [5]	68.422,37
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [5]	67.597,85

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 18 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 2005.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2005
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**51.023,43**	**5.693,31**	**6.747,98**	**800,44**	**13,90**	**21,76**	**64.300,82**
1. Energy	**49.155,61**	**641,08**	**450,00**				**50.246,69**
A. Fuel Combustion (Sectoral Approach)	48.715,66	540,07	447,60				49.703,34
1. Energy Industries	22.273,77	277,32	143,60				22.694,70
2. Manufacturing Industries and Construction	5.628,31	27,18	57,30				5.712,79
3. Transport	13.149,27	30,03	139,08				13.318,38
4. Other Sectors	7.387,00	205,26	104,87				7.697,13
5. Other	277,31	0,28	2,75				280,34
B. Fugitive Emissions from Fuels	439,95	101,02	2,39				543,36
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	439,95	101,02	2,39				543,36
2. Industrial Processes	**1.604,34**	**0,00**	**0,00**	**800,44**	**13,90**	**21,76**	**2.440,44**
A. Mineral Products	1.548,17	IE,NA,NE	IE,NA,NE				1.548,17
B. Chemical Industry	3,01	NA,NO	NO				3,01
C. Metal Production	15,58	NA,NO	NO		NO	NO	15,58
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				800,44	13,90	21,76	836,10
G. Other	37,59	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	37,59
3. Solvent and Other Product Use	**99,35**		**14,04**				**113,39**
4. Agriculture		**3.708,51**	**6.232,89**				**9.941,41**
A. Enteric Fermentation		2.683,27					2.683,27
B. Manure Management		1.025,25	576,14				1.601,39
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE,NO	5.656,75				5.656,75
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry[(1)]	**161,41**	**-0,49**	**0,07**				**160,99**
A. Forest Land	-1.796,71	NA,NO	NA,NO				-1.796,71
B. Cropland	1.888,39	NA	NA				1.888,39
C. Grassland	82,74	NA	NA				82,74
D. Wetlands	-13,01	-0,49	0,07				-13,43
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,71**	**1.344,21**	**50,98**				**1.397,89**
A. Solid Waste Disposal on Land	NA,NE,NO	1.082,64					1.082,64
B. Waste-water Handling		261,54	50,53				312,07
C. Waste Incineration	0,64	0,00	0,06				0,71
D. Other	2,07	0,02	0,38				2,47
7. Other ***(as specified in Summary 1.A)***	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	5.215,96	2,33	78,95				5.297,25
Aviation	2.575,38	1,03	27,52				2.603,93
Marine	2.640,58	1,31	51,43				2.693,32
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	10.888,72						**10.888,72**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	64.139,83
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	64.300,82

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 19 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 2006.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2006
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**57.850,83**	**5.639,84**	**6.491,10**	**820,40**	**15,68**	**36,00**	**70.853,86**
1. Energy	**56.981,43**	**633,27**	**476,38**				**58.091,09**
A. Fuel Combustion (Sectoral Approach)	56.556,62	503,85	474,06				57.534,54
1. Energy Industries	30.009,51	240,06	169,57				30.419,14
2. Manufacturing Industries and Construction	5.807,65	24,53	58,70				5.890,88
3. Transport	13.525,05	27,95	137,82				13.690,82
4. Other Sectors	7.081,18	211,17	106,65				7.399,00
5. Other	133,24	0,13	1,33				134,70
B. Fugitive Emissions from Fuels	424,81	129,42	2,32				556,55
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	424,81	129,42	2,32				556,55
2. Industrial Processes	**1.649,24**	**0,00**	**0,00**	**820,40**	**15,68**	**36,00**	**2.521,32**
A. Mineral Products	1.609,57	IE,NA,NE	IE,NA,NE				1.609,57
B. Chemical Industry	2,18	NA,NO	NO				2,18
C. Metal Production	0,00	NA,NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				820,40	15,68	36,00	872,08
G. Other	37,49	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	37,49
3. Solvent and Other Product Use	**92,05**		**37,89**				**129,94**
4. Agriculture		**3.671,62**	**5.926,37**				**9.597,98**
A. Enteric Fermentation		2.629,13					2.629,13
B. Manure Management		1.042,49	541,12				1.583,61
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE,NO	5.385,25				5.385,25
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry[(1)]	**-874,60**	**-0,49**	**0,07**				**-875,02**
A. Forest Land	-2.783,37	NA,NO	NA,NO				-2.783,37
B. Cropland	1.840,95	NA	NA				1.840,95
C. Grassland	81,21	NA	NA				81,21
D. Wetlands	-13,39	-0,49	0,07				-13,81
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,71**	**1.335,44**	**50,39**				**1.388,55**
A. Solid Waste Disposal on Land	NA,NE,NO	1.087,11					1.087,11
B. Waste-water Handling		248,31	49,96				298,28
C. Waste Incineration	0,64	0,00	0,06				0,71
D. Other	2,07	0,01	0,37				2,46
7. Other ***(as specified in Summary 1.A)***	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	6.023,69	2,82	94,42				6.120,93
Aviation	2.583,30	1,09	27,51				2.611,90
Marine	3.440,39	1,73	66,91				3.509,03
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	11.330,51						**11.330,51**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	71.728,88
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	70.853,86

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 20 SUMMARY 2: Summary report for CO_2 equivalent emissions in Denmark and Greenland 2007.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2007
Submission 2009 v2.1
DENMARK + GREENLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**52.749,83**	**5.762,97**	**6.788,63**	**846,01**	**15,36**	**30,35**	**66.193,14**
1. Energy	**52.139,87**	**595,62**	**462,27**				**53.197,76**
A. Fuel Combustion (Sectoral Approach)	51.773,23	467,29	461,25				52.701,77
1. Energy Industries	25.268,22	192,97	151,23				25.612,43
2. Manufacturing Industries and Construction	5.737,18	20,41	59,42				5.817,01
3. Transport	14.092,73	26,05	139,39				14.258,16
4. Other Sectors	6.493,23	227,69	109,37				6.830,29
5. Other	181,88	0,17	1,83				183,88
B. Fugitive Emissions from Fuels	366,64	128,32	1,03				495,99
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	366,64	128,32	1,03				495,99
2. Industrial Processes	**1.647,03**	**0,00**	**0,00**	**846,01**	**15,36**	**30,35**	**2.538,75**
A. Mineral Products	1.606,93	IE,NA,NE	IE,NA,NE				1.606,93
B. Chemical Industry	2,16	NA,NO	NO				2,16
C. Metal Production	0,00	NA,NO	NO		NO	NO	0,00
D. Other Production	NE						0,00
E. Production of Halocarbons and SF_6				NO	NA,NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				846,01	15,36	30,35	891,72
G. Other	37,94	NA,NO	NA,NO	NA;NO	NA,NO	NA,NO	37,94
3. Solvent and Other Product Use	**87,08**		**36,92**				**124,00**
4. Agriculture		**3.843,09**	**6.241,52**				**10.084,61**
A. Enteric Fermentation		2.794,95					2.794,95
B. Manure Management		1.048,13	589,93				1.638,06
C. Rice Cultivation		NO					0,00
D. Agricultural Soils[(3)]		NE,NO	5.651,59				5.651,59
E. Prescribed Burning of Savannas		NA,NO	NA,NO				NA,NO
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA,NO	NA,NO				NA,NO
5. Land Use, Land-Use Change and Forestry[(1)]	**-1.126,86**	**-0,49**	**0,07**				**-1.127,28**
A. Forest Land	-2.977,08	NA,NO	NA,NO				-2.977,08
B. Cropland	1.779,29	NA	NA				1.779,29
C. Grassland	84,31	NA	NA				84,31
D. Wetlands	-13,39	-0,49	0,07				-13,81
E. Settlements	NA,NE	NA,NE	NA,NE				NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE				NA,NE
G. Other	NE	NE,NO	NE				NE
6. Waste	**2,71**	**1.324,76**	**47,84**				**1.375,31**
A. Solid Waste Disposal on Land	NA,NE,NO	1.068,96					1.068,96
B. Waste-water Handling		255,78	47,41				303,19
C. Waste Incineration	0,64	0,00	0,06				0,71
D. Other	2,07	0,01	0,37				2,46
7. Other *(as specified in Summary 1.A)*	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**0,00**

Memo Items: [(4)]							
International Bunkers	6.270,02	2,96	98,04				6.371,02
Aviation	2.701,41	1,15	28,69				2.731,25
Marine	3.568,61	1,81	69,34				3.639,77
Multilateral Operations	NO	NO	NO				**NO**
CO_2 Emissions from Biomass	12.106,13						**12.106,13**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	67.320,43
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	66.193,14

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Annex 6.2.3 Methodology applied for the GHG inventory for Faroe Islands

GHG inventory for Faroe Islands

The GHG inventory for Greenland includes the following sectors:

- Energy sector
- Industrial processes (consumption of F-gasses)
- Agriculture (sheep and cows)
- Solid waste management (waste incineration)

The 1990-2007 Summary reports for CO_2 equivalents (CRF: Summary 2) is presented in Table 21.

Table 21 SUMMARY 2: Summary report for CO_2 equivalent emissions 1990.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1990
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**660,86**	**17,83**	**23,60**	**NO, NE**	**NO**	**NO, NE**	**702,28**
1. Energy	**656,73**	**0,57**	**8,57**				**665,87**
A. Fuel Combustion (Sectoral Approach)	656,73	0,57	8,57				665,87
1. Energy Industries	89,75	0,07	0,72				90,54
2. Manufacturing Industries and Construction	62,16	0,04	0,50				62,70
3. Transport	101,03	0,29	1,49				102,81
4. Other Sectors	403,79	0,17	5,85				409,82
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**NO, NE**	**NO**	**NO, NE**	**NE, NA, NO**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 [(2)]				NE	NO	NE	NE
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,23**	**14,80**				**32,04**
A. Enteric Fermentation		16,48					16,48
B. Manure Management		0,75	1,11				1,86
C. Rice Cultivation		NO					NO
D. Agricultural Soils [(3)]		NA	13,70				13,70
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry [(1)]	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**4,13**	**0,02**	**0,23**				**4,38**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	4	0,02	0,23				4,38
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				NO
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	702,28
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	702,28

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

Table 22 SUMMARY 2: Summary report for CO_2 equivalent emissions 1991.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 1991
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**641,90**	**17,11**	**23,05**	**NO, NE**	**NO**	**NO, NE**	**682,05**
1. Energy	**637,77**	**0,55**	**8,19**				**646,51**
A. Fuel Combustion (Sectoral Approach)	637,77	0,55	8,19				646,51
1. Energy Industries	86,24	0,07	0,69				86,99
2. Manufacturing Industries and Construction	73,47	0,05	0,60				74,11
3. Transport	99,47	0,27	1,47				101,21
4. Other Sectors	378,59	0,16	5,43				384,19
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**NO, NE**	**NO**	**NO, NE**	**NE, NA, NO**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 [(2)]				NE	NO	NE	NE
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**16,54**	**14,63**				**31,16**
A. Enteric Fermentation		15,86					15,86
B. Manure Management		0,67	1,09				1,76
C. Rice Cultivation		NO					NO
D. Agricultural Soils[(3)]		NA	13,54				13,54
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry[(1)]	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**4,13**	**0,02**	**0,23**				**4,38**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	4	0,02	0,23				4,38
D. Other	NO	NO	NO				NO
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation	NO	NO	NO				NO
Marine	0,00	0,00	0,00				0,00
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	682,05
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	682,05

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 23 SUMMARY 2: Summary report for CO_2 equivalent emissions 1992.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1992
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**631,12**	**17,27**	**23,30**	**NO, NE**	**NO**	**0,12**	**671,81**
1. Energy	**626,94**	**0,53**	**8,40**				**635,87**
A. Fuel Combustion (Sectoral Approach)	626,94	0,53	8,40				635,87
1. Energy Industries	85,11	0,06	0,68				85,86
2. Manufacturing Industries and Construction	43,49	0,03	0,35				43,87
3. Transport	110,70	0,28	1,69				112,66
4. Other Sectors	387,64	0,17	5,67				393,48
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**NO, NE**	**NO**	**0,12**	**0,12**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 [(2)]				NE	NO	0,12	0,12
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**16,71**	**14,65**				**31,36**
A. Enteric Fermentation		16,01					16,01
B. Manure Management		0,70	1,11				1,81
C. Rice Cultivation		NO					NO
D. Agricultural Soils[(3)]		NA	13,54				13,54
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry[(1)]	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**4,18**	**0,03**	**0,25**				**4,46**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	4	0,03	0,25				4,46
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: [(4)]							
International Bunkers	105,21	0,05	2,06				107,32
Aviation	NO	NO	NO				NO
Marine	105,21	0,05	2,06				107,32
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	671,81
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	671,81

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 24 SUMMARY 2: Summary report for CO_2 equivalent emissions 1993.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1993
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**520,81**	**17,31**	**21,66**	**NO, NE**	**NO**	**0,13**	**559,91**
1. Energy	**516,94**	**0,45**	**6,74**				**524,13**
A. Fuel Combustion (Sectoral Approach)	516,94	0,45	6,74				524,13
1. Energy Industries	78,56	0,06	0,63				79,25
2. Manufacturing Industries and Construction	39,46	0,03	0,32				39,81
3. Transport	95,57	0,23	1,47				97,28
4. Other Sectors	303,35	0,13	4,32				307,80
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**NO, NE**	**NO**	**0,13**	**0,13**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 (2)				NE	NO	0,13	0,13
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**16,83**	**14,67**				**31,51**
A. Enteric Fermentation		16,12					16,12
B. Manure Management		0,71	1,13				1,84
C. Rice Cultivation		NO					NO
D. Agricultural Soils(3)		NA	13,55				13,55
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry(1)	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**3,87**	**0,02**	**0,25**				**4,14**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	4	0,02	0,25				4,14
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: (4)							
International Bunkers	142,60	0,06	2,79				145,45
Aviation	NO	NO	NO				NO
Marine	142,60	0,06	2,79				145,45
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	559,91
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	559,91

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 25 SUMMARY 2: Summary report for CO_2 equivalent emissions 1994.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1994
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**525,56**	**18,18**	**22,01**	**0,02**	**NO**	**0,14**	**565,91**
1. Energy	**521,82**	**0,43**	**6,88**				**529,14**
A. Fuel Combustion (Sectoral Approach)	521,82	0,43	6,88				529,14
1. Energy Industries	74,71	0,06	0,60				75,36
2. Manufacturing Industries and Construction	38,53	0,03	0,31				38,87
3. Transport	86,65	0,21	1,34				88,20
4. Other Sectors	321,93	0,14	4,63				326,70
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**0,02**	**NO**	**0,14**	**0,16**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 (2)				0,02	NO	0,14	0,16
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,73**	**14,89**				**32,61**
A. Enteric Fermentation		16,92					16,92
B. Manure Management		0,81	1,17				1,98
C. Rice Cultivation		NO					NO
D. Agricultural Soils(3)		NA	13,72				13,72
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry(1)	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**3,74**	**0,02**	**0,24**				**4,00**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	4	0,02	0,24				4,00
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: (4)							
International Bunkers	140,01	0,06	2,74				142,82
Aviation	NO	NO	NO				NO
Marine	140,01	0,06	2,74				142,82
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	565,91
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	565,91

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 26 SUMMARY 2: Summary report for CO_2 equivalent emissions 1995.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 1995
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**530,48**	**18,19**	**22,23**	**0,02**	**NO**	**0,15**	**571,08**
1. Energy	**526,69**	**0,43**	**7,08**				**534,20**
A. Fuel Combustion (Sectoral Approach)	526,69	0,43	7,08				534,20
1. Energy Industries	71,32	0,05	0,57				71,94
2. Manufacturing Industries and Construction	32,03	0,02	0,26				32,31
3. Transport	93,05	0,22	1,46				94,72
4. Other Sectors	330,30	0,14	4,79				335,23
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**0,02**	**NO**	**0,15**	**0,18**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 [2]				0,02	NO	0,15	0,18
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,73**	**14,89**				**32,62**
A. Enteric Fermentation		16,92					16,92
B. Manure Management		0,81	1,16				1,97
C. Rice Cultivation		NO					NO
D. Agricultural Soils [3]		NA	13,73				13,73
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry [1]	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**3,80**	**0,03**	**0,25**				**4,08**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	4	0,03	0,25				4,08
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: [4]							
International Bunkers	131,59	0,06	2,58				134,23
Aviation	NO	NO	NO				NO
Marine	131,59	0,06	2,58				134,23
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [5]	571,08
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [5]	571,08

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

[5] These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 27 SUMMARY 2: Summary report for CO_2 equivalent emissions 1996.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

(Sheet 1 of 1)

Inventory 1996

Submission 2007

Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**549,56**	**18,07**	**22,35**	**0,06**	**NO**	**0,16**	**590,19**
1. Energy	**545,47**	**0,45**	**7,20**				**553,12**
A. Fuel Combustion (Sectoral Approach)	545,47	0,45	7,20				553,12
1. Energy Industries	84,87	0,07	0,68				85,61
2. Manufacturing Industries and Construction	38,08	0,02	0,31				38,42
3. Transport	88,00	0,22	1,36				89,58
4. Other Sectors	334,52	0,14	4,85				339,52
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**0,06**	**NO**	**0,16**	**0,22**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 [(2)]				0,06	NO	0,16	0,22
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,59**	**14,87**				**32,45**
A. Enteric Fermentation		16,79					16,79
B. Manure Management		0,79	1,15				1,94
C. Rice Cultivation		NO					NO
D. Agricultural Soils[(3)]		NA	13,72				13,72
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry[(1)]	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**4,08**	**0,03**	**0,29**				**4,40**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	4	0,03	0,29				4,40
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: [(4)]							
International Bunkers	142,02	0,06	2,78				144,87
Aviation	NO	NO	NO				NO
Marine	142,02	0,06	2,78				144,87
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	590,19
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	590,19

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 28 SUMMARY 2: Summary report for CO_2 equivalent emissions 1997.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1997
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**544,36**	**18,05**	**22,37**	**0,66**	**NO**	**0,18**	**585,62**
1. Energy	**539,67**	**0,45**	**7,17**				**547,29**
A. Fuel Combustion (Sectoral Approach)	539,67	0,45	7,17				547,29
1. Energy Industries	77,68	0,06	0,62				78,36
2. Manufacturing Industries and Construction	37,85	0,02	0,31				38,18
3. Transport	97,04	0,23	1,50				98,77
4. Other Sectors	327,09	0,14	4,74				331,98
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**0,66**	**NO**	**0,18**	**0,83**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 [(2)]				0,66	NO	0,18	0,83
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,57**	**14,87**				**32,44**
A. Enteric Fermentation		16,78					16,78
B. Manure Management		0,79	1,14				1,93
C. Rice Cultivation		NO					NO
D. Agricultural Soils[(3)]		NA	13,73				13,73
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry[(1)]	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**4,69**	**0,03**	**0,33**				**5,05**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	5	0,03	0,33				5,05
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: [(4)]							
International Bunkers	137,96	0,06	2,70				140,73
Aviation	NO	NO	NO				NO
Marine	137,96	0,06	2,70				140,73
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	585,62
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	585,62

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 29 SUMMARY 2: Summary report for CO_2 equivalent emissions 1998.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 1998
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**586,44**	**17,89**	**22,83**	**1,22**	**NO**	**0,19**	**628,57**
1. Energy	**580,75**	**0,46**	**7,60**				**588,82**
A. Fuel Combustion (Sectoral Approach)	580,75	0,46	7,60				588,82
1. Energy Industries	86,31	0,06	0,69				87,07
2. Manufacturing Industries and Construction	54,22	0,04	0,44				54,69
3. Transport	89,96	0,22	1,35				91,53
4. Other Sectors	350,26	0,15	5,12				355,53
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**1,22**	**NO**	**0,19**	**1,41**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 (2)				1,22	NO	0,19	1,41
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,39**	**14,83**				**32,22**
A. Enteric Fermentation		16,62					16,62
B. Manure Management		0,77	1,13				1,89
C. Rice Cultivation		NO					NO
D. Agricultural Soils(3)		NA	13,71				13,71
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry(1)	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**5,68**	**0,04**	**0,40**				**6,12**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	6	0,04	0,40				6,12
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: (4)							
International Bunkers	112,06	0,05	2,20				114,31
Aviation	NO	NO	NO				NO
Marine	112,06	0,05	2,20				114,31
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	628,57
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	628,57

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 30 SUMMARY 2: Summary report for CO_2 equivalent emissions 1999.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 1999

(Sheet 1 of 1) Submission 2007

Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**615,37**	**17,97**	**23,18**	**3,29**	**NO**	**0,09**	**659,90**
1. Energy	**609,28**	**0,49**	**7,91**				**617,68**
A. Fuel Combustion (Sectoral Approach)	609,28	0,49	7,91				617,68
1. Energy Industries	87,52	0,07	0,70				88,29
2. Manufacturing Industries and Construction	52,74	0,03	0,43				53,21
3. Transport	92,21	0,23	1,33				93,77
4. Other Sectors	376,80	0,16	5,45				382,41
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**3,29**	**NO**	**0,09**	**3,38**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 [(2)]				3,29	NO	0,09	3,38
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,43**	**14,84**				**32,28**
A. Enteric Fermentation		16,66					16,66
B. Manure Management		0,77	1,13				1,90
C. Rice Cultivation		NO					NO
D. Agricultural Soils[(3)]		NA	13,72				13,72
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry[(1)]	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**6,09**	**0,04**	**0,43**				**6,57**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	6	0,04	0,43				6,57
D. Other	NO	NO	NO				NO
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: [(4)]							
International Bunkers	121,34	0,06	2,38				123,78
Aviation	NO	NO	NO				NO
Marine	121,34	0,06	2,38				123,78
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	659,90
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	659,90

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 31 SUMMARY 2: Summary report for CO_2 equivalent emissions 2000.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

(Sheet 1 of 1)

Inventory 2000

Submission 2007

Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**651,75**	**18,15**	**23,62**	**4,35**	**NO**	**0,08**	**697,94**
1. Energy	**645,51**	**0,52**	**8,31**				**654,35**
A. Fuel Combustion (Sectoral Approach)	645,51	0,52	8,31				654,35
1. Energy Industries	105,68	0,08	0,85				106,61
2. Manufacturing Industries and Construction	59,53	0,04	0,49				60,05
3. Transport	93,70	0,24	1,32				95,25
4. Other Sectors	386,60	0,16	5,66				392,43
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**4,35**	**NO**	**0,08**	**4,42**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 (2)				4,35	NO	0,08	4,42
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,58**	**14,87**				**32,45**
A. Enteric Fermentation		16,79					16,79
B. Manure Management		0,79	1,14				1,93
C. Rice Cultivation		NO					NO
D. Agricultural Soils(3)		NA	13,74				13,74
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry(1)	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**6,23**	**0,04**	**0,44**				**6,71**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	6	0,04	0,44				6,71
D. Other	NO	NO	NO				NO
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: (4)							
International Bunkers	135,59	0,06	2,66				138,31
Aviation	NO	NO	NO				NO
Marine	135,59	0,06	2,66				138,31
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	697,94
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	697,94

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 32 SUMMARY 2: Summary report for CO_2 equivalent emissions 2001.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 2001
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**741,95**	**18,40**	**24,54**	**6,93**	**NO**	**0,08**	**791,90**
1. Energy	**735,54**	**0,61**	**9,19**				**745,35**
A. Fuel Combustion (Sectoral Approach)	735,54	0,61	9,19				745,35
1. Energy Industries	149,26	0,12	1,20				150,59
2. Manufacturing Industries and Construction	84,48	0,06	0,69				85,24
3. Transport	102,62	0,26	1,40				104,28
4. Other Sectors	399,18	0,17	5,89				405,24
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**6,93**	**NO**	**0,08**	**7,00**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 (2)				6,93	NO	0,08	7,00
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,74**	**14,90**				**32,64**
A. Enteric Fermentation		16,93					16,93
B. Manure Management		0,81	1,16				1,97
C. Rice Cultivation		NO					NO
D. Agricultural Soils(3)		NA	13,74				13,74
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry(1)	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**6,41**	**0,05**	**0,45**				**6,91**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	6	0,05	0,45				6,91
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: (4)							
International Bunkers	176,29	0,08	3,46				179,83
Aviation	NO	NO	NO				NO
Marine	176,29	0,08	3,46				179,83
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	791,90
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	791,90

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 33 SUMMARY 2: Summary report for CO_2 equivalent emissions 2002.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS (Sheet 1 of 1)

Inventory 2002
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**713,63**	**18,39**	**24,52**	**8,69**	**NO**	**0,09**	**765,32**
1. Energy	**707,10**	**0,57**	**9,16**				**716,82**
A. Fuel Combustion (Sectoral Approach)	707,10	0,57	9,16				716,82
1. Energy Industries	112,56	0,09	0,90				113,54
2. Manufacturing Industries and Construction	67,85	0,04	0,55				68,44
3. Transport	109,08	0,26	1,45				110,80
4. Other Sectors	417,61	0,18	6,25				424,04
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**8,69**	**NO**	**0,09**	**8,78**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 [(2)]				8,69	NO	0,09	8,78
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,77**	**14,91**				**32,68**
A. Enteric Fermentation		16,96					16,96
B. Manure Management		0,81	1,16				1,97
C. Rice Cultivation		NO					NO
D. Agricultural Soils[(3)]		NA	13,75				13,75
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry[(1)]	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**6,53**	**0,05**	**0,46**				**7,04**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	7	0,05	0,46				7,04
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: [(4)]							
International Bunkers	73,90	0,03	1,45				75,38
Aviation	NO	NO	NO				NO
Marine	73,90	0,03	1,45				75,38
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	765,32
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	765,32

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 34 SUMMARY 2: Summary report for CO_2 equivalent emissions 2003.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2003
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**729,92**	**18,37**	**24,59**	**10,20**	**NO**	**0,08**	**783,16**
1. Energy	**723,90**	**0,57**	**9,26**				**733,73**
A. Fuel Combustion (Sectoral Approach)	723,90	0,57	9,26				733,73
1. Energy Industries	120,20	0,10	0,96				121,26
2. Manufacturing Industries and Construction	83,89	0,06	0,68				84,63
3. Transport	106,50	0,24	1,40				108,14
4. Other Sectors	413,30	0,18	6,22				419,70
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**10,20**	**NO**	**0,08**	**10,28**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 (2)				10,20	NO	0,08	10,28
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,76**	**14,91**				**32,66**
A. Enteric Fermentation		16,94					16,94
B. Manure Management		0,81	1,16				1,97
C. Rice Cultivation		NO					NO
D. Agricultural Soils(3)		NA	13,75				13,75
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry(1)	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**6,02**	**0,04**	**0,42**				**6,49**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	6	0,04	0,42				6,49
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: (4)							
International Bunkers	64,64	0,03	1,27				65,94
Aviation	NO	NO	NO				NO
Marine	64,64	0,03	1,27				65,94
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	783,16
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	783,16

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 35 SUMMARY 2: Summary report for CO_2 equivalent emissions 2004.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2004
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**729,14**	**18,23**	**24,63**	**11,39**	**NO**	**0,19**	**783,58**
1. Energy	**723,50**	**0,55**	**9,35**				**733,41**
A. Fuel Combustion (Sectoral Approach)	723,50	0,55	9,35				733,41
1. Energy Industries	110,48	0,08	0,89				111,45
2. Manufacturing Industries and Construction	73,68	0,05	0,60				74,33
3. Transport	110,06	0,24	1,42				111,72
4. Other Sectors	429,28	0,18	6,44				435,91
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**11,39**	**NO**	**0,19**	**11,58**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 (2)				11,39	NO	0,19	11,58
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,64**	**14,89**				**32,53**
A. Enteric Fermentation		16,84					16,84
B. Manure Management		0,80	1,14				1,94
C. Rice Cultivation		NO					NO
D. Agricultural Soils(3)		NA	13,75				13,75
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry(1)	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**5,63**	**0,04**	**0,40**				**6,07**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	6	0,04	0,40				6,07
D. Other	NO	NO	NO				NO
7. Other *(as specified in Summary 1.A)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: (4)							
International Bunkers	74,68	0,04	1,47				76,18
Aviation	NO	NO	NO				NO
Marine	74,68	0,04	1,47				76,18
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	783,58
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	783,58

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 36 SUMMARY 2: Summary report for CO_2 equivalent emissions 2005.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2005
Submission 2007
Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**708,85**	**17,89**	**24,30**	**11,19**	**NO**	**0,15**	**762,38**
1. Energy	**703,35**	**0,53**	**9,09**				**712,97**
A. Fuel Combustion (Sectoral Approach)	703,35	0,53	9,09				712,97
1. Energy Industries	100,23	0,08	0,80				101,10
2. Manufacturing Industries and Construction	65,58	0,04	0,53				66,15
3. Transport	109,88	0,23	1,36				111,47
4. Other Sectors	427,67	0,18	6,40				434,24
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**11,19**	**NO**	**0,15**	**11,34**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 [(2)]				11,19	NO	0,15	11,34
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,32**	**14,82**				**32,14**
A. Enteric Fermentation		16,56					16,56
B. Manure Management		0,76	1,11				1,87
C. Rice Cultivation		NO					NO
D. Agricultural Soils[(3)]		NA	13,71				13,71
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry[(1)]	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**5,50**	**0,04**	**0,39**				**5,93**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	6	0,04	0,39				5,93
D. Other	NO	NO	NO				NO
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: [(4)]							
International Bunkers	65,04	0,03	1,28				66,35
Aviation	NO	NO	NO				NO
Marine	65,04	0,03	1,28				66,35
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	762,38
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	762,38

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 37 SUMMARY 2: Summary report for CO_2 equivalent emissions 2006.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 2006

(Sheet 1 of 1) Submission 2007

Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**716,64**	**17,69**	**24,31**	**11,65**	**NO**	**0,14**	**770,44**
1. Energy	**711,14**	**0,55**	**9,13**				**720,82**
A. Fuel Combustion (Sectoral Approach)	711,14	0,55	9,13				720,82
1. Energy Industries	110,05	0,09	0,88				111,03
2. Manufacturing Industries and Construction	71,12	0,05	0,58				71,76
3. Transport	110,29	0,22	1,29				111,80
4. Other Sectors	419,67	0,18	6,38				426,24
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**11,65**	**NO**	**0,14**	**11,79**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 (2)				11,65	NO	0,14	11,79
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,11**	**14,79**				**31,90**
A. Enteric Fermentation		16,37					16,37
B. Manure Management		0,73	1,08				1,81
C. Rice Cultivation		NO					NO
D. Agricultural Soils(3)		NA	13,71				13,71
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry(1)	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**5,50**	**0,04**	**0,39**				**5,92**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	5	0,04	0,39				5,92
D. Other	NO	NO	NO				NO
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: (4)							
International Bunkers	24,50	0,01	0,48				24,99
Aviation	NO	NO	NO				NO
Marine	24,50	0,01	0,48				24,99
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	770,44
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	770,44

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

(5) These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Table 38 SUMMARY 2: Summary report for CO_2 equivalent emissions 2007.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 2007

(Sheet 1 of 1) Submission 2007

Faroe Islands

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**717,20**	**17,72**	**24,34**	**12,00**	**NO**	**0,13**	**771,40**
1. Energy	**710,82**	**0,52**	**9,09**				**720,43**
A. Fuel Combustion (Sectoral Approach)	710,82	0,52	9,09				720,43
1. Energy Industries	110,88	0,08	0,89				111,85
2. Manufacturing Industries and Construction	63,74	0,04	0,52				64,30
3. Transport	124,07	0,22	1,48				125,78
4. Other Sectors	412,13	0,18	6,20				418,50
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	NO	NO	NO				NO
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	NO	NO	NO				NO
2. Industrial Processes	**NE, NO**	**NA, NO**	**NA, NO**	**12,00**	**NO**	**0,13**	**12,13**
A. Mineral Products	NE	NA	NA				NE, NA
B. Chemical Industry	NO	NO	NO				NO
C. Metal Production	NO	NO	NO		NO	NO	NO
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6 [2]				12,00	NO	0,13	12,13
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**		**NE**				**NE**
4. Agriculture		**17,16**	**14,80**				**31,96**
A. Enteric Fermentation		16,42					16,42
B. Manure Management		0,74	1,09				1,83
C. Rice Cultivation		NO					NO
D. Agricultural Soils[3]		NA	13,71				13,71
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry[1]	**NE**	**NE**	**NE**				**NE**
A. Forest Land	NE	NE	NE				NE
B. Cropland	NE	NE	NE				NE
C. Grassland	NE	NE	NE				NE
D. Wetlands	NE	NE	NE				NE
E. Settlements	NE	NE	NE				NE
F. Other Land	NE	NE	NE				NE
G. Other	NE	NE	NE				NE
6. Waste	**6,38**	**0,05**	**0,45**				**6,88**
A. Solid Waste Disposal on Land	NE	NE					NE
B. Waste-water Handling		NE	NE				NE
C. Waste Incineration	6	0,05	0,45				6,88
D. Other	NO	NO	NO				NO
7. Other ***(as specified in Summary 1.A)***	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo Items: [4]							
International Bunkers	24,50	0,01	0,48				24,99
Aviation	NO	NO	NO				NO
Marine	24,50	0,01	0,48				24,99
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**NE**						**NE**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [5]	771,40
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [5]	771,40

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

[5] These totals will differ from the totals reported in table 10, sheet 5 if Parties report non-CO_2 emissions from LULUCF.

Annex 7 Table 6.1 and 6.2 of the IPCC goodpractice guidance

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncer-tainty	Emission factor uncer-tainty	Combined uncer-tainty	Combined un-certainty as % of total national emissions in year t	Type A sensitiv-ity	Type B sensitiv-ity	Unceratinty i trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg CO_2 eq	Gg CO_2 eq	%	%	%	%	%	%	%	%	%
Stationary Combustion, Coal	CO_2	24077	18302	1	5	5,099	1,426	-0,061	0,262	-0,304	0,371	0,479
Stationary Combustion, BKB	CO_2	11	0	3	5	5,831	0,000	0,000	0,000	-0,001	0,000	0,001
Stationary Combustion, Coke	CO_2	138	121	3	5	5,831	0,011	0,000	0,002	-0,001	0,007	0,007
Stationary Combustion, Petroleum coke	CO_2	410	970	3	5	5,831	0,086	0,008	0,014	0,042	0,059	0,072
Stationary Combustion, Plastic waste	CO_2	349	728	5	5	7,071	0,079	0,006	0,010	0,029	0,074	0,079
Stationary Combustion, Residual oil	CO_2	2505	1655	2	2	2,828	0,072	-0,010	0,024	-0,020	0,067	0,070
Stationary Combustion, Gas oil	CO_2	4547	1614	4	5	6,403	0,158	-0,038	0,023	-0,189	0,131	0,230
Stationary Combustion, Kerosene	CO_2	366	9	4	5	6,403	0,001	-0,005	0,000	-0,024	0,001	0,024
Stationary Combustion, Natural gas	CO_2	4320	9702	3	1	3,162	0,469	0,081	0,139	0,081	0,589	0,595
Stationary Combustion, LPG	CO_2	169	90	4	5	6,403	0,009	-0,001	0,001	-0,005	0,007	0,009
Stationary Combustion, Refinery gas	CO_2	806	906	3	5	5,831	0,081	0,002	0,013	0,011	0,055	0,056
Stationary combustion plants, gas engines	CH_4	7	215	2,2	40	40,060	0,132	0,003	0,003	0,120	0,010	0,120
Stationary combustion plants, other	CH_4	115	217	2,2	100	100,024	0,331	0,002	0,003	0,156	0,010	0,156

Continued												
IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncer-tainty	Emission factor uncer-tainty	Combined uncer-tainty	Combined un-certainty as % of total national emissions in year t	Type A sensitiv-ity	Type B sensitiv-ity	Uncertainty i trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data Gg CO_2 eq	Input data Gg CO_2 eq	Input data %	Input data %	%	%	%	%	%	%	%
Stationary combustion plants	N_2O	240	277	2,2	1000	1000,002	4,230	0,001	0,004	0,738	0,012	0,739
Transport, Road transport	CO_2	9275	13198	2	5	5,385	1,086	0,064	0,189	0,322	0,534	0,624
Transport, Military	CO_2	119	175	2	5	5,385	0,014	0,001	0,003	0,005	0,007	0,008
Transport, Railways	CO_2	297	228	2	5	5,385	0,019	-0,001	0,003	-0,004	0,009	0,010
Transport, Navigation (small boats)	CO_2	48	101	21	5	21,587	0,033	0,001	0,001	0,004	0,043	0,043
Transport, Navigation (large vessels)	CO_2	666	352	11	5	12,083	0,065	-0,004	0,005	-0,019	0,078	0,081
Transport, Fisheries	CO_2	591	382	2	5	5,385	0,031	-0,002	0,005	-0,012	0,015	0,020
Transport, Agriculture	CO_2	1272	1166	13	5	13,928	0,248	0,000	0,017	-0,002	0,307	0,307
Transport, Forestry	CO_2	36	17	16	5	16,763	0,004	0,000	0,000	-0,001	0,006	0,006
Transport, Industry (mobile)	CO_2	842	1088	18	5	18,682	0,310	0,004	0,016	0,021	0,396	0,397
Transport, Residential	CO_2	113	232	18	5	18,682	0,066	0,002	0,003	0,009	0,085	0,085
Transport, Civil aviation	CO_2	243	107	10	5	11,180	0,018	-0,002	0,002	-0,009	0,022	0,023
Transport, Road transport	CH_4	55	25	2	40	40,050	0,015	0,000	0,000	-0,015	0,001	0,015
Transport, Military	CH_4	0	0	2	100	100,020	0,000	0,000	0,000	0,000	0,000	0,000
Transport, Railways	CH_4	0	0	2	100	100,020	0,000	0,000	0,000	0,000	0,000	0,000
Transport, Navigation (small boats)	CH_4	0	1	21	100	102,181	0,001	0,000	0,000	0,000	0,000	0,000
Transport, Navigation (large vessels)	CH_4	0	0	11	100	100,603	0,000	0,000	0,000	0,000	0,000	0,000
Transport, Fisheries	CH_4	0	0	2	100	100,020	0,000	0,000	0,000	0,000	0,000	0,000
Transport, Agriculture	CH_4	2	2	13	100	100,841	0,002	0,000	0,000	-0,001	0,000	0,001
Transport, Forestry	CH_4	0	0	16	100	101,272	0,000	0,000	0,000	0,000	0,000	0,000
Transport, Industry (mobile)	CH_4	1	1	18	100	101,607	0,001	0,000	0,000	0,000	0,000	0,001
Transport, Residential	CH_4	3	5	18	100	101,607	0,008	0,000	0,000	0,003	0,002	0,003
Transport, Civil aviation	CH_4	0	0	10	100	100,499	0,000	0,000	0,000	0,000	0,000	0,000
Transport, Road transport	N_2O	97	127	2	50	50,040	0,097	0,001	0,002	0,026	0,005	0,026

Continued												
IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncer-tainty	Emission factor uncer-tainty	Combined uncer-tainty	Combined un-certainty as % of total national emissions in year t	Type A sensitiv-ity	Type B sensitiv-ity	Unceratinty i trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg CO_2 eq	Gg CO_2 eq	%	%	%	%	%	%	%	%	%
Transport, Military	N_2O	1	2	2	1000	1000,002	0,027	0,000	0,000	0,010	0,000	0,010
Transport, Railways	N_2O	3	2	2	1000	1000,002	0,030	0,000	0,000	-0,006	0,000	0,006
Transport, Navigation (small boats)	N_2O	0	1	21	1000	1000,220	0,016	0,000	0,000	0,010	0,000	0,010
Transport, Navigation (large vessels)	N_2O	13	7	11	1000	1000,060	0,106	0,000	0,000	-0,076	0,002	0,076
Transport, Fisheries	N_2O	11	7	2	1000	1000,002	0,114	0,000	0,000	-0,047	0,000	0,047
Transport, Agriculture	N_2O	15	15	13	1000	1000,084	0,233	0,000	0,000	0,013	0,004	0,014
Transport, Forestry	N_2O	0	0	16	1000	1000,128	0,003	0,000	0,000	0,000	0,000	0,000
Transport, Industry (mobile)	N_2O	11	14	18	1000	1000,162	0,218	0,000	0,000	0,062	0,005	0,062
Transport, Residential	N_2O	1	1	18	1000	1000,162	0,017	0,000	0,000	0,009	0,000	0,009
Transport, Civil aviation	N_2O	3	2	10	1000	1000,050	0,033	0,000	0,000	-0,012	0,000	0,012
Energy, fugitive emissions, oil and natural gas	CO_2	263	367	15	5	15,811	0,089	0,002	0,005	0,009	0,111	0,112
Energy, fugitive emissions, oil and natural gas	CH_4	40	128	15	50	52,202	0,102	0,001	0,002	0,065	0,039	0,076
Energy, fugitive emissions, oil and natural gas	N_2O	1	1	15	50	52,202	0,001	0,000	0,000	0,000	0,000	0,000
6 A. Solid Waste Disposal on Land	CH_4	1335	1063	10	63	63,591	1,033	-0,003	0,015	-0,169	0,215	0,274
6 B. Wastewater Handling	CH_4	126	256	20	35	40,311	0,158	0,002	0,004	0,069	0,104	0,125
6 B. Wastewater Handling	N_2O	88	47	10	30	31,623	0,023	0,000	0,001	-0,015	0,010	0,018
2A1 Cement production	CO_2	882	1407	1	2	2,236	0,048	0,008	0,020	0,017	0,028	0,033
2A2 Lime production	CO_2	116	67	5	5	7,071	0,007	-0,001	0,001	-0,003	0,007	0,007
2A3 Limestone and dolo-mite use	CO_2	18	51	5	5	7,071	0,006	0,000	0,001	0,002	0,005	0,006
2A5 Asphalt roofing	CO_2	0	0	5	25	25,495	0,000	0,000	0,000	0,000	0,000	0,000

Continued

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncer-tainty	Emission factor uncer-tainty	Combined uncer-tainty	Combined un-certainty as % of total national emissions in year t	Type A sensitiv-ity	Type B sensitiv-ity	Uncerатinty i trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions ntroduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
		Input data	Input data	Input data	Input data							
		Gg CO_2 eq	Gg CO_2 eq	%	%	%	%	%	%	%	%	%
2A6 Road paving with asphalt	CO_2	2	2	5	25	25,495	0,001	0,000	0,000	0,000	0,000	0,000
2A7 Glass and Glass wool	CO_2	55	80	5	2	5,385	0,007	0,000	0,001	0,001	0,008	0,008
2B5 Catalysts/Fertilizers, Pesticides and Sulphuric acid	CO_2	1	2	5	5	7,071	0,000	0,000	0,000	0,000	0,000	0,000
2C1 Iron and steel produc-tion	CO_2	28	0	5	5	7,071	0,000	0,000	0,000	-0,002	0,000	0,002
2B2 Nitric acid production	N_2O	1043	0	2	25	25,080	0,000	-0,014	0,000	-0,350	0,000	0,350
2F Consumption of HFC	HFC	218	840	10	50	50,990	0,654	0,009	0,012	0,455	0,170	0,486
2F Consumption of PFC	PFC	1	15	10	50	50,990	0,012	0,000	0,000	0,011	0,003	0,011
2F Consumption of SF_6	SF_6	107	30	10	50	50,990	0,024	-0,001	0,000	-0,050	0,006	0,051
4A Enteric Fermentation	CH_4	3259	2787	10	8	12,806	0,545	-0,004	0,040	-0,031	0,564	0,565
4B Manure Management	CH_4	751	1048	10	100	100,499	1,609	0,005	0,015	0,492	0,212	0,536
4B Manure Management	N2O	685	586	10	100	100,499	0,900	-0,001	0,008	-0,080	0,119	0,143
4D Agricultural Soils	N_2O	8314	5652	7,4	22,9	24,118	2,083	-0,031	0,081	-0,702	0,850	1,103
5.A Forests	CO_2	-2831	-2977	20	20	28,284	-1,286	-0,005	-0,043	-0,093	-1,206	1,209
5.B Cropland	CO_2	2722	1587	7	32	32,498	0,788	-0,014	0,023	-0,439	0,215	0,489
5.C.Grassland	CO_2	93	84	10	50	50,990	0,066	0,000	0,001	-0,002	0,017	0,017
5.D Wetlands	CO_2	2	-13	10	50	50,990	-0,010	0,000	0,000	-0,011	-0,003	0,011
Liming	CO_2	566	192	5	50	50,249	0,147	-0,005	0,003	-0,242	0,019	0,243
5.D Wetlands	CH_4	-1	0	10	100	100,499	-0,001	0,000	0,000	0,000	0,000	0,000
5.D Wetlands	N_2O	0	0	10	100	100,499	0,000	0,000	0,000	0,000	0,000	0,000
3 Solvents	CO_2	179	87	50	325	328,824	0,437	-0,001	0,001	-0,377	0,088	0,387
Total		69843	65452				33,879					6,138
Total uncertainties				Overall uncertainty i the year (%):			5,821			Trend uncertainty (%):		2,477

Annex 8 Other annexes – (Any other relevant information)

Please see Chapter 1.6 for information

Annex 9 Annual emission inventories 1990-2007 CRF Table 10 for Denmark

Up until NIR 2004, NERI included the full CRF tables in the NIR report itself as well as the CRF submitted as spreadsheet files. Since NIR 2005 only the trend tables 1990-2007 (CRF Table 10 sheet 1-5) have been included in the NIR as Tables A9.1-.5. These tables are copied from the CRF 2007 spreadsheet file, Tables 10.1-10.5. The full CRF tables 1990-2007 are submitted as spreadsheets separately, as well as the xml file generated by the CRF Reporter tool. Notice that this tool defines the base year regarding emissions in the sense of the Climate Change Convention (not as in the Kyoto protocol) which is the emissions in 1990.

Table A9.1.

TABLE 10 EMISSION TRENDS
CO_2
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**51.461,78**	**61.974,02**	**56.066,67**	**58.364,51**	**61.982,06**	**58.938,47**	**72.284,68**	**62.616,03**	**58.454,88**	**55.765,12**
A. Fuel Combustion (Sectoral Approach)	51.198,34	61.456,01	55.532,46	57.896,17	61.514,46	58.575,67	71.885,99	62.052,99	58.034,27	54.869,13
1. Energy Industries	26.173,20	35.113,22	30.082,25	31.627,29	35.351,77	31.934,16	44.320,89	35.084,13	31.276,91	28.231,12
2. Manufacturing Industries and Construction	5.423,69	5.944,19	5.768,87	5.609,13	5.768,64	5.891,36	6.080,67	6.123,52	6.153,77	6.221,75
3. Transport	10.528,09	10.904,05	11.101,68	11.224,72	11.712,26	11.852,02	12.109,30	12.302,59	12.274,57	12.270,78
4. Other Sectors	8.954,35	9.207,86	8.438,88	9.197,91	8.429,78	8.646,24	9.199,20	8.371,93	8.124,98	7.963,12
5. Other	119,01	286,69	140,79	237,13	252,01	251,89	175,92	170,83	204,03	182,35
B. Fugitive Emissions from Fuels	263,44	518,02	534,21	468,34	467,60	362,80	398,70	563,04	420,62	895,99
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	263,44	518,02	534,21	468,34	467,60	362,80	398,70	563,04	420,62	895,99
2. Industrial Processes	**1.152,16**	**1.324,26**	**1.442,95**	**1.462,16**	**1.487,33**	**1.494,80**	**1.601,06**	**1.768,30**	**1.707,84**	**1.686,07**
A. Mineral Products	1.073,21	1.246,16	1.365,58	1.382,84	1.406,08	1.406,59	1.515,54	1.685,28	1.620,24	1.599,73
B. Chemical Industry	0,80	0,80	0,80	0,80	0,80	0,80	1,45	0,87	0,56	0,58
C. Metal Production	28,45	28,45	28,45	30,97	33,50	38,56	35,19	35,01	42,19	43,04
D. Other Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	49,71	48,86	48,12	47,55	46,95	48,84	48,89	47,15	44,85	42,72
3. Solvent and Other Product Use	179,38	174,21	169,05	163,88	158,71	140,96	154,36	139,45	128,40	126,88
4. Agriculture										
A. Enteric Fermentation										
B. Manure Management										
C. Rice Cultivation										
D. Agricultural Soils										
E. Prescribed Burning of Savannas										
F. Field Burning of Agricultural Residues										
G. Other										
5. Land Use, Land-Use Change and Forestry[(2)]	**551,67**	**-1.688,16**	**-1.548,54**	**-1.157,00**	**-1.617,00**	**-1.669,23**	**-1.217,10**	**-1.179,30**	**-1.954,14**	**-1.234,83**
A. Forest Land	-2.830,67	-3.009,20	-3.000,80	-3.212,99	-3.102,55	-2.992,51	-3.069,15	-3.162,10	-3.319,98	-3.319,91
B. Cropland	3.287,48	1.228,40	1.361,37	1.969,70	1.401,93	1.232,78	1.767,65	1.909,20	1.297,25	2.015,81
C. Grassland	92,90	90,68	88,92	84,35	81,68	88,58	82,47	71,68	66,83	68,22
D. Wetlands	1,96	1,96	1,96	1,95	1,94	1,93	1,92	1,92	1,77	1,05
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**
A. Solid Waste Disposal on Land	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
B. Waste-water Handling										
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	NO	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**53.344,99**	**61.784,34**	**56.130,12**	**58.833,54**	**62.011,09**	**58.904,99**	**72.823,00**	**63.344,48**	**58.336,98**	**56.343,24**
Total CO_2 emissions excluding net CO_2 from LULUCF	**52.793,32**	**63.472,50**	**57.678,66**	**59.990,54**	**63.628,09**	**60.574,22**	**74.040,10**	**64.523,78**	**60.291,12**	**57.578,07**
Memo Items:										
International Bunkers	**4.823,30**	**4.394,45**	**4.580,16**	**5.958,34**	**6.646,69**	**6.927,68**	**6.773,80**	**6.413,77**	**6.573,23**	**6.445,41**
Aviation	1.736,10	1.632,12	1.693,19	1.658,84	1.817,70	1.867,05	1.971,08	2.010,44	2.158,98	2.290,07
Marine	3.087,20	2.762,33	2.886,97	4.299,50	4.828,99	5.060,63	4.802,71	4.403,33	4.414,25	4.155,35
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	4.640,89	5.032,95	5.321,34	5.574,45	5.533,46	5.868,80	6.295,78	6.542,43	6.491,97	6.857,21

Table A9.1 *continued.*

TABLE 10 EMISSION TRENDS
CO_2
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**51.262,61**	**52.839,50**	**52.442,48**	**57.755,88**	**52.091,08**	**48.524,96**	**56.327,40**	**51.493,70**	**0,06**
A. Fuel Combustion (Sectoral Approach)	50.670,07	52.208,25	51.909,62	57.207,93	51.484,65	48.085,02	55.902,59	51.127,06	-0,14
1. Energy Industries	25.129,81	26.414,87	26.584,35	31.401,90	25.406,03	22.139,63	29.868,70	25.132,33	-3,98
2. Manufacturing Industries and Construction	6.004,64	6.071,16	5.788,10	5.751,44	5.797,52	5.576,12	5.755,87	5.686,05	4,84
3. Transport	12.060,59	12.057,17	12.159,22	12.621,38	12.932,62	13.050,23	13.417,89	13.985,63	32,84
4. Other Sectors	7.364,49	7.568,17	7.289,17	7.341,22	7.109,46	7.048,25	6.733,67	6.148,19	-31,34
5. Other	110,53	96,87	88,78	91,98	239,02	270,80	126,46	174,87	46,93
B. Fugitive Emissions from Fuels	592,55	631,24	532,86	547,95	606,43	439,95	424,81	366,64	39,18
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Oil and Natural Gas	592,55	631,24	532,86	547,95	606,43	439,95	424,81	366,64	39,18
2. Industrial Processes	**1.701,26**	**1.702,65**	**1.700,75**	**1.569,31**	**1.688,48**	**1.604,34**	**1.649,24**	**1.647,03**	**42,95**
A. Mineral Products	1.620,19	1.616,66	1.660,33	1.531,22	1.647,74	1.548,17	1.609,57	1.606,93	49,73
B. Chemical Industry	0,65	0,83	0,55	1,05	3,01	3,01	2,18	2,16	169,63
C. Metal Production	40,73	46,68	NA,NO	NA,NO	NA,NO	15,58	NA,NO	NA,NO	-100,00
D. Other Production	NE	NE	NE	NE	NE	NE	NE	NE	0,00
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	39,70	38,49	39,86	37,03	37,73	37,59	37,49	37,94	-23,67
3. Solvent and Other Product Use	126,61	112,54	115,01	103,70	99,17	99,35	92,05	87,08	-51,46
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. Land Use, Land-Use Change and Forestry[(2)]	**1.630,64**	**-769,20**	**-1.978,74**	**-2.290,28**	**-824,36**	**161,14**	**-874,87**	**-1.127,13**	**-304,31**
A. Forest Land	-664,25	-3.551,13	-3.827,01	-3.547,21	-3.465,22	-1.796,67	-2.783,33	-2.977,03	5,17
B. Cropland	2.227,07	2.712,61	1.779,33	1.190,96	2.579,57	1.888,30	1.840,86	1.779,20	-45,88
C. Grassland	71,10	74,29	75,93	75,97	73,79	82,52	80,99	84,09	-9,49
D. Wetlands	-3,28	-4,97	-6,99	-10,00	-12,50	-13,01	-13,39	-13,39	-784,62
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	0,00
6. Waste	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**IE,NA,NE,NO**	**0,00**
A. Solid Waste Disposal on Land	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0,00
B. Waste-water Handling									
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	NA	NA	NA	NA	NA	NA	NO	NO	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CO_2 emissions including net CO_2 from LULUCF	**54.721,13**	**53.885,48**	**52.279,50**	**57.138,60**	**53.054,37**	**50.389,81**	**57.193,81**	**52.100,67**	**-2,33**
Total CO_2 emissions excluding net CO_2 from LULUCF	**53.090,49**	**54.654,68**	**54.258,24**	**59.428,88**	**53.878,73**	**50.228,66**	**58.068,68**	**53.227,80**	**0,82**
Memo Items:									
International Bunkers	**6.629,22**	**5.989,77**	**5.024,93**	**5.272,10**	**4.993,36**	**5.211,34**	**6.015,95**	**6.260,43**	**29,80**
Aviation	2.349,78	2.384,94	2.059,41	2.142,08	2.448,86	2.575,38	2.583,30	2.701,41	55,60
Marine	4.279,45	3.604,83	2.965,52	3.130,03	2.544,50	2.635,96	3.432,65	3.559,02	15,28
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass	7.169,29	7.902,41	8.429,61	9.452,90	10.142,31	10.888,72	11.330,51	12.106,13	160,86

Table A9.2.

TABLE 10 EMISSION TRENDS
CH_4
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	10,69	11,92	12,39	14,74	18,05	24,28	28,90	28,97	30,35	30,64
A. Fuel Combustion (Sectoral Approach)	8,80	9,64	10,22	12,35	15,50	21,34	26,07	25,85	27,23	27,07
1. Energy Industries	1,11	1,54	1,86	3,46	6,53	11,84	15,41	14,92	16,16	16,09
2. Manufacturing Industries and Construction	0,71	0,74	0,72	0,73	0,74	0,84	1,28	1,28	1,37	1,37
3. Transport	2,67	2,71	2,68	2,65	2,56	2,42	2,32	2,23	2,14	2,03
4. Other Sectors	4,31	4,63	4,96	5,50	5,67	6,21	7,05	7,40	7,55	7,57
5. Other	0,01	0,02	0,01	0,01	0,01	0,02	0,01	0,01	0,01	0,01
B. Fugitive Emissions from Fuels	1,89	2,28	2,17	2,39	2,55	2,94	2,83	3,12	3,12	3,56
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	1,89	2,28	2,17	2,39	2,55	2,94	2,83	3,12	3,12	3,56
2. Industrial Processes	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**
A. Mineral Products	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA
B. Chemical Industry	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C. Metal Production	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
3. Solvent and Other Product Use										
4. Agriculture	**190,96**	**192,95**	**193,39**	**197,73**	**191,32**	**190,50**	**190,59**	**186,01**	**187,64**	**181,06**
A. Enteric Fermentation	155,19	155,33	153,12	154,92	149,91	149,20	148,63	143,40	143,24	137,29
B. Manure Management	35,77	37,62	40,26	42,81	41,41	41,31	41,96	42,60	44,41	43,77
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,03**	**-0,02**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Grassland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Wetlands	-0,03	-0,03	-0,03	-0,03	-0,03	-0,03	-0,03	-0,03	-0,03	-0,02
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**69,56**	**70,56**	**70,98**	**71,93**	**71,29**	**70,39**	**71,12**	**70,44**	**68,67**	**69,12**
A. Solid Waste Disposal on Land	63,58	64,72	65,20	65,86	64,05	61,96	61,50	58,63	56,64	57,84
B. Waste-water Handling	5,98	5,84	5,78	6,07	7,24	8,43	9,62	11,81	12,03	11,28
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	NO	0,00	0,00	0,00	0,00	0,00	0,00
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**271,19**	**275,40**	**276,73**	**284,38**	**280,63**	**285,14**	**290,58**	**285,38**	**286,64**	**280,80**
Total CH_4 emissions excluding CH_4 from LULUCF	**271,21**	**275,43**	**276,76**	**284,41**	**280,66**	**285,17**	**290,61**	**285,41**	**286,66**	**280,82**
Memo Items:										
International Bunkers	0,10	0,09	0,09	0,12	0,14	0,15	0,14	0,13	0,14	0,13
Aviation	0,03	0,03	0,03	0,03	0,03	0,04	0,04	0,04	0,04	0,04
Marine	0,07	0,06	0,06	0,09	0,10	0,11	0,11	0,10	0,10	0,09
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

Table A9.2 *continued.*

TABLE 10 EMISSION TRENDS
CH_4
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	30,45	32,10	32,16	32,40	32,30	30,49	30,11	28,32	164,94
A. Fuel Combustion (Sectoral Approach)	26,64	28,28	28,22	28,38	27,47	25,68	23,95	22,21	152,30
1. Energy Industries	15,28	16,55	16,48	16,17	15,18	13,20	11,42	9,18	724,90
2. Manufacturing Industries and Construction	1,57	1,64	1,50	1,50	1,49	1,29	1,17	0,97	37,36
3. Transport	1,91	1,78	1,68	1,62	1,53	1,42	1,32	1,23	-53,88
4. Other Sectors	7,88	8,31	8,56	9,09	9,26	9,75	10,03	10,82	151,07
5. Other	0,01	0,01	0,00	0,01	0,01	0,01	0,01	0,01	44,86
B. Fugitive Emissions from Fuels	3,81	3,82	3,94	4,02	4,84	4,81	6,16	6,11	223,95
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Oil and Natural Gas	3,81	3,82	3,94	4,02	4,84	4,81	6,16	6,11	223,95
2. Industrial Processes	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**0,00**
A. Mineral Products	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	0,00
B. Chemical Industry	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C. Metal Production	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
3. Solvent and Other Product Use									
4. Agriculture	**181,81**	**186,11**	**183,50**	**181,76**	**178,52**	**176,19**	**174,44**	**182,60**	**-4,38**
A. Enteric Fermentation	136,37	138,94	135,59	133,53	129,05	127,37	124,81	132,69	-14,50
B. Manure Management	45,44	47,16	47,91	48,23	49,47	48,81	49,63	49,90	39,50
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	0,00
D. Agricultural Soils	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	0,00
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	0,00
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
5. Land Use, Land-Use Change and Forestry	**-0,02**	**-0,02**	**-0,02**	**-0,02**	**-0,02**	**-0,02**	**-0,02**	**-0,02**	**-17,33**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	0,00
B. Cropland	NA	NA	NA	NA	NA	NA	NA	NA	0,00
C. Grassland	NA	NA	NA	NA	NA	NA	NA	NA	0,00
D. Wetlands	-0,02	-0,02	-0,02	-0,02	-0,02	-0,02	-0,02	-0,02	-17,33
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	0,00
6. Waste	**68,22**	**68,59**	**69,77**	**70,38**	**64,69**	**63,73**	**63,31**	**62,80**	**-9,72**
A. Solid Waste Disposal on Land	57,87	57,57	54,99	56,08	51,60	51,27	51,49	50,62	-20,38
B. Waste-water Handling	10,34	11,02	14,78	14,30	13,08	12,45	11,82	12,18	103,62
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	0,00	0,00	0,00	0,00	0,00	0,00	NO	NO	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CH_4 emissions including CH_4 from LULUCF	**280,45**	**286,78**	**285,41**	**284,52**	**275,49**	**270,38**	**267,84**	**273,70**	**0,93**
Total CH_4 emissions excluding CH_4 from LULUCF	**280,47**	**286,80**	**285,43**	**284,54**	**275,52**	**270,40**	**267,86**	**273,72**	**0,92**
Memo Items:									
International Bunkers	0,14	0,12	0,11	0,11	0,11	0,11	0,13	0,14	45,21
Aviation	0,04	0,04	0,04	0,04	0,05	0,05	0,05	0,05	75,53
Marine	0,10	0,08	0,07	0,07	0,06	0,06	0,08	0,09	30,76
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass									

Table A9.3.

TABLE 10 EMISSION TRENDS
N_2O
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**1,28**	**1,42**	**1,37**	**1,42**	**1,47**	**1,49**	**1,69**	**1,60**	**1,54**	**1,53**
A. Fuel Combustion (Sectoral Approach)	1,28	1,41	1,36	1,41	1,46	1,49	1,69	1,59	1,53	1,51
1. Energy Industries	0,38	0,47	0,43	0,45	0,49	0,50	0,65	0,57	0,53	0,52
2. Manufacturing Industries and Construction	0,18	0,19	0,18	0,18	0,18	0,18	0,19	0,19	0,19	0,19
3. Transport	0,37	0,40	0,41	0,43	0,46	0,48	0,50	0,51	0,50	0,50
4. Other Sectors	0,34	0,35	0,33	0,35	0,32	0,33	0,34	0,32	0,30	0,30
5. Other	0,00	0,01	0,00	0,01	0,01	0,01	0,01	0,00	0,01	0,01
B. Fugitive Emissions from Fuels	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02
2. Industrial Processes	**3,36**	**3,08**	**2,72**	**2,56**	**2,60**	**2,92**	**2,69**	**2,74**	**2,60**	**3,07**
A. Mineral Products	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA
B. Chemical Industry	3,36	3,08	2,72	2,56	2,60	2,92	2,69	2,74	2,60	3,07
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
3. Solvent and Other Product Use	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
4. Agriculture	**29,03**	**28,51**	**27,56**	**26,84**	**26,16**	**25,50**	**24,41**	**24,17**	**24,08**	**22,63**
A. Enteric Fermentation										
B. Manure Management	2,21	2,20	2,21	2,20	2,14	2,07	2,07	2,07	2,10	2,03
C. Rice Cultivation										
D. Agricultural Soils	26,82	26,32	25,35	24,64	24,02	23,43	22,34	22,09	21,97	20,60
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Grassland	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Wetlands	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**0,28**	**0,27**	**0,24**	**0,29**	**0,30**	**0,27**	**0,22**	**0,21**	**0,21**	**0,20**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0,28	0,27	0,24	0,29	0,30	0,27	0,22	0,21	0,21	0,20
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	NO	0,00	0,00	0,00	0,00	0,00	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**33,96**	**33,28**	**31,89**	**31,11**	**30,53**	**30,19**	**29,02**	**28,71**	**28,43**	**27,42**
Total N_2O emissions excluding N_2O from LULUCF	**33,96**	**33,28**	**31,89**	**31,11**	**30,53**	**30,19**	**29,02**	**28,71**	**28,43**	**27,42**
Memo Items:										
International Bunkers	**0,25**	**0,23**	**0,24**	**0,33**	**0,37**	**0,38**	**0,37**	**0,35**	**0,35**	**0,34**
Aviation	0,06	0,06	0,06	0,06	0,06	0,06	0,07	0,07	0,08	0,08
Marine	0,19	0,17	0,18	0,27	0,30	0,32	0,30	0,28	0,28	0,26
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

Table A9.3 *continued*.

TABLE 10 EMISSION TRENDS
N_2O
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**1,47**	**1,49**	**1,48**	**1,53**	**1,48**	**1,44**	**1,52**	**1,48**	**15,33**
A. Fuel Combustion (Sectoral Approach)	1,46	1,48	1,48	1,52	1,47	1,43	1,51	1,47	15,49
1. Energy Industries	0,48	0,51	0,52	0,55	0,50	0,46	0,54	0,48	26,13
2. Manufacturing Industries and Construction	0,19	0,19	0,18	0,18	0,19	0,18	0,19	0,19	8,29
3. Transport	0,48	0,47	0,46	0,46	0,46	0,45	0,44	0,45	19,83
4. Other Sectors	0,30	0,31	0,31	0,32	0,31	0,33	0,34	0,35	1,99
5. Other	0,00	0,00	0,00	0,00	0,01	0,01	0,00	0,01	53,16
B. Fugitive Emissions from Fuels	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,00	-28,44
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Oil and Natural Gas	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,00	-28,44
2. Industrial Processes	**3,24**	**2,86**	**2,50**	**2,89**	**1,71**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**-100,00**
A. Mineral Products	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	0,00
B. Chemical Industry	3,24	2,86	2,50	2,89	1,71	NA,NO	NA,NO	NA,NO	-100,00
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	0,00
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
3. Solvent and Other Product Use	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,05	0,12	0,12	100,00
4. Agriculture	**21,82**	**21,33**	**20,58**	**19,82**	**20,18**	**20,09**	**19,11**	**20,12**	**-30,69**
A. Enteric Fermentation									
B. Manure Management	1,94	1,94	1,90	1,83	1,86	1,85	1,73	1,89	-14,41
C. Rice Cultivation									
D. Agricultural Soils	19,88	19,38	18,68	18,00	18,31	18,25	17,37	18,23	-32,03
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	0,00
F. Field Burning of Agricultural Residues	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
5. Land Use, Land-Use Change and Forestry	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**-17,33**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	0,00
B. Cropland	NA	NA	NA	NA	NA	NA	NA	NA	0,00
C. Grassland	NA	NA	NA	NA	NA	NA	NA	NA	0,00
D. Wetlands	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-17,33
E. Settlements	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	0,00
6. Waste	**0,21**	**0,18**	**0,19**	**0,16**	**0,17**	**0,16**	**0,16**	**0,15**	**-45,90**
A. Solid Waste Disposal on Land									
B. Waste-water Handling	0,21	0,18	0,19	0,16	0,17	0,16	0,16	0,15	-45,90
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	0,00	0,00	0,00	0,00	0,00	0,00	NO	NO	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total N_2O emissions including N_2O from LULUCF	**26,74**	**25,86**	**24,75**	**24,40**	**23,54**	**21,74**	**20,91**	**21,87**	**-35,59**
Total N_2O emissions excluding N_2O from LULUCF	**26,74**	**25,86**	**24,75**	**24,40**	**23,54**	**21,74**	**20,91**	**21,87**	**-35,59**
Memo Items:									
International Bunkers	**0,35**	**0,31**	**0,26**	**0,27**	**0,25**	**0,25**	**0,30**	**0,32**	**24,92**
Aviation	0,08	0,08	0,07	0,07	0,08	0,09	0,09	0,09	56,80
Marine	0,27	0,23	0,19	0,20	0,16	0,17	0,22	0,22	15,23
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass									

Table A9.4.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Emissions of HFCs[3] - (Gg CO_2 equivalent)	**NA,NE,NO**	**NA,NE,NO**	**3,44**	**93,93**	**134,53**	**217,73**	**329,30**	**323,75**	**411,19**	**502,98**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-32	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00	0,00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-125	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,00	0,00	0,01	0,02	0,02	0,03
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	NA,NE,NO	NA,NE,NO	0,00	0,07	0,10	0,15	0,20	0,17	0,21	0,23
HFC-152a	NA,NE,NO	NA,NE,NO	0,00	0,03	0,05	0,04	0,03	0,02	0,01	0,04
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,00	0,00	0,01	0,01	0,02	0,03
HFC-227ea	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed HFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of PFCs[3] - (Gg CO_2 equivalent)	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NO**	**0,05**	**0,50**	**1,66**	**4,12**	**9,10**	**12,48**
CF_4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_2F_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_3F_8	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,00	0,00	0,00	0,00	0,00	0,00
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
$c\text{-}C_4F_8$	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of SF6[3] - (Gg CO_2 equivalent)	**44,45**	**63,50**	**89,15**	**101,17**	**122,06**	**107,34**	**60,96**	**73,06**	**59,42**	**65,36**
SF_6	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00

Table A9.4 *continued*.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
Emissions of HFCs[3] - (Gg CO_2 equivalent)	**604,64**	**647,32**	**672,06**	**695,48**	**748,96**	**795,00**	**814,90**	**840,00**	**100,00**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	100,00
HFC-32	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02	100,00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-125	0,04	0,05	0,05	0,05	0,06	0,07	0,07	0,07	100,00
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-134a	0,25	0,27	0,28	0,27	0,29	0,28	0,28	0,29	100,00
HFC-152a	0,02	0,01	0,01	0,00	0,01	0,00	0,00	0,00	100,00
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-143a	0,04	0,04	0,04	0,05	0,05	0,06	0,06	0,07	100,00
HFC-227ea	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Unspecified mix of listed HFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Emissions of PFCs[3] - (Gg CO_2 equivalent)	**17,89**	**22,13**	**22,17**	**19,34**	**15,90**	**13,90**	**15,68**	**15,36**	**100,00**
CF_4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	100,00
C_2F_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C_3F_8	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
$c\text{-}C_4F_8$	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	100,00
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Unspecified mix of listed PFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Emissions of SF6[3] - (Gg CO_2 equivalent)	**59,23**	**30,40**	**25,01**	**31,37**	**33,15**	**21,75**	**35,99**	**30,35**	**-31,73**
SF_6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-31,73

Table A9.5

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)
CO_2 emissions including net CO_2 from LULUCF	53.344,99	61.784,34	56.130,12	58.833,54	62.011,09	58.904,99	72.823,00	63.344,48	58.336,98	56.343,24
CO_2 emissions excluding net CO_2 from LULUCF	52.793,32	63.472,50	57.678,66	59.990,54	63.628,09	60.574,22	74.040,10	64.523,78	60.291,12	57.578,07
CH_4 emissions including CH_4 from LULUCF	5.694,90	5.783,35	5.811,29	5.971,96	5.893,28	5.987,98	6.102,18	5.993,07	6.019,34	5.896,77
CH_4 emissions excluding CH_4 from LULUCF	5.695,50	5.783,95	5.811,89	5.972,56	5.893,87	5.988,57	6.102,77	5.993,66	6.019,92	5.897,26
N_2O emissions including N_2O from LULUCF	10.526,74	10.317,68	9.885,27	9.645,01	9.464,50	9.357,96	8.995,80	8.901,39	8.814,01	8.501,43
N_2O emissions excluding N_2O from LULUCF	10.526,65	10.317,59	9.885,18	9.644,92	9.464,42	9.357,87	8.995,71	8.901,30	8.813,92	8.501,35
HFCs	NA,NE,NO	NA,NE,NO	3,44	93,93	134,53	217,73	329,30	323,75	411,19	502,98
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,05	0,50	1,66	4,12	9,10	12,48
SF_6	44,45	63,50	89,15	101,17	122,06	107,34	60,96	73,06	59,42	65,36
Total (including LULUCF)	**69.611,08**	**77.948,87**	**71.919,28**	**74.645,62**	**77.625,51**	**74.576,50**	**88.312,90**	**78.639,87**	**73.650,04**	**71.322,26**
Total (excluding LULUCF)	**69.059,92**	**79.637,55**	**73.468,32**	**75.803,12**	**79.243,02**	**76.246,23**	**89.530,50**	**79.819,67**	**75.604,67**	**72.557,51**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)
1. Energy	52.083,08	62.665,17	56.751,96	59.112,72	62.817,24	59.911,52	73.416,08	63.720,27	59.569,88	56.882,58
2. Industrial Processes	2.239,52	2.342,60	2.379,13	2.452,18	2.550,48	2.724,21	2.827,30	3.017,46	2.994,05	3.217,09
3. Solvent and Other Product Use	179,38	174,21	169,05	163,88	158,71	140,96	154,36	139,45	128,40	126,88
4. Agriculture	13.009,54	12.890,40	12.604,32	12.472,86	12.127,21	11.906,20	11.569,83	11.398,07	11.404,27	10.817,40
5. Land Use, Land-Use Change and Forestry[(5)]	551,16	-1.688,67	-1.549,05	-1.157,50	-1.617,51	-1.669,73	-1.217,60	-1.179,80	-1.954,63	-1.235,25
6. Waste	1.548,40	1.565,16	1.563,87	1.601,49	1.589,39	1.563,34	1.562,94	1.544,43	1.508,06	1.513,56
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)[(5)]	**69.611,08**	**77.948,87**	**71.919,28**	**74.645,62**	**77.625,51**	**74.576,50**	**88.312,90**	**78.639,87**	**73.650,04**	**71.322,26**

Table A9.5 *continued*.

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.1
DENMARK

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	(%)
CO_2 emissions including net CO_2 from LULUCF	54.721,13	53.885,48	52.279,50	57.138,60	53.054,37	50.389,81	57.193,81	52.100,67	-2,33
CO_2 emissions excluding net CO_2 from LULUCF	53.090,49	54.654,68	54.258,24	59.428,88	53.878,73	50.228,66	58.068,68	53.227,80	0,82
CH_4 emissions including CH_4 from LULUCF	5.889,37	6.022,32	5.993,60	5.974,84	5.785,34	5.677,96	5.624,65	5.747,60	0,93
CH_4 emissions excluding CH_4 from LULUCF	5.889,87	6.022,82	5.994,09	5.975,33	5.785,84	5.678,45	5.625,14	5.748,09	0,92
N_2O emissions including N_2O from LULUCF	8.288,16	8.017,00	7.672,99	7.562,69	7.296,49	6.739,35	6.482,33	6.779,85	-35,59
N_2O emissions excluding N_2O from LULUCF	8.288,08	8.016,93	7.672,91	7.562,62	7.296,42	6.739,27	6.482,26	6.779,78	-35,59
HFCs	604,64	647,32	672,06	695,48	748,96	795,00	814,90	840,00	100,00
PFCs	17,89	22,13	22,17	19,34	15,90	13,90	15,68	15,36	100,00
SF_6	59,23	30,40	25,01	31,37	33,15	21,75	35,99	30,35	-31,73
Total (including LULUCF)	**69.580,41**	**68.624,65**	**66.665,32**	**71.422,32**	**66.934,20**	**63.637,77**	**70.167,37**	**65.513,83**	**-5,89**
Total (excluding LULUCF)	**67.950,19**	**69.394,27**	**68.644,48**	**73.713,03**	**67.758,98**	**63.477,05**	**71.042,66**	**66.641,38**	**-3,50**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	CO_2 eqv. (Gg)	(%)
1. Energy	52.357,55	53.977,00	53.578,15	58.909,32	53.227,57	49.610,69	57.431,46	52.546,08	0,89
2. Industrial Processes	3.386,52	3.287,80	3.194,05	3.210,16	3.017,20	2.435,00	2.515,81	2.532,74	13,09
3. Solvent and Other Product Use	126,61	112,54	115,01	103,70	99,17	113,39	129,94	124,00	-30,88
4. Agriculture	10.581,54	10.519,17	10.233,91	9.962,00	10.003,39	9.929,16	9.585,98	10.072,34	-22,58
5. Land Use, Land-Use Change and Forestry[(5)]	1.630,22	-769,62	-1.979,16	-2.290,70	-824,78	160,72	-875,29	-1.127,55	-304,58
6. Waste	1.497,97	1.497,77	1.523,35	1.527,84	1.411,65	1.388,81	1.379,47	1.366,23	-11,77
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
Total (including LULUCF)[(5)]	**69.580,41**	**68.624,65**	**66.665,32**	**71.422,32**	**66.934,20**	**63.637,77**	**70.167,37**	**65.513,83**	**-5,89**

Annex 10 Memorandum from the Ministry of Climate and Energy

Please see letter next page. Will only be available for the UNFCCC reporting due April 15th 2009.

MINISTRY OF CLIMATE AND ENERGY

Memorandum

April 15, 2009
File no. 3007-0011
Ref. ER /KAR(ENS)

Denmark's and Greenland's annual non-inventory information under the Kyoto Protocol

Referring to Decision 15/CMP.1 on Guidelines for the preparation of the information required under Articles 7 of the Kyoto Protocol[i], this memorandum includes information and references to Denmark's and Greenland's annual non-inventory information under the Kyoto Protocol.
The Annotated outline of the National Inventory Report including reporting elements under the Kyoto Protocol has been used as guidance for this submission.

Chapter 12: Information on accounting of Kyoto units

12.1 Background information

In accordance with paragraph 10 of the annex to Decision 15/CMP.1 information on emission reduction units, certified emission reductions, temporary certified emission reductions, long-term certified emission reductions, assigned amount units and removal units will be reported for the first calendar year in which these units will be transferred or acquired.

12.2 Summary of information reported in the SEF tables

The information required is contained in the UNFCCC Standard Electronic Format (SEF) application version 1.1.4, which is attached to this memorandum. Below is a small summary from the SEF, with the holdings of and transactions of Kyoto units. Please keep it mind that some of this information is confidential and Denmark is not allowed to publish this according to EU law. This is described in the section "Publicly accessible information":

Table on Kyoto units in the Danish Emissions Trading Registry

Kyoto unit	Additions	Subtractions	Holding
AAU	191.772.275	174.391.031	294.220.199
ERU	0	0	0
RMU	0	0	0
CER	27.439.229	23.971.973	3.467.256
tCER	0	0	0
lCER	0	0	0

On the 28 October 2008 the EU Emissions Trading System and the Community Independent Transaction Log connected to the International Transaction Log (ITL) and Denmark's assigned amount units were issued in accordance with the Report of the review of the initial report of Denmark published on 2 November 2007[ii]. Documentation for the issuance is also available in the SEF.

Ministry of Climate and Energy
Stormgade 2-6
DK-1470 København K

Phone +45 33 92 28 00
Fax +45 33 92 28 01
E-mail: kemin@kemin.dk
www.kemin.dk

12.3 Discrepancies and notifications
Annex 1 parties are also required to submit four reports according to paragraphs 12 to 16 of the annex to decision 15/CMP.1. These reports are:

Paragraph 12 – List of discrepancies identified by the ITL.
Paragraph 13/14 – List of notifications from the CDM Executive Board regarding lCERs.
Paragraph 15 – List of non-replacement identified by the ITL.
Paragraph 16 – List of invalid Kyoto units.

The reports described in paragraph 13-15 are not attached to this memorandum, as there are no tCERs or lCERs in the Danish Registry. For paragraph 16, the Danish Registry has yet to receive invalid Kyoto units. This also renders this report unnecessary to submit.
The last report described in paragraph 12, however is attached to this memorandum as "Report – List of discrepancies identified by the ITL according to paragraph 12 of the annex to decision 15/CMP.1".

12.4 Publicly accessible information
Information to be publically available from the SEF is attached to this memorandum ("SEF data allowed to be published according to Commission Regulation (EC) No 2216/2004 of 21 December 2004[iii]"). The information will be publically available on the Danish Energy Agency's website[iv].

12.5 Calculation of the Commitment Period Reserve (CPR)
The calculation and check of the commitment period reserve has not been altered since the Report of the review of the initial report of Denmark published on 2 November 2007. The software still checks if the CPR is respected before a transaction from the Danish Registry can be carried out.

Chapter 14: Information on changes in the national registry
Referring to paragraph 22 of the annex to Decision 15/CMP.1, the following changes have occurred in the national registry, compared with the information provided in "The Kingdom of Denmark's Report on Assigned Amount - under the Kyoto Protocol" submitted on 20 December 2006[v]:
According to chapter 14 of the Annotated outline of the National Inventory Report including reporting elements under the Kyoto Protocol both the old and the new information on changes in the national registry should be available.

Internet address for the registry:
https://www.kvoteregister.mst.dk/ changed to https://www.kvoteregister.dk/

Changes regarding the functioning of the registry have been made in order to fulfil the requirements for registries as evaluated in the Independent Assessment Report prepared by International Transaction Log (ITL) Administrator published on 16 October 2007[vi].

Chapter 15: Information on the minimization of adverse impacts in accordance with Articles 3, paragraph 14
Referring to paragraph 23 of the annex to Decision 15/CMP.1, information on how Denmark is striving to implement commitments under the Kyoto Protocol in such a way to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention is available in Chapter 4.6.5 in Denmark's Fourth National Communication on Climate Change submitted on 30 December 2005[vii].

Annex 6.2: Supplementary information under Article 7.1
./. *Annex 6.2.2:* Standard Electronic Format application - DK_SEF_2008:20090330.xls (See following pages)
./. *Annex 6.2.4.b:* List of discrepancies identified by the ITL according to paragraph 12 of the annex to decision 15/CMP.1 – DK_Reports_2008_R2.xls. (See following pages)

./. *Annex 6.2.4.d:* SEF data allowed to be published according to Commission Regulation (EC) No 2216/2004 of 21 December 2004. (Uploaded separately)

	Average number of occurrences per transaction (x 100.000)							Units Involved abbreviated		
DES Response Code	**Reported year**	**Prior to the Reported Year**	**Transaction Number**	**Proposal Date Time**	**Transaction Type**	**Final State**	**Explanation**	**Serial Number**	**Unit Type**	**Quantity**
4003	0,1	0								
			DK356991	20-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
								CZ-449012847-449014846	AAU	2000
								ES-1570306690-1570307101	AAU	412
								ES-1596950244-1596951243	AAU	1000
								ES-1642891337-1642892327	AAU	991
								PT-1658294019-1658298106	AAU	4088
								PT-1664443819-1664444271	AAU	453
								PT-1664449304-1664449803	AAU	500
								PT-1664484820-1664485319	AAU	500
								PT-1664543915-1664543961	AAU	47
								SK-101795372-101795380	AAU	9
			DK357078	20-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
								CZ-448425750-448428749	AAU	3000
								CZ-449012847-449014846	AAU	2000
								ES-1520868408-1520870091	AAU	1684
								ES-1520871404-1520871560	AAU	157
								ES-1520876945-1520876956	AAU	12
								ES-1570306690-1570307101	AAU	412
								ES-1570326485-1570329484	AAU	3000
								ES-1589200782-1589207781	AAU	7000
								ES-1596950244-1596951243	AAU	1000
								ES-1605443062-1605443161	AAU	100
								ES-1609349946-1609350445	AAU	500

						ES-1642891337-1642892327	AAU	991
						ES-1642923328-1642924827	AAU	1500
						ES-1646853381-1646854030	AAU	650
						FI-162588119-162588173	AAU	55
						PT-1658294019-1658298106	AAU	4088
						PT-1663900228-1663901227	AAU	1000
						PT-1664442718-1664443153	AAU	436
						PT-1664443819-1664444271	AAU	453
						PT-1664446572-1664446771	AAU	200
						PT-1664447039-1664447271	AAU	233
						PT-1664449304-1664449803	AAU	500
						PT-1664449804-1664450226	AAU	423
						PT-1664484820-1664485319	AAU	500
						PT-1664543915-1664543961	AAU	47
						PT-1685656340-1685656539	AAU	200
						PT-1686037501-1686037992	AAU	492
						SK-101795372-101795380	AAU	9
						SK-116341573-116342572	AAU	1000
						SK-116422118-116425117	AAU	3000
						SK-116429644-116430643	AAU	1000
						SK-116441644-116442643	AAU	1000
						SK-116457644-116459001	AAU	1358
						SK-116488644-116489643	AAU	1000
						SK-99047490-99048489	AAU	1000
	DK357079	20-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						CZ-449012847-449014846	AAU	2000
						ES-1570306690-1570307101	AAU	412
						ES-1596950244-1596951243	AAU	1000
						ES-1642891337-1642892327	AAU	991
						PT-1658294019-1658298106	AAU	4088
						PT-1664443819-1664444271	AAU	453
						PT-1664449304-1664449803	AAU	500
						PT-1664484820-1664485319	AAU	500
						PT-1664543915-1664543961	AAU	47
						SK-101795372-101795380	AAU	9
	DK357080	20-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						ES-1570306690-1570307101	AAU	412

						PT-1658294019-1658297106	AAU	3088
						PT-1664443819-1664444271	AAU	453
						PT-1664449304-1664449803	AAU	500
						PT-1664484820-1664485319	AAU	500
						PT-1664543915-1664543961	AAU	47
	DK357081	20-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						CZ-393808818-393809569	AAU	752
						CZ-393832818-393833065	AAU	248
						CZ-448425750-448428749	AAU	3000
						CZ-449012847-449014846	AAU	2000
						ES-1520868408-1520870091	AAU	1684
						ES-1520871404-1520871560	AAU	157
						ES-1520876945-1520876956	AAU	12
						ES-1570306690-1570307101	AAU	412
						ES-1570326485-1570329484	AAU	3000
						ES-1589200782-1589207781	AAU	7000
						ES-1596950244-1596951243	AAU	1000
						ES-1605443062-1605443161	AAU	100
						ES-1609349946-1609350445	AAU	500
						ES-1642891337-1642892327	AAU	991
						ES-1642923328-1642924827	AAU	1500
						ES-1646853381-1646854030	AAU	650
						FI-162588119-162588173	AAU	55
						PT-1658294019-1658297106	AAU	3088
						PT-1663900228-1663901227	AAU	1000
						PT-1664442718-1664443153	AAU	436
						PT-1664443819-1664444271	AAU	453
						PT-1664446572-1664446771	AAU	200
						PT-1664447039-1664447271	AAU	233
						PT-1664449304-1664449803	AAU	500
						PT-1664449804-1664450226	AAU	423
						PT-1664484820-1664485319	AAU	500
						PT-1664543915-1664543961	AAU	47
						PT-1685656340-1685656539	AAU	200
						PT-1686037501-1686037992	AAU	492
						SK-101795372-101795380	AAU	9
						SK-116341573-116342572	AAU	1000
						SK-116422118-116425117	AAU	3000
						SK-116429644-116430643	AAU	1000
						SK-116441644-116442643	AAU	1000
						SK-116457644-116459001	AAU	1358
						SK-116488644-116489643	AAU	1000

								SK-99047490-99048489	AAU	1000
			DK357096	21-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
								CZ-448367372-448368406	AAU	1035
								CZ-448974847-448975846	AAU	1000
								CZ-448975847-448978846	AAU	3000
								CZ-448990273-448991618	AAU	1346
								CZ-448995119-448995527	AAU	409
								CZ-448995528-448995877	AAU	350
								CZ-449001558-449007118	AAU	5561
								CZ-449008047-449008083	AAU	37
								CZ-449008084-449008203	AAU	120
								CZ-449010047-449011046	AAU	1000
								CZ-463166797-463178201	AAU	11405
								ES-1589206640-1589207781	AAU	1142
								ES-1596883244-1596887989	AAU	4746
								ES-1596898990-1596899243	AAU	254
								ES-1596933386-1596935243	AAU	1858
								ES-1642921186-1642923327	AAU	2142
								FR-508943872-508944071	AAU	200
								FR-542681379-542681531	AAU	153
								FR-569678407-569678662	AAU	256
								FR-569689102-569689314	AAU	213
								FR-569689315-569689401	AAU	87
								PT-1658291419-1658292876	AAU	1458
								PT-1658297107-1658298106	AAU	1000
								PT-1658298107-1658298218	AAU	112
								PT-1658298219-1658299018	AAU	800
								PT-1664434733-1664434803	AAU	71
								PT-1664439383-1664439682	AAU	300
								PT-1664442554-1664442717	AAU	164
								PT-1664444272-1664444631	AAU	360
								PT-1664446390-1664446571	AAU	182
								PT-1664450227-1664450803	AAU	577
								PT-1664543762-1664543914	AAU	153
								PT-1664544762-1664544879	AAU	118
								PT-1667126719-1667126918	AAU	200
								PT-1672237490-1672237744	AAU	255
								PT-1686038346-1686038500	AAU	155
								PT-1686479676-1686479823	AAU	148
								SK-116459002-116459643	AAU	642
								SK-96378844-96379834	AAU	991

	DK357097	21-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						CZ-448367372-448368406	AAU	1035
						CZ-448974847-448975846	AAU	1000
						CZ-448975847-448978846	AAU	3000
						CZ-448990273-448991618	AAU	1346
						CZ-448995119-448995527	AAU	409
						CZ-448995528-448995877	AAU	350
						CZ-449001558-449007118	AAU	5561
						CZ-449008047-449008083	AAU	37
						CZ-449008084-449008203	AAU	120
						CZ-449010047-449011046	AAU	1000
						CZ-463178202-463191796	AAU	13595
						ES-1589206640-1589207018	AAU	379
						ES-1596883244-1596887989	AAU	4746
						ES-1596898990-1596899243	AAU	254
						ES-1596933386-1596935243	AAU	1858
						ES-1642921186-1642923327	AAU	2142
						FR-508943872-508944071	AAU	200
						FR-542681379-542681531	AAU	153
						FR-569678407-569678662	AAU	256
						FR-569689102-569689314	AAU	213
						FR-569689315-569689401	AAU	87
						PT-1658291419-1658292876	AAU	1458
						PT-1658297107-1658298106	AAU	1000
						PT-1664434733-1664434803	AAU	71
						PT-1664439383-1664439682	AAU	300
						PT-1664442554-1664442717	AAU	164
						PT-1664446390-1664446571	AAU	182
						PT-1664450227-1664450803	AAU	577
						PT-1664543762-1664543914	AAU	153
						PT-1664544762-1664544879	AAU	118
						PT-1667126719-1667126918	AAU	200
						PT-1672237490-1672237744	AAU	255
						PT-1686479676-1686479823	AAU	148
						SK-116459002-116459643	AAU	642
						SK-96378844-96379834	AAU	991
	DK357099	21-08-2008 00:00	External - External transfer of unit between reg-	5	Terminated			

					istries					
								CZ-448367372-448368406	AAU	1035
								CZ-448975580-448975846	AAU	267
								CZ-448990273-448991618	AAU	1346
								CZ-448995119-448995527	AAU	409
								CZ-448995528-448995877	AAU	350
								CZ-449001558-449007118	AAU	5561
								CZ-449008047-449008083	AAU	37
								CZ-449008084-449008203	AAU	120
								ES-1596883244-1596887989	AAU	4746
								ES-1596898990-1596899243	AAU	254
								ES-1596933386-1596935243	AAU	1858
								ES-1642921186-1642923327	AAU	2142
								PT-1658297107-1658297339	AAU	233
								SK-116459002-116459643	AAU	642
4010	0,21	0								
			DK355 479	09-07- 2008 00:00	External - External transfer of unit between registries	5	Terminated			
								CZ-448302750-448303749	AAU	1000
			DK355 687	15-07- 2008 00:00	External - External transfer of unit between registries	5	Terminated			
								ES-1520882729-1520883944	AAU	1216
								ES-1520883945-1520886944	AAU	3000
								ES-1526481297-1526482080	AAU	784
								ES-1564369712-1564370711	AAU	1000
								ES-1570308702-1570309701	AAU	1000
								ES-1577587614-1577588613	AAU	1000
								ES-1580602242-1580603241	AAU	1000
								ES-1591547734-1591549733	AAU	2000
								ES-1591549734-1591550733	AAU	1000
								ES-1591554734-1591555809	AAU	1076
								ES-1591556734-1591558733	AAU	2000
								ES-1591633734-1591634733	AAU	1000
								ES-1619947983-1619948906	AAU	924
								ES-1623419855-1623420854	AAU	1000
								ES-1623420855-1623421854	AAU	1000
			DK356 983	19-08- 2008	External - External	5	Terminated			

		00:00	transfer of unit between registries					
						CZ-449012847-449014846	AAU	2000
						ES-1570306690-1570307101	AAU	412
						ES-1595664823-1595664910	AAU	88
						ES-1596950244-1596951243	AAU	1000
						ES-1642891337-1642892327	AAU	991
						PT-1658294019-1658298106	AAU	4088
						PT-1658298107-1658299018	AAU	912
						PT-1664443819-1664444271	AAU	453
						PT-1664449304-1664449803	AAU	500
						PT-1664484820-1664485319	AAU	500
						PT-1664543915-1664543961	AAU	47
						SK-101795372-101795380	AAU	9
	DK356984	19-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						CZ-449012847-449014846	AAU	2000
						ES-1570306690-1570307101	AAU	412
						ES-1596950244-1596951243	AAU	1000
						ES-1642891337-1642892327	AAU	991
						PT-1658294019-1658298106	AAU	4088
						PT-1664443819-1664444271	AAU	453
						PT-1664449304-1664449803	AAU	500
						PT-1664484820-1664485319	AAU	500
						PT-1664543915-1664543961	AAU	47
						SK-101795372-101795380	AAU	9
	DK356986	19-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						CZ-449012847-449014846	AAU	2000
						ES-1570306690-1570307101	AAU	412
						ES-1596950244-1596951243	AAU	1000
						ES-1642891337-1642892327	AAU	991
						PT-1658294019-1658298106	AAU	4088
						PT-1664443819-1664444271	AAU	453
						PT-1664449304-1664449803	AAU	500
						PT-1664484820-1664485319	AAU	500
						PT-1664543915-1664543961	AAU	47

						SK-101795372-101795380	AAU	9
	DK356987	19-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						CZ-449012847-449014846	AAU	2000
						ES-1570306690-1570307101	AAU	412
						ES-1596950244-1596951243	AAU	1000
						ES-1642891337-1642892327	AAU	991
						PT-1658294019-1658298106	AAU	4088
						PT-1664443819-1664444271	AAU	453
						PT-1664449304-1664449803	AAU	500
						PT-1664484820-1664485319	AAU	500
						PT-1664543915-1664543961	AAU	47
						SK-101795372-101795380	AAU	9
	DK356988	19-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						CZ-449012847-449014846	AAU	2000
						ES-1570306690-1570307101	AAU	412
						ES-1596950244-1596951243	AAU	1000
						ES-1642891337-1642892327	AAU	991
						PT-1658294019-1658298106	AAU	4088
						PT-1664443819-1664444271	AAU	453
						PT-1664449304-1664449803	AAU	500
						PT-1664484820-1664485319	AAU	500
						PT-1664543915-1664543961	AAU	47
						SK-101795372-101795380	AAU	9
	DK356989	19-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						CZ-449012847-449014846	AAU	2000
						ES-1570306690-1570307101	AAU	412
						ES-1596950244-1596951243	AAU	1000
						ES-1642891337-1642892327	AAU	991
						PT-1658294019-1658298106	AAU	4088
						PT-1664443819-1664444271	AAU	453
						PT-1664449304-1664449803	AAU	500
						PT-1664484820-1664485319	AAU	500

						PT-1664543915-1664543961	AAU	47
						SK-101795372-101795380	AAU	9
	DK356 990	19-08-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						CZ-449012847-449014846	AAU	2000
						ES-1570306690-1570307101	AAU	412
						ES-1596950244-1596951243	AAU	1000
						ES-1642891337-1642892327	AAU	991
						PT-1658294019-1658298106	AAU	4088
						PT-1664443819-1664444271	AAU	453
						PT-1664449304-1664449803	AAU	500
						PT-1664484820-1664485319	AAU	500
						PT-1664543915-1664543961	AAU	47
						SK-101795372-101795380	AAU	9
	DK357 882	08-09-2008 00:00	Internal - Internal transfer of unit/supplementary program transaction	5	Terminated			
						CZ-393785308-393785817	AAU	510
						CZ-393807818-393807917	AAU	100
						CZ-404788358-404788721	AAU	364
						CZ-404821039-404821528	AAU	490
						CZ-448441750-448442735	AAU	986
						CZ-448442736-448442936	AAU	201
						CZ-449039847-449039872	AAU	26
						ES-1563914135-1563919134	AAU	5000
						ES-1601362223-1601364222	AAU	2000
						FR-477987940-477989939	AAU	2000
						FR-509934378-509934913	AAU	536
						FR-509934914-509936216	AAU	1303
						FR-509950160-509950320	AAU	161
						FR-509959621-509961932	AAU	2312
						FR-509961933-509963369	AAU	1437
						FR-572051870-572052656	AAU	787
						FR-572565967-572570966	AAU	5000
						FR-572589967-572593966	AAU	4000
						FR-572593967-572598966	AAU	5000
						SK-100542075-100543074	AAU	1000
						SK-104845331-104845653	AAU	323
						SK-104930542-104930948	AAU	407

						SK-116230294-116230384	AAU	91
						SK-116267952-116267971	AAU	20
						SK-122904463-122905221	AAU	759
						SK-122912463-122913278	AAU	816
						SK-122913279-122914058	AAU	780
						SK-99326791-99327381	AAU	591
	DK360179	02-10-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						ES-1583125739-1583133738	AAU	8000
						ES-1583133739-1583134738	AAU	1000
	DK360180	02-10-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						ES-1583125739-1583133738	AAU	8000
						ES-1583133739-1583134738	AAU	1000
	DK360182	02-10-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						ES-1583115739-1583125738	AAU	10000
						ES-1583125739-1583133738	AAU	8000
	DK360186	02-10-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						ES-1583125739-1583133738	AAU	8000
	DK360187	02-10-2008 00:00	External - External transfer of unit between registries	5	Terminated			
						ES-1583125739-1583126738	AAU	1000
	DK360188	02-10-2008 00:00	External - External transfer of	5	Terminated			

			unit be- tween reg- istries						

SEF data allowed to be published according to Commission Regulation (EC) No 2216/2004 of 21 December 2004

Party	Denmark
Submission year	2008
Reported year	2008
Commitment period	1

Summary information on additions and subtractions

	Additions						Subtractions					
	Unit type						Unit type					
Starting values	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Issuance pursuant to Article 3.7 and 3.8	276838955											
Non-compliance cancellation							NO	NO	NO	NO		
Carry-over	NO	NO		NO								

Annual internal transactions

Transaction type	Additions			Subtractions			
	Unit type			Unit type			
	AAUs	ERUs	RMUs	AAUs	ERUs	RMUs	CERs
Article 6 issuance and conversion							
Party-verified projects		NO					
Independently verifed projects		NO					
Article 3.3 and 3.4 issuance or cancellation							
3.3 Afforestation and reforestation			NO	NO	NO	NO	NO
3.3 Deforestation			NO	NO	NO	NO	NO
3.4 Forest management			NO	NO	NO	NO	NO
3.4 Cropland management			NO	NO	NO	NO	NO
3.4 Grazing land management			NO	NO	NO	NO	NO
3.4 Revegetation			NO	NO	NO	NO	NO

Total quantities of Kyoto Protocol units by account type at end of reported year

Account type	Unit type			
	AAUs	ERUs	RMUs	CERs
Other cancellation accounts	NO	NO	NO	NO
Retirement account	NO	NO	NO	NO

Party	Denmark
Submission year	2008
Reported year	2008
Commitment period	1

Table 4. Total quantities of Kyoto Protocol units by account type at end of reported year

Account type	Unit type			
	AAUs	ERUs	RMUs	CERs
Other cancellation accounts	NO	NO	NO	NO
Retirement account	NO	NO	NO	NO

[i] http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf

[ii] http://unfccc.int/resource/docs/2007/irr/dnk.pdf

[iii] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:386:0001:0077:EN:PDF

[iv] http://www.ens.dk/sw61389.asp/

[v]http://unfccc.int/files/national_reports/initial_reports_under_the_kyoto_protocol/application/pdf/aareporttounfccc-20dec2006.pdf

[vi] http://unfccc.int/resource/docs/2007/iar/dnk01.pdf

[vii] http://unfccc.int/resource/docs/natc/dennc4.pdf

Annex 11 Information on activities under Article 3, paragraph 3 and elected activities under Article 3, paragraph 4 under the Kyoto Protocol

Information on afforestation activities, going to be reported for 2008-2012 in 2010-2014 under Article 3, paragraph 3 of the Kyoto Protocol, is included for 1990-2007 in the LULUCF greenhouse gas inventory information reported under the United Nations Framework Convention on Climate Change.

In "The Kingdom of Denmark's Report on Assigned Amount - under the Kyoto Protocol" submitted on 20 December 2006 it has been reported that activities elected under Article 3, paragraph 4 of the Kyoto Protocol include emissions and removals from forest management, cropland management and grazing land management.

Information on emissions and removals related to these activities will be reported for 1990 and 2008-2012 in 2010-2014.

Further information relating to activities under Article 3 paragraphs 3 and 4 of the Kyoto Protocol will be reported April 15th, 2010, and from then on, annually.

NERI **National Environmental Research Institute**
DMU Danmarks Miljøundersøgelser

National Environmental Research Institute, NERI, is a part of Aarhus University.

At NERI's website www.neri.dk you'll find information regarding ongoing research and development projects.

NERI undertakes research, monitoring and consultancy within environment and nature.

Furthermore the website contains a database of publications including scientific articles, reports, conference contributions etc. produced by NERI staff members.

Further information: www.neri.dk

National Environmental Research Institute
Frederiksborgvej 399
PO Box 358
DK-4000 Roskilde
Denmark
Tel: +45 4630 1200
Fax: +45 4630 1114

Management
Department of Arctic Environment
Department of Atmospheric Environment
Department of Environmental Chemistry and Microbiology
Department of Marine Ecology
Department of Policy Analysis

National Environmental Research Institute
Vejlsøvej 25
PO Box 314
DK-8600 Silkeborg
Denmark
Tel: +45 8920 1400
Fax: +45 8920 1414

Department of Freshwater Ecology
Department of Marine Ecology
Department of Terrestrial Ecology

National Environmental Research Institute
Grenåvej 14, Kalø
DK-8410 Rønde
Denmark
Tel: +45 8920 1700
Fax: +45 8920 1514

Department of Policy Analysis
Department of Wildlife Ecology and Biodiversity

NERI Technical Reports

NERI's website www.neri.dk contains a list of all published technical reports along with other NERI publications. All recent reports can be downloaded in electronic format (pdf) without charge. Some of the Danish reports include an English summary.

Nr./No. 2009

716 Annual Danish informative inventory report to UNECE. Emission inventories from the base year of the protocols to year 2007.
By Nielsen, O-K., Winther, M., Mikkelsen, M.H., Hoffmann, L., Nielsen, M., Gyldenkærne, S., Fauser, P., Plejdrup, M.S., Albrektsen, R. & Hjelgaard, K. 498 pp.

714 Vandmiljø og Natur 2007. NOVANA. Tilstand og udvikling – faglig sammenfatning.
Af Nordemann Jensen, P., Boutrup, S., Bijl, L. van der, Svendsen, L.M., Grant, R., Bøgestrand, J., Jørgensen, T.B., Ellermann, T., Dahl, K., Josefson, A.B., Ejrnæs, R., Søgaard, B., Thorling, L. & Dahlgren, K. 118 s.

713 Arter 2007. NOVANA.
Af Søgaard, B. & Asferg T. (red.). 140 s.

712 Terrestriske Naturtyper 2007. NOVANA.
Af Ejrnæs, R., Nygaard, B., Fredshavn, J.R., Nielsen, K.E. & Damgaard, C. 150 s.

711 Vandløb 2007. NOVANA.
Af Bøgestrand, J. (red.). 108 s.

710 Søer 2007. NOVANA.
Af Jørgensen, T.B., Clausen, J., Bjerring Hansen, R., Søndergaard, M., Sortkjær, L. & Jeppesen, E. 68 s.

709 Landovervågningsoplande 2007. NOVANA.
Af Grant, R., Pedersen, L.E., Blicher-Mathiesen, G., Jensen, P.G., Hansen, B. & Thorling, L. 128 s.

708 Atmosfærisk deposition 2007. NOVANA.
Af Ellermann, T., Andersen, H.V., Bossi, R., Christensen, J., Geels, C., Kemp, K., Løfstrøm, P., Mogensen, B.B. & Monies, C. 97 s.

707 Marine områder 2007 – Tilstand og udvikling i miljø- og naturkvaliteten. NOVANA.
Af Dahl, K. & Josefson, A.B. (red.) 113 s.

706 Beregning af naturtilstand for vandhuller og mindre søer. Tilstandsvurdering af Habitatdirektivets søtyper.
Af Fredshavn, J.F., Jørgensen, T.B. & Moeslund. B. 38 s.

705 Hazardous substances and heavy metals in the aquatic environment. State and trend, 1998-2003.
By Boutrup, S. (ed.), Fauser, P., Thomsen, M., Dahllöff, I., Larsen M.M., Strand, J., Sortkjær, O., Ellermann, T., Rasmussen, P., Jørgensen, L.F., Pedersen, M.W. & Munk, L.M. 44 pp.

704 Contaminants in the traditional Greenland diet – Supplementary data.
By Johansen, P., Muir, D., Asmund, G. & Riget, F. 22 pp.

703 Projection of Greenhouse Gas Emissions 2007 to 2025.
By Nielsen, O-K., Winther, M., Mikkelsen, M.H., Gyldenkærne, S., Lyck, E., Plejdrup, M., Hoffmann, L., Thomsen, M., Fauser, P. 211 pp.

702 Rastende vandfugle i Margrethe Kog og på forlandet vest for Tøndermarsken, 1984-2007.
Af Laursen, K., Hounisen, J.P., Rasmussen, L.M., Frikke, J., Pihl, S., Kahlert, J., Bak, M. & Amstrup, O. 78 s.

700 Drivhusgasopgørelse på kommuneniveau. Beskrivelse af beregningsmetoder.
Af Nielsen, O.-K., Winther, M., Gyldenkærne, S., Lyck, E., Thomsen, M., Hoffmann, L. & Fauser, P. 104 s.

699 Omsætning af formalin i danske dambrug.
Af Sortkjær, O., Pedersen, L-F. & Ovesen, N.B. 126 s. (2008)

698 Environmental monitoring at the Nalunaq Gold Mine, South Greenland, 2008.
By Glahder, C.M., Asmund, G. & Riget, F. 30 pp.

2008

697 OML-spredningsberegninger på basis af 10 års meteorologi i relation til Luftvejledningen.
Af Løfstrøm, P. & Olesen, H.R. 35 s.

696 Beregning af skovtilstand – tilstandsvurdering af Habitatdirektivets skovtyper.
Af Fredshavn, J.R., Johannsen, V.K., Ejrnæs, R., Nielsen, K.E. & Rune, F. 48 s.

695 Værdisætning af natur- og kulturgoder. Et metodestudie af betydningen for ændringer i skala og betalingsformat. Af Hasler B., Jacobsen, J.B., Lundhede, T.H., Martinsen, L., Thorsen, B.J. 78 s.

DENMARK'S NATIONAL INVENTORY REPORT 2009

This report is Denmark's National Inventory Report 2009. The report contains information on Denmark's emission inventories for all years' from 1990 to 2007 for CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, NO_x, CO, NMVOC, SO_2.

ISBN: 978-87-7073-106-5
ISSN: 1600-0048