National Environmental Research Institute
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NERI Technical Report No. 667, 2008

Denmark's National Inventory Report 2008

Emission Inventories 1990-2006
– Submitted under the United Nations Framework Convention on Climate Change

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Data sheet

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Abstract: This report is Denmark's National Inventory Report 2008 reported to the Conference of the Parties under the United Nations Framework Convention on Climate Change (UNFCCC) due by 15 April 2008. The report contains information on Denmark's inventories for all years' from 1990 to 2006 for CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, CO, NMVOC, SO_2.

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

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Contents

Executive summary

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

Reporting

This report is Denmark's National Inventory Report (NIR) 2008, for submission to the United Nations Framework Convention on Climate change, due April 15, 2008. The report contains detailed information about Denmark's inventories for all years from 1990 to 2006. 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, 2008, and this report to UNFCCC is reporting of territories. The NIR 2008 to the EU Commission was for Denmark, while this NIR 2008 to UNFCCC is for Denmark, Greenland and the Faroe Islands. The annual emission inventory report for Denmark for the years from 1990 to 2006 is unchanged compared with the NIR 2008 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, 2008. The reporting format is 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 is available to the public on the National Environmental Research Institutes homepage
http://www.dmu.dk/International/Publications/ (search for "National Inventory Report 2008")

This report it self 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/Submission_UNFCCC/envrtkpa

Concerning figures, 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 in Danish.

Institute responsible

The National Environmental Research Institute (NERI), University of Aarhus, is responsible for the annual preparation and submission 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. NERI is also the body designated with overall responsibility for the national inventory under the Kyoto Protocol. The work concerning the annual greenhouse gas emission inventory is carried out in cooperation with Danish ministries, research institutes, organisations and companies.

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, methane 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.

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 2006. The emissions are not corrected for electricity trade or temperature variations. CO_2 is the most important greenhouse gas contributing in 2006 to national total emission in CO_2 equiv. excluding LULUCF (Land Use and Land Use Change and Forestry with 81.7 %, followed by N_2O with 9.2 %, CH_4 7.8 % and F-gases (HFCs, PFCs and SF_6) with 1.3 %. Seen over the time span from 1990 to 2006 these percentages have been increasing for CO_2 and F-gases, almost constant for CH_4 and falling 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 2006 2.6 % of the total emission in CO_2 equivalents in 2006. The National total greenhouse gas emission in CO_2 equivalents excluding LULUCF has increased by 2.1 % from 1990 to 2006 and decreased 1.3 % including LULUCF. Comments on the overall trends etc seen in Figure ES.1 are given in the sections below on the individual greenhouse gases.

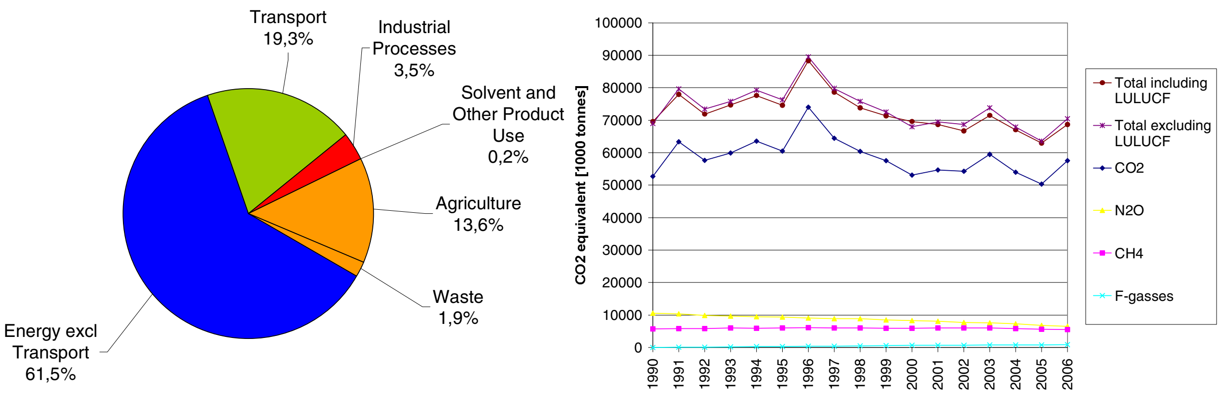


Figure ES.1 Greenhouse gas emissions in CO_2 equivalents distributed on main sectors for 2006 and time-series for 1990 to 2006.

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. Public power and district heating plants contribute in 2006 with 51 % of the national total CO_2 emissions. Approximately 23 % come from the transport sector. The CO_2 emission from the energy sector increased by approximately 15 % from 2005 to 2006. A relatively large fluctuation in the emission time-series from 1990 to 2006 is due to inter-country electricity trade. Thus, high emissions in 1991, 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 CO_2 emission from the transport sector has increased by 27 % since 1990, mainly due to increasing road traffic.

Agriculture

The agricultural sector contributes with 13.6 % 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 2006 the contributions to the total emissions of N_2O and CH_4 were 91 % and 66 %, respectively. The main reason for the fall at approximately 34 % in the emission of N_2O from 1990 to 2006, is legislative demand for an improved utilisation of nitrogen in manure. This result in less nitrogen excreted per livestock unit produced and a considerable reduction in the use of fertilisers. From 1990 to 2006, 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 9 % from 1990 to 2006.

Industrial processes

The emissions from industrial processes – i.e. emissions from processes other than fuel combustion, amount to 3.5 % 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 % of the national total – increased by 58 % from 1990 to 2006. 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, since 1995 until 2006, increased by 172 %, largely due to the increasing emission of HFCs. The use of HFCs, and especially HFC-134a, has increased several fold, so HFCs have become dominant F-gases, contributing 67% to the F-gas total in 1995, rising to 94% in 2006. HFC-134a is mainly used as a refrigerant. However, the use of HFC-134a is now stable. This is due to Danish legislation, which, in 2007, forbids new HFC-based refrigerant stationary systems. Running counter to this trend, however, is the increasing use of air conditioning systems in mobile systems.

Land Use and Land Use Change and Forestry (LULUCF)

The LULUCF sector is generally a net sink. In 2006 it has been estimated to be a net sink equivalent to 2.6% of the total emission. This is slightly higher compared with 2005 due to stormfelling in the forests in 2005 reducing the net sink in forests from normally 3 000-3 500 Gg CO_2/yr to 2757 Gg CO_2/yr. In cropland a net emission has been estimated to 708 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 winter 2005/2006 was very mild and therefore the mineral soil was a large emitter 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 2006 with 1.9 % of the national total. The trend of emission from 1990 to 2006 is decreasing by 14.3 %. The sector is dominated by CH_4 emission from solid waste disposal contributing 77.5 % to the sector total in 2006 This emission has decreased by 23.0 % from 1990 to 2006, at which point the contribution from waste was 18.6 % of the total CH_4 emission. 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 1A1a IPCC category. The CH_4 and N_2O emissions from wastewater handling contribute to the sectoral total with 18.7 and 3.8% respectively. For the wastewater handling emissions the CH_4 has an increasing trend while N_2O decreases.

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 27 % decrease in total VOC emissions from 1995 to 2006. This year's inventory comprises N_2O for the first time. N_2O comprises in 2006 26 % of the total CO_2-equivalent emissions for solvent use.

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 fulfill 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 performed.

ES.4.2. Completeness

The Danish greenhouse gas emission inventories include all sources identified by the revised IPPC guidelines except the following:

Agriculture: The methane 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 1990-2005.

For natural gas fired gas engines emission factors for CH_4, NMVOC, CO and NO_x were updated in connection with a research project including a higher emission factor during start-up/shut-down in the total emission factor.

Data from the ETS has been utilised for the first time in the inventory for 2006. It was mainly coal and residual oil fuelled power plants where detailed information was available.

Based on the in-country review in April 2007 several improvements have been made to the NIR:

- The greenhouse gas trend discussion has been modified so that it handles each CRF subsector separately, in addition the references to the SNAP nomenclature has been toned down in favour of the CRF nomenclature.
- A short description of the Danish energy statistics and the transfer to SNAP codes has been included as appendix to annex 3A.
- As recommended by the ERT Denmark has included data from the EU-ETS (EU Emission Trading Scheme) in the emission inventory.
- An improved documentation for the use of town gas has been included in the NIR.

Mobile sources

The biggest changes for CO_2 are noted for national sea transport and fisheries. Based on new research findings, the fuel consumption of heavy oil and gas oil for national sea transport is now calculated directly by NERI. Fuel adjustments are made in the fishery sector (gas oil) and stationary industry sources (heavy fuel oil) in order to maintain the Grand National energy balance. The fuel consumption changes for national sea transport cause the CO_2, CH_4 and N_2O emissions to change from 1990 to 2005, and the emission changes are followed by the opposite emission changes in fisheries of approximately the same absolute values.

Minor changes are:

1. For road transport, an error occurring for the years 1990-2005 in the distribution of the total mileage between passenger cars and vans has been corrected, and this change in input data has given small emission changes. Also changes have been made to the gasoline fuel consumption input data for the NERI model, throughout the 1990-2005 time series, due to a reduced gasoline consumption calculated for non road working machinery in the same years.
2. For road transport, the emission factors of CH_4 and N_2O have been updated due to new emission data provided by the COPERT IV model developers.

The changes described in 1) and 2) cause the CO_2, CH_4 and N_2O emissions from road transport to change for the years from 1990 to 2005.

3. For military, the emission factors derived from the new road transport simulations have caused minor emission changes of CH_4 and N_2O for the years from 1990 to 2005.
4. For residential, the CO_2, CH_4 and N_2O emissions decrease somewhat for the years 1990 to 2005 due to a smaller amount of fuel used by gasoline fuelled working machinery.
5. For agriculture, updated stock information for ATV's (All Terrain Vehicles) from 2002 to 2005, has given a small fuel use and CO_2, CH_4 and N_2O emissions increase for these years.

Industry

No major methodological changes have been introduced in the 2006 GHG inventory. However, the calculations have been changed for calcination of lime to handle lime and hydrated lime separately. For cement industry and sugar refining EU-ETS data has been implemented for 2006.

Solvents

The mean volume of spraying cans is reduced according to information from e.g. trade associations, which reduces the propane and butane emissions in households for the years 1990-2005. Propylalcohol used as windscreen washing agent is reallocated from autopaint and repair to household use and the emission factor is changed, this affects the years 1990-2005. N_2O emission is introduced in the solvents emission inventory from 2005.

Agriculture

Small changes in the emission estimates for the agricultural sector 1994-2005 have taken place and influence the total emission from agriculture by less than 1 %. Based on updated data for 2005 from Statistics Denmark a change in livestock production and cultivated area has been made. Another change is due to updated data concerning the N-fixing crops and amount of biogas treated slurry (2002-2005). There is no change in the calculation methodology.

Waste

The methodology for CH_4-emissions from solid waste disposal sites is unchanged; a very small change from this category occurs due to update of data for biogas recovery for 2005. For waste water handling and the years 2003-2005 an error in the model formulation has been corrected resulting in a minor increase in CH_4 emissions.

Land Use and Land Use Change and Forestry (LULUCF)

Forestry, cropland, grassland and wetlands

A small error for forestry in 2005 as well as a rounding error for lime consumption in 1990 has been corrected. Recalculations have been made for mineral soils in 2003, 2004 and 2005 due to errors in the export of data from the the spreadsheets to the CRF-Reporter. Furthermore a recalculation is made due to the chosen methodology where a five-year average is used. The recalculation has the largest impact on the emission estimate for 2004, which has turned from a net sink of 836 Gg CO_2 to a large emitter of 1422 Gg CO_2.

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 -0.61 % (2005) and +0.26 % (1994). Therefore, the implications of the recalculations on the level and on the trend, 1990-2005, of this national total emission 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 small, although the impact is larger than without LULUCF. The differences vary between –0.44 % (2001) and +2.90 % (2004). These differences refer to recalculated estimates, with major changes in the LULUCF for those years.

Sammenfatning

S.1. Baggrund for opgørelse af drivhusgasemissioner og klimaændringer

Rapporteringen

Denne rapport er Danmarks årlige rapport – den såkaldte Nationale Inventory Report (NIR) som beskriver drivhusgasopgørelsen og som blev fremsendt til FN's konvention om klimaændringer (UNFCCC) den 15. april 2008. Rapporten indeholder detaljerede informationer om Danmarks drivhusgasudslip for alle år fra 1990 til 2006. Rapportens struktur er i overensstemmelse med UNFCCC's retningslinjer for rapportering og review. Forskellen mellem Danmarks NIR 2008 som blev fremsendt til EU-Kommissionen til den 15. marts 2008, og denne rapport til UNFCCC vedrører det territorium rapporteringen omfatter. NIR 2008 til EU-Kommissionen var for Danmark, mens NIR 2008 til UNFCCC er for Danmark, Grønland og Færøerne. Opgørelserne for Danmark er uændrede siden 15. marts, 2008-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 2006, 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 er offentlig tilgængelig på DMUs hjemmeside

http://www.dmu.dk/Udgivelser/
(søg efter "National Inventory Report 2008")

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 1990-2006 (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/Submission_UNFCCC/envrtkpa

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.

Ansvarligt institut

Danmarks Miljøundersøgelser (DMU) under Aarhus Universitet, er ansvarlig for udarbejdelse af de danske drivhusgasemissioner og den årlige rapportering til EU og Klimakonventionen og er kontaktpunktet for Danmarks nationale system til drivhusgasopgørelser under Kyotoprotokollen. 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.

Drivhusgasser

Til Klimakonventionen rapporteres følgende drivhusgasser:

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

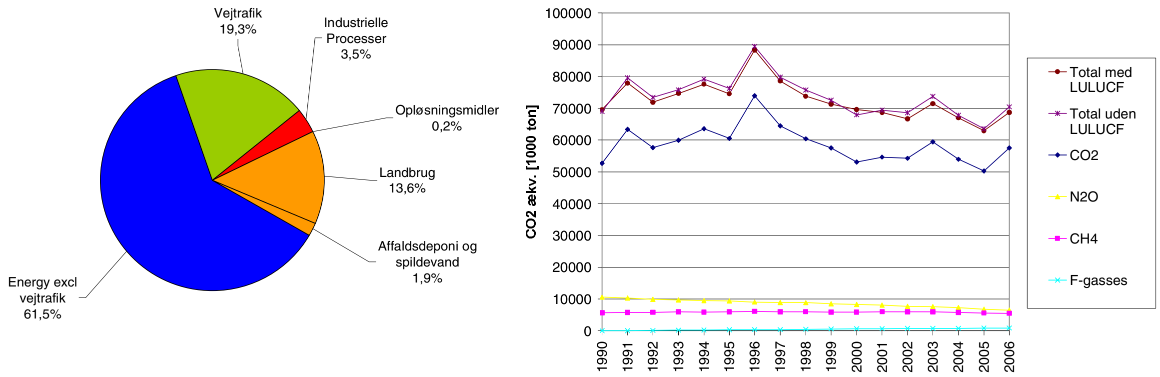
Det globale opvarmningspotentiale, på engelsk Global Warming Potential (GWP), udtrykker klimapåvirkningen over en nærmere angivet tid af en vægtenhed af en given drivhusgas relativt til samme vægtenhed af CO_2. Drivhusgasser har forskellige karakteristiske levetider i atmosfæren, således for metan ca. 12 år og for lattergas 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 kuldioxid, dvs. til den mængde kuldioxid 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.

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 syv 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 2006. 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 2006 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 2006 udgjorde et optag for drivhusgasser.



Figur S.1 Danske drivhusgasemissioner. Bidrag til total emission fra hovedsektorer for 2006 og tidsserier i CO_2-ækvivalenter for 1990-2006.

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 2006 med 81,7 % af det nationale totale udslip, efterfulgt af N_2O med 9,2 % og CH_4 med 7,8 %, mens HFC'er, PFC'er og SF_6 kun udgør 1,3 % af de totale emissioner. Set over perioden 1990-2006 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 2006 2,6 % af den nationale totale emission. Med hensyn til sektorene (figur S.1) så bidrager energi ekskl. vejtransport (hovedsageligt stationære forbrændingsanlæg), vejtransport og landbrug mest med i 2006 henholdsvis 61,5, 19,3 og 13,6 %. De nationale totale drivhusgasemissioner i CO_2-ækvivalenter er steget med 2,1 % fra 1990 til 2006, hvis nettobidraget fra skovenes og jordenes udledninger og optag af CO_2 ikke indregnes, og faldet med 1,3 % hvis de indregnes.

S.3. Oversigt over drivhusgasemissioner og optag fra sektorer

1. Energi

Sektoren bidrager i 2006 med 80,7 % af den danske totale emission. Udledningen af CO_2 stammer altovervejende fra forbrænding af kul, olie og naturgas på kraftværker samt i beboelsesejendomme og industri. Kraft- og fjernvarmeværker bidrager med 51 % af de totale CO_2 emissioner, omkring 23 % stammer fra transportsektoren. CO_2-emissionen fra energisektorerne steg med omkring 15 % fra 2005 til 2006. 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 metan fra energiproduktion har været stigende på grund af øget anvendelse af gasmotorer, som har et stort metan-udslip i forhold til andre forbrændingsteknologier. Transportsektorens CO_2-emissioner er steget med ca. 27 % siden 1990 hovedsagelig på grund af voksende vejtrafik.

2. Industrielle processer

Emissionen fra industrielle processer – hvilket vil sige andre processer end forbrændingsprocesser – udgør i 2006 3,5 % 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. 1,9 % af den totale emission i 2006 og stigningen fra 1990 til 2006 er 58 %. Den anden største kilde har tidligere været lattergas fra produktion af salpetersyre. Produktionen af salpetersyre stoppede i midten af 2004, hvilket betyder at lattergasemissionen er nul for denne kilde fra 2005.

Emissionen af HFC'er, PFC'er og SF_6 er i perioden fra 1995 og til 2006 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 94 % i 2006. 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 2006 med 0,2 % af totalmængden af emitterede drivhusgasser i CO_2-ækvivalenter. Der er en reduktion på 27 % i total VOC emissionerne i perioden 1995 til 2006. Dette års opgørelse inkluderer N_2O-forbruget for første gang. Bidraget herfra til de totale CO_2-ækvivalent emissioner for solventer er 26 %.

4. Landbrug

Landbrugssektoren bidrager i 2006 med 13,6 % til den totale drivhusgasemission i CO_2-ækvivalenter og er den vigtigste sektor hvad angår emissioner af N_2O og CH_4. I 2006 var landbrugets bidrag til de totale emissioner af N_2O og CH_4 henholdsvis 91 % og 66 %. Fra 1990 til 2006 ses et fald på 34 % i N_2O-emissionen fra landbrug. Dette skyldes mindre brug af handelsgødning og bedre udnyttelse af husdyrgødningen, hvilket resulterer i mindre emissioner pr. produceret dyreenhed. Emissioner af CH_4 fra husdyrenes fordøjelsessystem er faldet fra 1990 til 2006 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 9 % fra 1990 til 2006.

5. Arealanvendelse skove og jorder (LULUCF)

Arealanvendelse omfatter emissioner og optag/bindinger fra skov- og landbrugsarealet. Denne sektor binder generelt CO_2. I 2006 er sektoren estimeret til at binde ca. 2,6 % af det samlede udslip af drivhusgasser. Dette er større end i 2005, hvor stormfaldet i de danske skove reducerede bindingen fra normalt 3000-3500 Gg CO_2/år til 2575 Gg CO_2/år. For landbrugsarealet er der estimeret en samlet emission på 708 Gg CO_2/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. Vinteren 2005/2006 var en meget varm hvilket medførte en stor nedbrydning af organisk materiale i vinterperioden. Som følge heraf er jordene i 2006 en meget stor CO_2-kilde. 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 2006 1,9 % af den danske total-emission. Lossepladser er den tredjestørste kilde til CH_4-emissioner og dominerer sektor-bidraget med 77,5 %. Emissionen er faldet med 23,0 % fra 1990 til 2006. 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 1A1a, der omfatter kraft- og fjernvarmeværker. Emissioner af CH_4 og N_2O fra spildevandsanlæg udgør i 2006 henholdsvis 18,7 og 3,8 % af sektorens bidrag. CH_4 fra spildevandsanlæg er stigende fra 1990 til 2006 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, er der for alle emissionskilder udarbejdet 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 1990-2005. Denne opdatering er grundlaget for de fleste ændringer indenfor stationær forbrænding.

For naturgasfyrede gasmotorer er emissionsfaktorerne for CH_4, NMVOC, CO og NO_x opdateret i forbindelse med et forskningsprogram, der har indregnet emissioner fra start/stop af gasmotorer i den samlede emissionsfaktor.

Data fra CO_2-kvote-indberetninger er for første gang inkluderet i emissionsopgørelsen for 2006. Det er hovedsageligt fra centrale kraftværker, der benytter kul og fuelolie, hvor detaljerede oplysninger er til rådighed.

Baseret på den gennemgang (et såkaldt in-country review) af drivhusgasopgørelserne, som blev foretaget i april 2007 af et hold af eksperter fra FN, er der foretaget en række forbedringer vedrørende data samt form og indhold i rapporteringen:

- Diskussionen af udviklingen i drivhusgasemissionen er gjort mere detaljeret, og gennemgangen er nu på CRF-niveau.
- En beskrivelse af energistatistikken og en beskrivelse af dens aggregering til SNAP-niveau er nu medtaget.
- Data fra CO_2-kvote-indberetninger er inkluderet.
- Bedre dokumentation for bygas er inkluderet.

Mobile kilder

De største ændringer i CO_2-emissionen ses for national søtransport og fiskeri. Afledt af nye forskningsresultater beregner DMU nu direkte forbruget af tung olie og diesel for national søtransport. Med det formål at bevare den nationale energibalance sker der en vekselvirkning med forbruget af diesel indenfor fiskeri og forbruget af tung olie indenfor industriens stationære kilder. Ændringerne i energiforbrug for national søtransport medfører emissionsændringer for CO_2, CH_4 og N_2O fra 1990 til

2005, og omtrent de samme ændringer med omvendt fortegn for fiskeri i samme periode.

Der sker mindre ændringer indenfor områderne:

1. Vejtrafik. En fejl er blevet rettet hvad angår fordelingen af det samlede trafikarbejde mellem personbiler og varebiler, og disse ændringer i input data har medført mindre emissionsændringer. Der er også sket ændringer i input data for forbruget af benzin i perioden 1990-2005, pga. et mindre beregnet benzinforbrug for arbejdsredskaber og maskiner i samme tidsperiode.
2. For vejtrafik er CH_4 og N_2O emissionsfaktorerne opdateret med nye emissionsdata fra COPERT IV-modellen.

De beskrevne ændringer i 1) og 2) medfører emissionsændringer for vejtrafikkens CO_2, CH_4 og N_2O fra 1990 til 2005.

3. For militær sker der små emissionsændringer for CH_4 og N_2O fra 1990-2005, pga. af nye afledte emissionsfaktorer fra vejtrafik.
4. For have- og hushold falder CO_2, CH_4 og N_2O-emissionen noget fra 1990-2005 pga. et mindre beregnet forbrug af benzin i denne periode.
5. For landbrug medfører opdaterede bestandsdata for ATV'er (All Terrain Vehicles) fra 2002-2005, at energiforbrug og CO_2, CH_4 og N_2O-emissioner stiger en smule i disse år.

Industri

Der er ikke introduceret større metodiske ændringer i opgørelsen for 2006. Dog er beregningerne vedrørende fremstilling af brændt kalk ændret til at basere sig på brændt kalk og hydratkalk hver for sig. EU-ETS (EU Emission Trading Scheme) informationer er implementeret for cementproduktion og raffinering af sukker for 2006.

Opløsningsmidler

Middelvolumen for spraydåser er reduceret, hvilket reducerer propan- og butan-emissionerne for husholdninger. Emissionsfaktoren for anvendelse af propylalkohol i sprinklervæske er ændret. N_2O-emissioner er medregnet for første gang.

Landbrug

Mindre ændringer af emissionen fra landbrugssektoren har resulteret i en mindre justering af emissionen for årene fra 1994 til 2005, men ændringerne betyder en justering på totalemissionen på mindre end 1 % per år. Der er ikke foretaget ændringer i beregningsmetoden. De vigtigste ændringer omfatter en opdatering af husdyrproduktionen og arealanvendelsen fra Danmarks Statistik for 2005, en opdatering af mængden af biogasbehandlet gylle for årene 2002 – 2005 og en lille ændring i andelen af kløver i kløvergræs-marker i forbindelse med beregning af emissionen fra N-fikserende planter. På baggrund af review-temaets (in-country review) anbefalinger og forslag fra april 2007, er der i NIR foretaget nogle supplerende beskrivelser, for at øge forståelsen i de tilfælde hvor Danmark anvender nationale data. Dette gælder f.eks. nøgledata for underkategorier for svin og kvæg, for på denne måde bedre at kunne sammenholde emissionsfaktorerne med de i IPCC retningsgivne standard værdier.

Affald

Der er ingen metodeændringer for beregning af CH4 for lossepladser. En mindre ændring til kategorien skyldes opdatering af biogas optag for 2005. For spildevand er for 2003-2005 rettet en fejl i modelformuleringen. Resultat af rettelsen er en mindre stigning i CH4 emissionen.

Arealanvendelse (LULUCF)

Afgrøder, græsområder og vådområder

En fejlberegning for skov i 2005 er blevet rettet, lige såvel som en afrundingsfejl for kalkforbruget i 1990. Da der for mineraljorder anvendes en glidende femårs gennemsnit i emissionsopgørelsen, er der som normalt genberegnet emissionerne fra disse jorde for 2004 og 2005.

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 2005 ligger mellem -0,02 % og +0,18 %.

Ændringer i de danske totale drivhusgasemissioner (i CO_2-ækvivalenter) er større, når emissioner og optag fra jorde og skov medtages. Det skyldes rekalkulationer i LULUCF-sektoren for 2003 og 2004. Ændringerne i forhold til sidste rapportering er dog stadig forholdsvis små og ligger for hele tidsserien 1990 til 2005 mellem –1,01 % og +0,14 %.

1 Introduction

1.1 Background information on greenhouse gas inventories and climate change

Annual report

This report is Denmark's National Inventory Report (NIR) 2008, for submission to the United Nations Framework Convention on Climate change, due April 15, 2008. The report contains detailed information on Denmark's inventories for all years from 1990 to 2006. 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 2006, 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 2006, 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 2006. 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 Reserch Institutes homepage
http://www.dmu.dk/International/Publications/ (search for "National Inventory Report 2008")

This report it self 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.and. 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/envrtkpa

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, Firth 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 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 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 the EU Greenhouse Gas Monitoring Mechanism, to guarantee that the EU meets its reporting commitments.

1.2 A description of the institutional arrangement for inventory preparation

NERI, Aarhus University, is responsible for the annual preparation and submission to the UNFCCC and the EU of the National Inventory Report and the GHG inventories in the Common Reporting Format in accordance with the UNFCCC Guidelines. NERI have been and are 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 on greenhouse gases, 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:

Sector	Sub-sector	Expert name
Energy	Stationary combustion:	Ole-Kenneth Nielsen
	Transport and other mobile sources	Morten Winther
	Fugitive emissions:	Marlene Plejdrup
Industrial processes		Leif Hoffmann
Solvent and other product use		Patrik Fauser
Agriculture		Mette Hjorth Mikkelsen & 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, Collec-tEr2CRFand 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

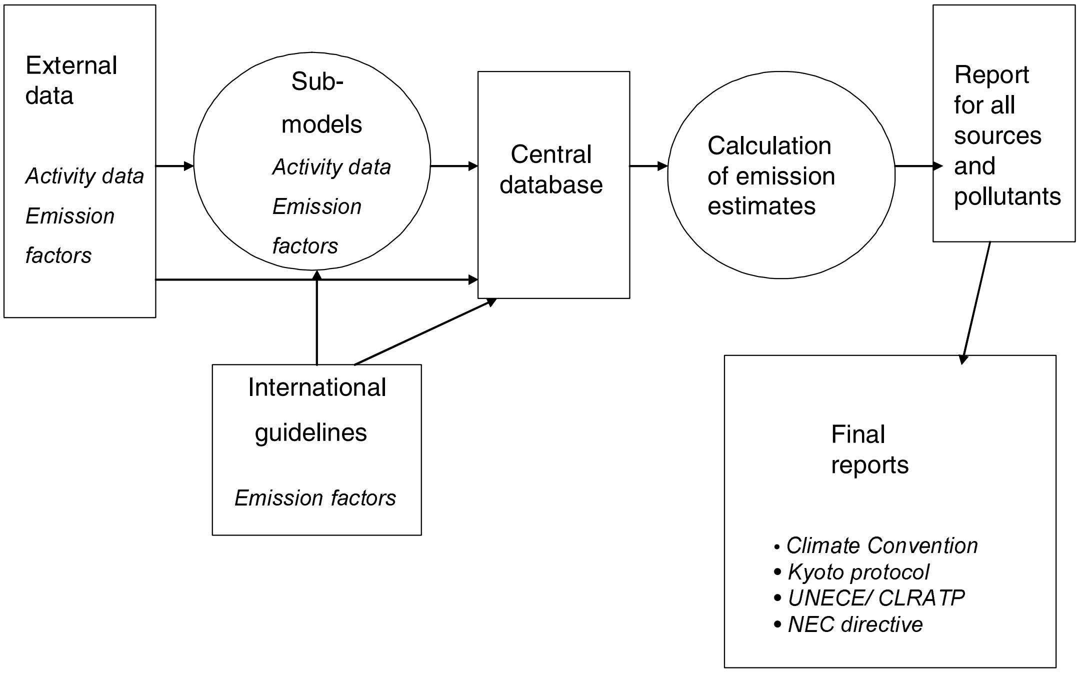


Figure 1.1 Schematic diagram of the process of inventory preparation.

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 per 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 2006, the CO_2 emission inventory based on the reference approach and the national approach, respectively, differ by -0.3 %.

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, Gastra (former DONG) and on a Danish inventory for the years 1999-2006, 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 2001-2006 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).

For transport, the CO_2 emissions are determined with the lowest uncertainty, while the levels of the CH_4 and N_2O estimates are significantly more uncertain. The overall uncertainties in 2005 for CO_2, CH_4 and N_2O are around 4, 34 and 136%, while the 1990-2006 emission trend uncertainties for the same three components are 4, 6 and 62%, respectively.

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 National 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 weighting 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 is zero 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, 2008) is available in English as documentation of inventory data up to the year 2006. The methodology is implemented for the whole time-series 1990-2006, but full information on activities only exists since 1995 (1993).

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 per year (from 1995 to 2005) 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 1 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 (2005). 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., 2005). 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 (DIEMA – Danish Integrated Emission Model for Agriculture) is used to estimate emission from both greenhouse gases and ammonia. A more detailed description is published in Mikkelsen et al. (2005). The emission from the agricultural sector is mainly related to livestock production. DIEMA works on a detailed level and includes around 30 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. The data for the amount of wood annually harvested are 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 2008 submission.

For cropland converted to forest land (afforestation), the reported change in C stock also concerned living biomass only. 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. There is as yet no harvesting conducted in the young afforested stands. No changes in methodology or recalculations were done for the 2008 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 The specific methodologies regarding 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 2006 (Danish Environmental Protection Agency, 2008). 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 per 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 2006 has been carried out in accordance with the IPCC Good Practice Guidance. The present KCA differs from the approach for the previous KCA as presented in NIRs from 2002 to 2007. In this KCA the LULUCF sector has been included. Further, some categorisations in the industry sector have changed. 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 91 categories, of which 22 are identified as key categories due to both level and trend. The energy sector and CO_2 emissions from stationary combustion contributes to those 22 key sources with 11 key sources, of which CO_2 from coal contributes most with 28.9 % of the national total. The category, CO_2 emissions from mobile combustion and road transportation, is also a key source and the second highest contributor, with 16.9 %. CO_2 from natural gas is the third largest contributor with 14.6 %. In the agricultural sector, there are 5 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 3.8, 3.5 and 3.5 %, respectively, to the national total in 2006. The fourth agricultural key category is CH_4 from manure management contributing 1.4 %. N_2O from manure management contributes 0.7 %. Finally, the industrial sector contributes with 2 level and trend key sources: CO_2 from cement production (contributes 2.3 %) and HFC and PFC emissions from refrigeration and air conditioning (0.9 %). The waste sector includes one level and trend key category, which is CH_4 from solid waste disposal on land, contributing 1.6 % 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.

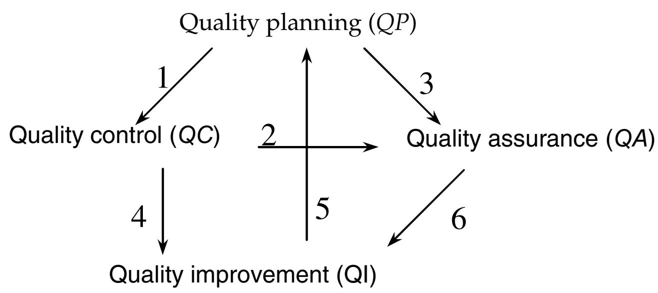


Figure 1.2 Interrelation between the activities with regard to quality. The arrows are explained in the text below this figure.

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 the sense that they are systematically neither over nor under true emissions or removals, as far as can be judged, and that uncertainties are reduced as far as practicable. 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.

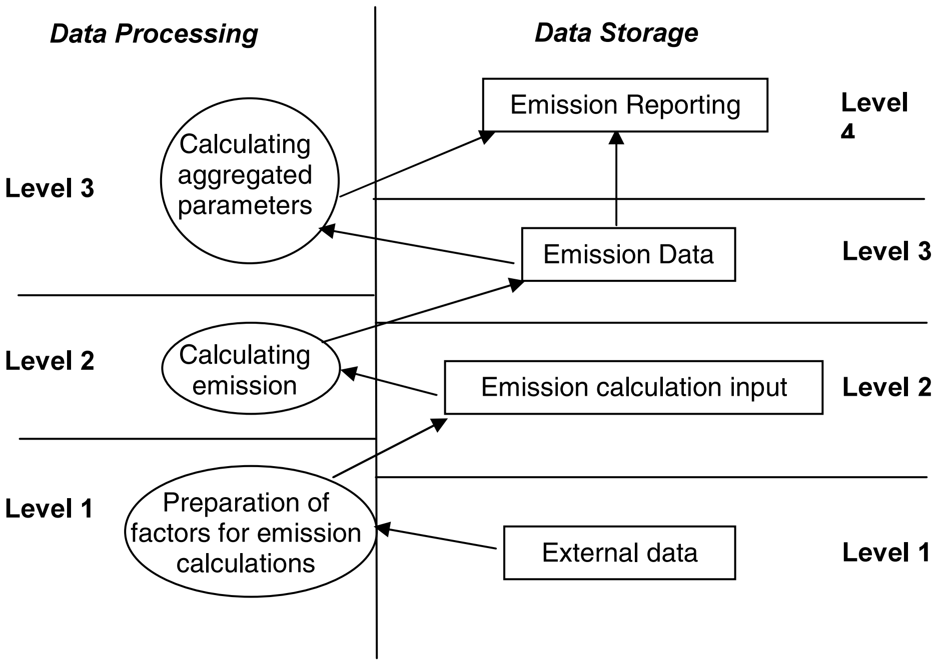


Figure 1.3 The general data structure for the emission inventory.

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 per year 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 sources in particular. Therefore, the identification of key sources is crucial for planning quality work. However, there exist several issues regarding the listing of priority sources: (1) The contribution to the total emission figure (key source listing); (2) The contribution to the total uncertainty; (3) Most critical sources 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 sources. Verification in relation to other countries has been undertaken for priority sources.

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 the energy sector, two persons have detailed insight in data gathering, while this is only partly achieved for the other sectors. The plan is to fulfil this PM in 2008.

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 except agriculture and land use change and forestry. 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 emission.

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 ±5.7% and the trend in GHG emission since 1990 has been estimated to be -1.7% ± 2.6%-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 5.7% and the trend uncertainty is 8.9% ±1.7%-age points.

Table 1.3 Uncertainties 1990-2006.

[1)]	Uncertainty [%]	Trend [%]	Uncertainty in trend [%-age points]
GHG	5.7	-1.7	2.6
CO_2	2.9	4.8	±2.5
CH_4	24	-3.2	±10.1
N_2O	50	-39	±15
F-gases	48	+172	±65

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

The uncertainty estimates include stationary combustion plants, mobile combustion, fugitive emissions from fuels, industry, solid waste and wastewater treatment CO_2 from solvents, agriculture and LULUCF.

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	24 077	21 465	1	5
Stationary Combustion, BKB	CO_2	11	0	3	5
Stationary Combustion, Coke	CO_2	138	109	3	5
Stationary Combustion, Petroleum coke	CO_2	410	847	3	5
Stationary Combustion, Plastic waste	CO_2	349	702	5	5
Stationary Combustion, Residual oil	CO_2	2 505	2 014	2	2
Stationary Combustion, Gas oil	CO_2	4 547	1 983	4	5
Stationary Combustion, Kerosene	CO_2	366	16	4	5
Stationary Combustion, Natural gas	CO_2	4 320	10 846	3	1
Stationary Combustion, LPG	CO_2	169	112	4	5
Stationary Combustion, Refinery gas	CO_2	806	932	3	5
Stationary combustion plants, gas engines	CH_4	7	277	2.2	40
Stationary combustion plants, other	CH_4	115	184	2.2	100
Stationary combustion plants	N_2O	240	291	2.2	1 000
Transport, Road transport	CO_2	9 275	12 594	2	5
Transport, Military	CO_2	119	126	2	5
Transport, Railways	CO_2	297	227	2	5
Transport, Navigation (small boats)	CO_2	48	102	21	5
Transport, Navigation (large vessels)	CO_2	666	353	11	5
Transport, Fisheries	CO_2	591	473	2	5
Transport, Agriculture	CO_2	1 272	1 109	13	5
Transport, Forestry	CO_2	36	17	16	5
Transport, Industry (mobile)	CO_2	842	1 021	18	5
Transport, Residential	CO_2	113	233	18	5
Transport, Civil aviation	CO_2	243	141	10	5
Transport, Road transport	CH_4	55	27	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	125	2	50
Transport, Military	N_2O	1	1	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	9	2	1000
Transport, Agriculture	N_2O	15	14	13	1000
Transport, Forestry	N_2O	0	0	16	1000
Transport, Industry (mobile)	N_2O	11	13	18	1000
Transport, Residential	N_2O	1	1	18	1000
Transport, Civil aviation	N_2O	3	3	10	1000
Energy, fugitive emissions, oil and natural gas	CO_2	263	415	15	5
Energy, fugitive emissions, oil and natural gas	CH_4	40	98	15	50
Energy, fugitive emissions, oil and natural gas	N_2O	1	2	15	50
6 A. Solid Waste Disposal on Land	CH_4	1 335	1 028	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	248	20	35
6 B. Wastewater Handling	N_2O	88	50	10	30
2A1 Cement production	CO_2	882	1 395	1	2
2A2 Lime production	CO_2	116	69	5	5
2A3 Limestone and dolomite use	CO_2	18	74	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	69	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	1 043	0	2	25
2F Consumption of HFC	HFC	218	835	10	50
2F Consumption of PFC	PFC	1	16	10	50
2F Consumption of SF6	SF_6	107	36	10	50
4A Enteric Fermentation	CH_4	3 259	2 602	10	8
4B Manure Management	CH_4	751	1 042	10	100
4B Manure Management	N_2O	684	519	10	100
4D Agricultural Soils	N_2O	8 349	5 442	7.4	22.9
5A Forests	CO_2	-2 831	-2 758	20	20
5B Cropland	CO_2	2 722	709	7	32
5CGrassland	CO_2	93	81	10	50
5D Wetlands	CO_2	2	-13	10	50
Liming	CO_2	566	179	5	50
5D Wetlands	CH_4	-1	0	10	100
5D Wetlands	N_2O	0	0	10	100
3 Solvents	CO_2	148	102	50	325

1.8 General assessment of the completeness

The present Danish greenhouse gas emission inventory includes all sources identified by the Revised IPPC Guidelines except the following:

Agriculture: The methane conversion factor in relation to the enteric fermentation for poultry and fur farming is not estimated. There is no default value recommended by IPCC (Table A-4 in GPG). However, this emission is seen as non-significant compared with the total emission from enteric fermentation.

LULUCF: Carbon stock changes for "Settlement" and "Other land" is not estimated.

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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 2006. The emissions are not corrected for electricity trade or temperature variations. CO_2 is the most important greenhouse gas contributing in 2006 to National total in CO_2 equiv. excluding LULUCF (Land Use and Land Use Change and Forestry with 81.7 %, followed by N_2O with 9.2 %, CH_4 7.8 % and F-gases (HFCs, PFCs and SF_6) with 1.3 %. Seen over the time series from 1990 to 2006 these percentages have been increasing for CO_2 and F-gases, almost constant for 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 20062.6 % of the total emission in CO_2 equivalents. The National total greenhouse gas emission in CO_2 equivalents excluding LULUCF has increased by 2.1 % from 1990 to 2006 and decreased 1.3 % including LULUCF. Comments on the overall trends etc seen in Figure 2.1 are given in the sections below on the individual greenhouse gases.

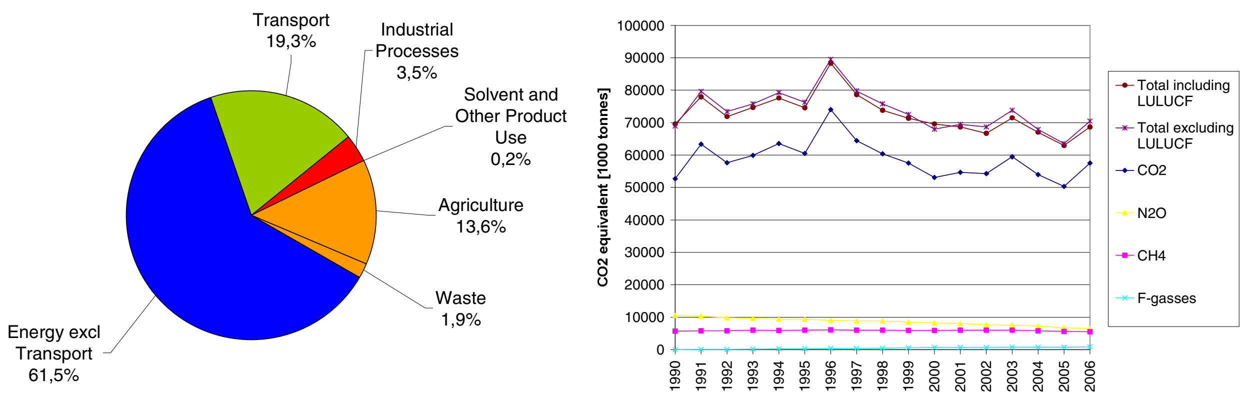


Figure 2.1 Greenhouse gas emissions in CO_2 equivalents distributed on main sectors for 2006 and time-series for 1990 to 2006.

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 51 % of the emissions. About 23 % come from the transport sector. The CO_2 emission increased by approximately 14 % from 2005 to 2006. The main reason for this increase was export of electricity. In 2006, the actual CO_2 emission was about 9 % higher than the emission in 1990.

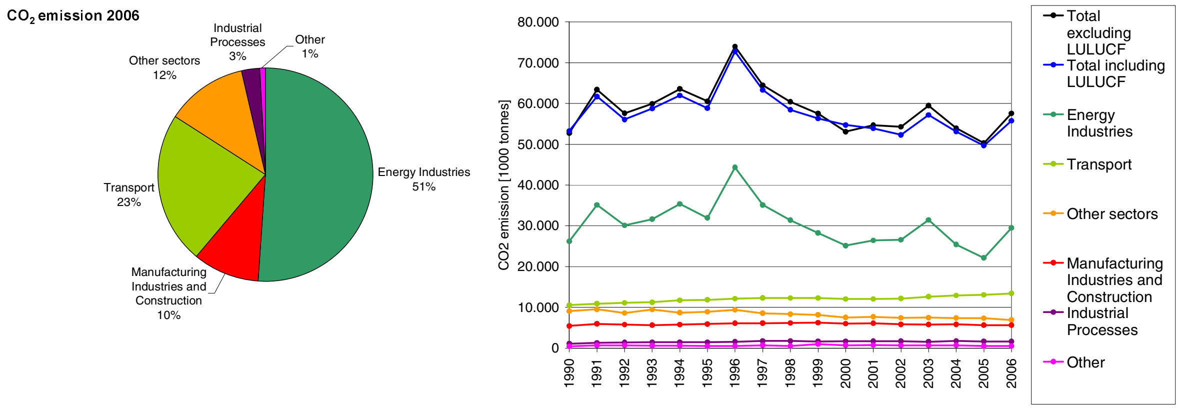


Figure 2.2 CO_2 emissions. Distribution according to the main sectors (2006) and time-series for 1990 to 2006.

Nitrous oxide

Agriculture is the most important N_2O emission source in 2006 contributing 91.5 % (Figure 2.3) of which N_2O from soil dominates (83.5 %). 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 fertilisers. The main reason for the drop in the emissions of N_2O in the agricultural sector of 34 % from 1990 to 2006 is legislation to improve the utilisation of nitrogen in manure. The legislation has resulted in less nitrogen excreted per unit of livestock produced and a considerable reduction in the use of 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 7.2 %. The N_2O emission from transport contributes by 2.1 % in 2006. 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 zero in 2005 and 2006. The sector other covers N_2O from product use, e.g. anesthesia.

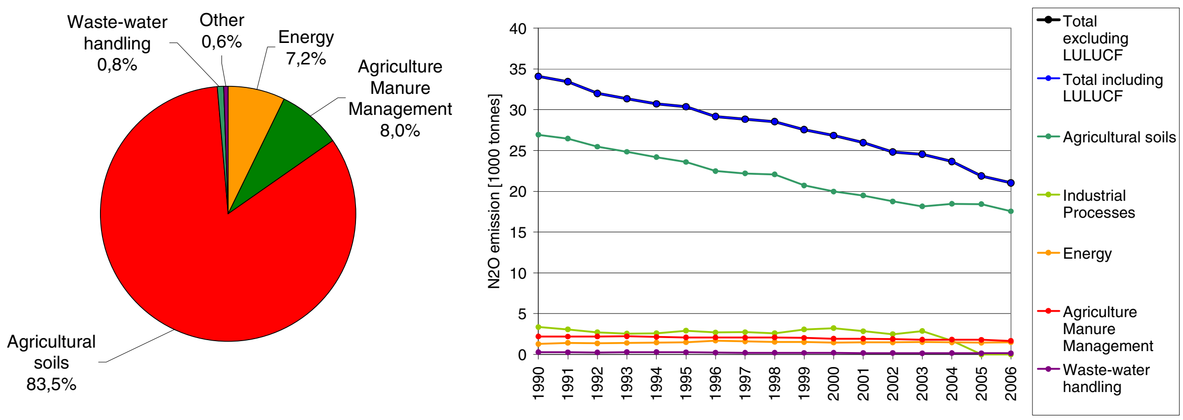


Figure 2.3 N_2O emissions. Distribution according to the main sectors (2006) and time-series for 1990 to 2006.

Methane

The largest sources of anthropogenic CH_4 emissions are agricultural activities contributing in 2006 with 66.1 %, waste (23.1 %), public power and district heating plants (4.3 %), see figure 2.4. The emission from agriculture derives from enteric fermentation (47.2 %) and management of animal manure (18.9 %). The CH_4 emission from public power and district heating plants increases 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. Over the time series from 1990 to 2006, the emission of CH_4 from enteric fermentation has decreased 20.1 % due to the decrease in the number of cattle. However, the emission from manure management has in the same period increased 38.8 % 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 9.1 % from 1990 to 2006. The emission of CH_4 from waste disposal has decreased slightly due to an increase in the incineration of waste.

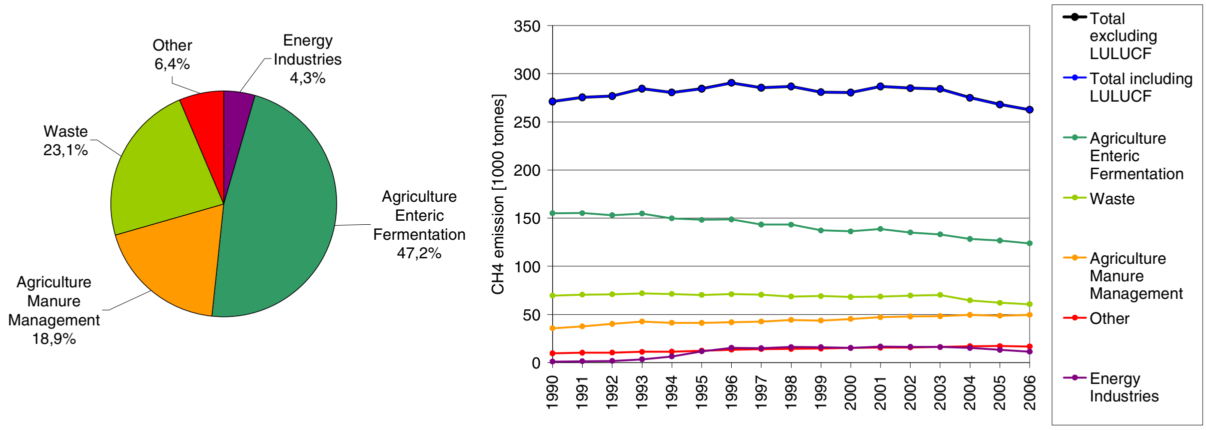


Figure 2.4 CH_4 emissions. Distribution according to the main sectors (2006) and time-series for 1990 to 2006.

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 2000-2006, the increase is lower than for the years 1995 to 2000. The increase from 1995 to 2006 is 172.3 %. 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 2006 was only 4.1 %. The use of HFCs has increased several fold. HFCs have, therefore, become dominant F-gases, comprising 66.7 % in 1995, but 94.2 % in 2006. 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 and the use of air conditioning in mobile systems increases.

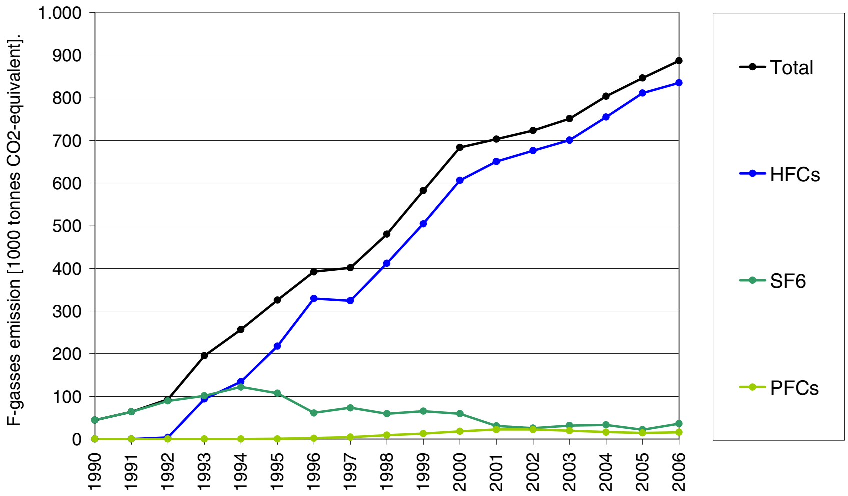


Figure 2.5 F-gas emissions. Time-series for 1990 to 2006.

2.3 Description and interpretation of emission trends by source

Energy

The emission of CO_2 from Energy Industries has increased by approximately 13 % from 1990 to 2006. 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 CO_2 emission from the transport sector increased by 27 % from 1990 to 2006, mainly due to increasing road traffic.

Agriculture

The agricultural sector contributes in 2006 with 13.6 % 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 2006, the contribution of N_2O and CH_4 to the total emission of these gases was 91.8 % and 66.4 %, respectively. The N_2O emission decreased by 34.0 % and the CH_4 emission by 9.1 % from 1990 to 2006.

Industrial processes

The emissions from industrial process, i.e. emissions from processes other than fuel combustion, amount in 2006 to 3.6 % 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 2006 with 1,9 % of the National total – increased by 58 % from 1990 to 2006. 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 is also ceased.

Waste

The waste sector contributes in 2006 with 1.9 % to the National total of greenhouse gas emissions, 23.1 % of the total CH_4 emission and 0.8 % of the total N_2O emission. The emission from the sector has decreased by 14.3 % from 1990 to 2006. This decrease is a result of (1) a decrease in the

CH_4 emission from solid waste disposal sites (SWDS) by 23% 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 43 % due to upgrading of WW treatment plants. These decreases are counteracted by an increase in CH_4 from WW of 197 % due to increasing industrial load to WW systems. In 2006 the contribution of CH_4 from SWDS was 18.6 % of the total CH_4 emission. The CH_4 emission from WW amounts in 2006 to 4.5 % of the total CH_4 emissions. The emission of N_2O from WW is in 2006 0.8 % of national total of N_2O. Since all incinerated waste is used for power and heat production, the emissions are included in the 1A1a IPCC category.

Forest

The annual C-stock change for forest land remaining forest land was reduced from 3326 Gg CO_2 in 2004 to 1672 Gg CO_2 in 2005 due to storms. As no storms occurred in 2006 this figure increased to 2574 Gg CO_2 in 2006. The annual C sequestration in forests remaining forests were slightly lower in 2006 than in previous years because the harvested amount of wood was relatively high for a storm-free year. 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. Changes in soil carbon pools following afforestation have for the first time been included in the NIR for 2008. 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 as well as a number of studies on forest floor C in stands established by afforestation of cropland. These studies indicated that the forest floor is the main soil pool contributing to C sequestration 30-40 years after afforestation. Annual rates of C sequestration were estimated for coniferous and deciduous stands, respectively, based on the national studies.

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 2006 has the emission from cropland has been estimated to 2200 Gg CO_2. In previous years the emission has been estimated to almost zero. The reason is a 7% lover crop yield in 2006 compared to 2005 and the very high temperatures having increased the degradation of crop residues in soil. The reported emission is a five-year average 2004-2008 and thus a recalculation of the estimates for 2004 and 2005 has been made. The emission from organic agricultural soils is estimated to 1055 Gg CO_2. 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.

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 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 2006, 42% 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 public power plants and district heating plants have decreased by 52 % from 1990 to 2006. In the same period, the total emission decreased by 37%. 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.

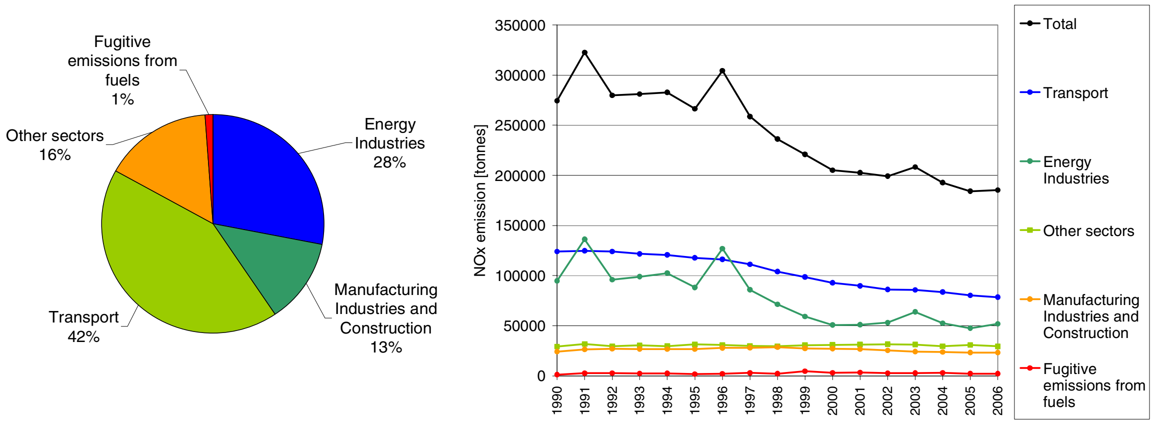


Figure 2.6 NO_X emissions. Distribution according to the main sectors (2006) and time-series for 1990 to 2006.

CO

Wood combustion in residential plants is responsible for the dominant share of the total CO emission. Also road transport and other mobile sources contribute significantly to the total emission of this pollutant. The emission decreased further by 22 % from 1990 to 2006, largely because of decreasing emissions from road transportation.

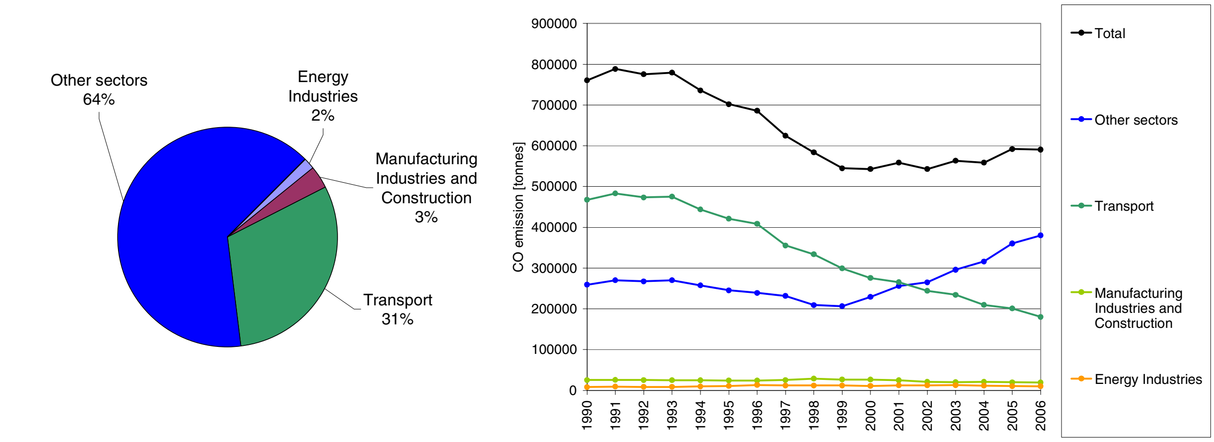


Figure 2.7 CO emissions. Distribution according to the main sectors (2006) and time-series for 1990 to 2006.

NMVOC

The emissions of NMVOC originate from many different sources and can be divided into two main groups: incomplete combustion and evaporation. Wood combustion in the residential sector, 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. 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 36 % from 1990 to 2006, largely due to the increased use of catalyst cars and reduced emissions from use of solvents.

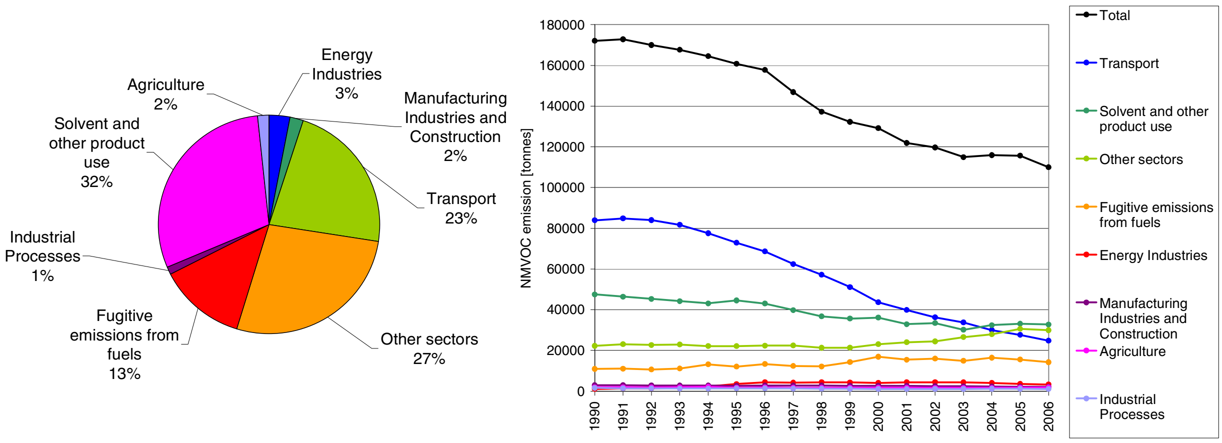


Figure 2.8 NMVOC emissions. Distribution according to the main sectors (2006) and time-series for 1990 to 2006.

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 1990 to 2006, the total emission decreased by 86 %. 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 41 % 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 7 % of the total SO_2 emission. This is due to the use of residual oil with high sulphur content.

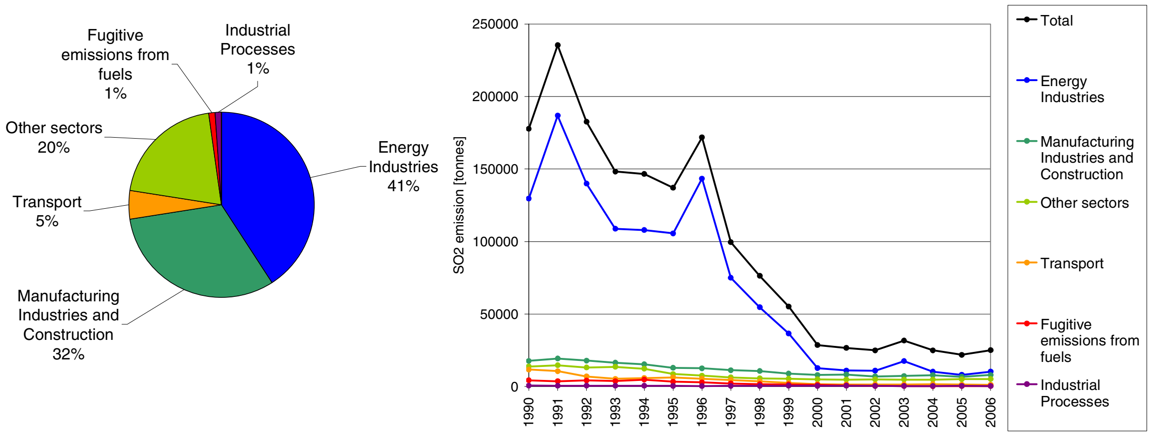


Figure 2.9 SO_2 emissions. Distribution according to the main sectors (2006) and time-series for 1990 to 2006.

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	58 364	61 982	58 938	72 285	62 616	58 559	55 765
A. Fuel Combustion (Sectoral Approach)	51 198	61 456	55 532	57 896	61 514	58 576	71 886	62 053	58 138	54 869
1. Energy Industries	26 173	35 113	30 082	31 627	35 352	31 934	44 321	35 084	31 381	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	12 106	12 291	12 263	12 258
4. Other Sectors	8 954	9 208	8 439	9 198	8 430	8 646	9 202	8 384	8 136	7 976
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
1. Energy	51 273	52 863	52 454	57 783	52 121	48 543	55 838
A. Fuel Combustion (Sectoral Approach)	50 680	52 232	51 921	57 235	51 515	48 109	55 423
1. Energy Industries	25 114	26 400	26 553	31 402	25 396	22 136	29 470
2. Manufacturing Industries and Construction	6 008	6 089	5 801	5 770	5 816	5 607	5 630
3. Transport	12 050	12 048	12 151	12 613	12 923	13 056	13 417
4. Other Sectors	7 398	7 598	7 328	7 358	7 141	7 039	6 779
5. Other	111	97	89	92	239	271	126
B. Fugitive Emissions from Fuels	593	631	533	548	606	435	415
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	593	631	533	548	606	435	415

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	2.64	2.55	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
1. Energy	30.45	32.10	32.17	32.40	32.31	30.47	28.31
A. Fuel Combustion (Sectoral Approach)	26.64	28.29	28.22	28.38	27.47	25.68	23.66
1. Energy Industries	15.28	16.55	16.48	16.17	15.18	13.20	11.42
2. Manufacturing Industries and Construction	1.57	1.64	1.50	1.50	1.49	1.29	1.16
3. Transport	1.91	1.79	1.68	1.62	1.53	1.42	1.34
4. Other Sectors	7.88	8.31	8.56	9.09	9.26	9.76	9.74
5. Other	0.01	0.01	0.00	0.01	0.01	0.01	0.01
B. Fugitive Emissions from Fuels	3.81	3.82	3.94	4.02	4.84	4.80	4.65
1. Solid Fuels	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	4.80	4.65

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	1.41	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	1.68	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
Continued	2000	2001	2002	2003	2004	2005	2006			
1. Energy	1.47	1.49	1.48	1.53	1.48	1.44	1.52			
A. Fuel Combustion (Sectoral Approach)	1.46	1.48	1.48	1.52	1.47	1.43	1.51			
1. Energy Industries	0.48	0.51	0.52	0.55	0.50	0.46	0.54			
2. Manufacturing Industries and Construction	0.19	0.19	0.18	0.18	0.19	0.18	0.19			
3. Transport	0.48	0.47	0.46	0.46	0.46	0.45	0.44			
4. Other Sectors	0.30	0.31	0.31	0.32	0.31	0.33	0.33			
5. Other	0.00	0.00	0.00	0.00	0.01	0.01	0.00			
B. Fugitive Emissions from Fuels	0.01	0.01	0.01	0.01	0.01	0.01	0.01			
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO			
2. Oil and Natural Gas	0.01	0.01	0.01	0.01	0.01	0.01	0.01			

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 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 2006, the total fuel consumption for stationary combustion plants was 618 PJ of which 505 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 - 62% - of all fuels is combusted in the sector, *Public electricity and heat production.* Other sectors with high fuel consumption are *Residential* and *Industry*.

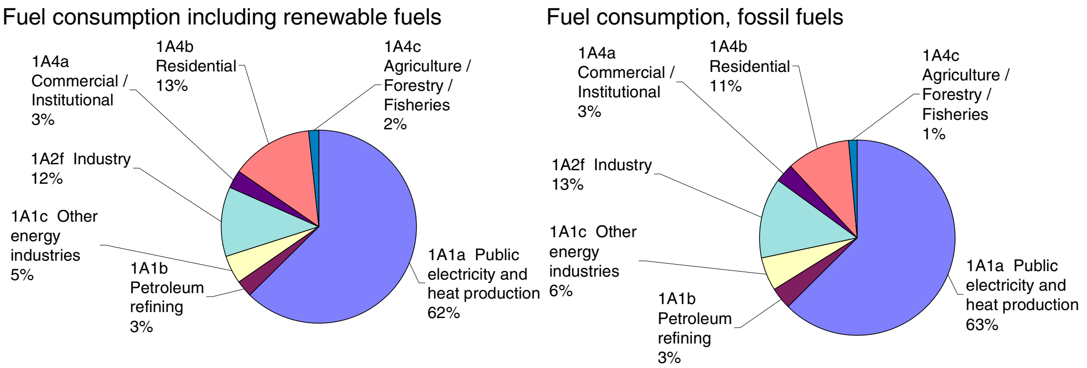


Figure 3.1 Fuel consumption rate of stationary combustion, 2006 (based on DEA 2007a)

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.

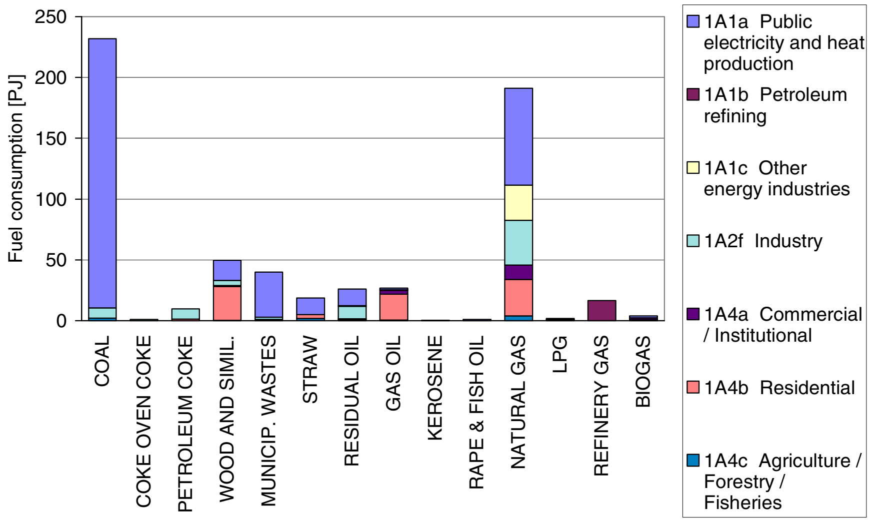


Figure 3.2 Fuel consumption of stationary combustion plants 2006 (based on DEA 2007a)

Fuel consumption time-series for stationary combustion plants are presented in Figure 3.3. The total fuel consumption increased by 24% from 1990 to 2006, while the fossil fuel consumption increased by 13.1%. 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".

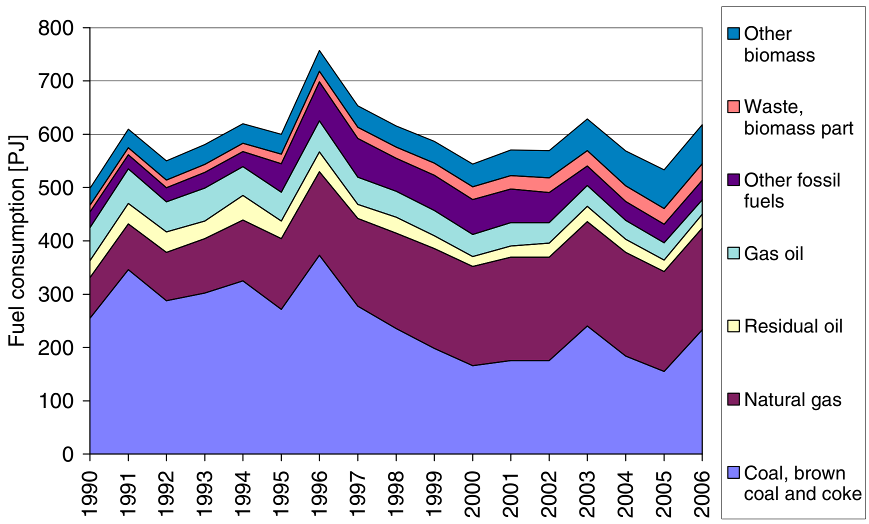


Figure 3.3 Fuel consumption time-series, stationary combustion (based on DEA 2007a)

Emissions

The GHG emissions from stationary combustion are listed in Table 3.5. The emission from stationary combustion accounts for 58% of the total Danish GHG emission.

The CO_2 emission from stationary combustion plants accounts for 70% of the total Danish CO_2 emission (not including land-use change and forestry). The CH_4 emission from stationary combustion accounts for 8% of the total Danish CH_4 emission and the N_2O emission from stationary combustion accounts for 4% of the total Danish N_2O emission.

Table 3.5 Greenhouse gas emission for the year 2006 [1)].

	CO_2	CH_4	N_2O
	Gg CO_2 equivalent		
1A1 Fuel consumption, Energy industries	29 470	240	168
1A2 Fuel consumption, Manufacturing Industries and Construction[1)]	4 609	23	44
1A4 Fuel consumption, Other sectors [1)]	4 948	198	79
Total emission from stationary combustion plants	39 026	461	291
Total Danish emission (gross)	55 749	5 515	6 518
			%
Emission share for stationary combustion	70	8	4

1) Only stationary combustion sources of the sector is included

CO_2 is the most important GHG pollutant and accounts for 97.7% of the GHG emission (CO_2 eqv.).

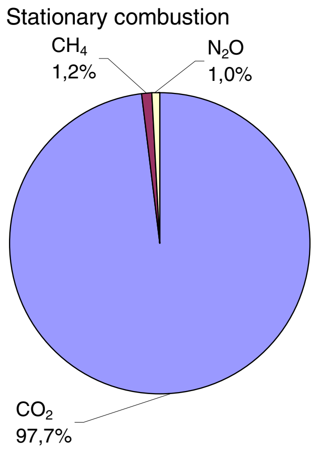


Figure 3.4 GHG emission (CO_2 equivalent) from stationary combustion plants

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 higher in 2006 than in 1990 – CO_2 by 4% and GHG by 5%. However, fluctuations in the GHG emission level are large.

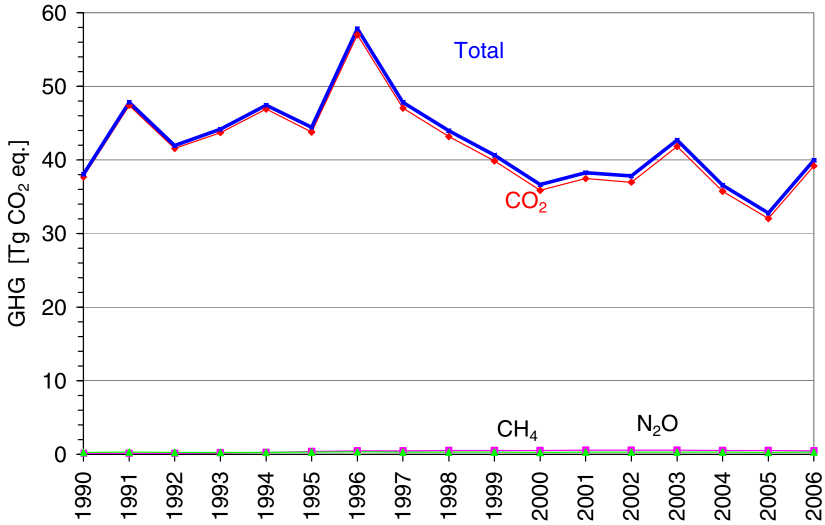


Figure 3.5 GHG emission time-series for stationary combustion

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 2006 the net electricity export was 24971 TJ in 2005 there had been a net import. The electricity export in 2006 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 23% since 1990, and the CO_2 emission by 24%.

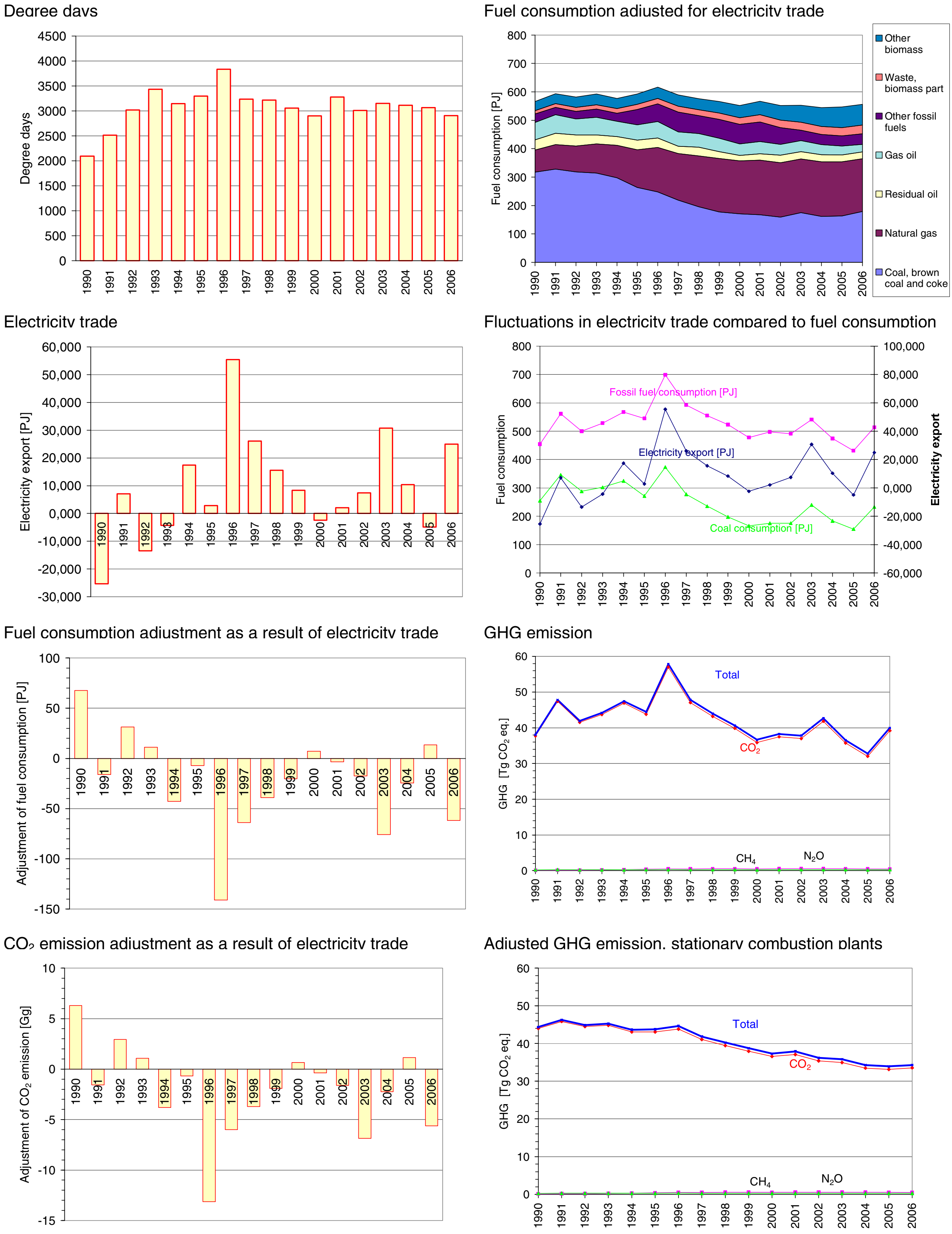


Figure 3.6 GHG emission time-series for stationary combustion and adjustment for electricity import/export and temperature variations (DEA 2007b)

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 70% of the total Danish CO_2 emission. Table 3.6 lists the CO_2 emission inventory for stationary combustion plants for 2006. Figure 3.7 reveals that *Electricity and heat production* accounts for 69% of the CO_2 emission from stationary combustion. This share is somewhat higher than the fossil fuel consumption share for this sector, which is 63% (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 2006[1)]

CO_2	2006	
1A1a Public electricity and heat production	26858	Gg
1A1b Petroleum refining	982	Gg
1A1c Other energy industries	1631	Gg
1A2 Industry	4609	Gg
1A4a Commercial / Institutional	957	Gg
1A4b Residential	3462	Gg
1A4c Agriculture / Forestry / Fisheries	529	Gg
Total	39026	Gg

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

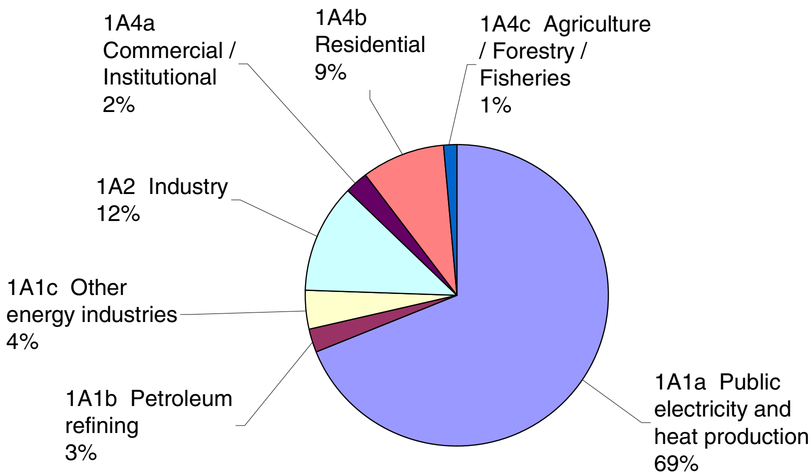


Figure 3.7 CO_2 emission sources, stationary combustion plants, 2006

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 2006, the CO_2 emission from biomass combustion was 11186 Gg.

Time-series for CO_2 emissions are provided in Figure 3.8. Despite an increase in fuel consumption of 24% since 1990, CO_2 emission from stationary combustion has only increased by 4% due to the change in the type of fuels used.

The fluctuations of CO_2 emission are discussed earlier.

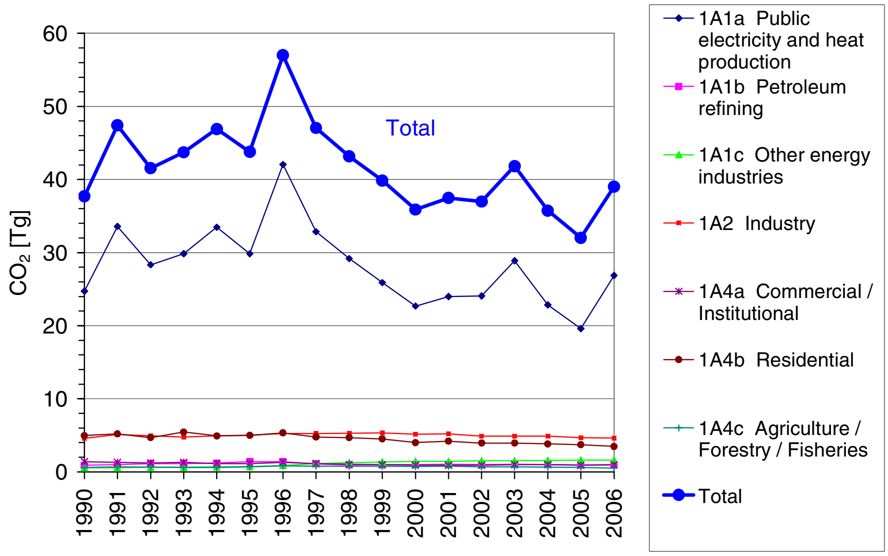


Figure 3.8 CO_2 emission time-series for stationary combustion plants

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 total Danish CH_4 emission. Table 3.7 lists the CH_4 emission inventory for stationary combustion plants in 2006. Figure 3.9 reveals that *Electricity and heat production* accounts for 52% of the CH_4 emission from stationary combustion, which is somewhat less than the fuel consumption share.

Table 3.7 CH_4 emission from stationary combustion plants 2006 [1)]

CH_4	2006	
1A1a Public electricity and heat production	11 337	Mg
1A1b Petroleum refining	0.5	Mg
1A1c Other energy industries	86	Mg
1A2 Industry	1 115	Mg
1A4a Commercial / Institutional	872	Mg
1A4b Residential	7 088	Mg
1A4c Agriculture / Forestry / Fisheries	1 450	Mg
Total	21 947	Mg

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

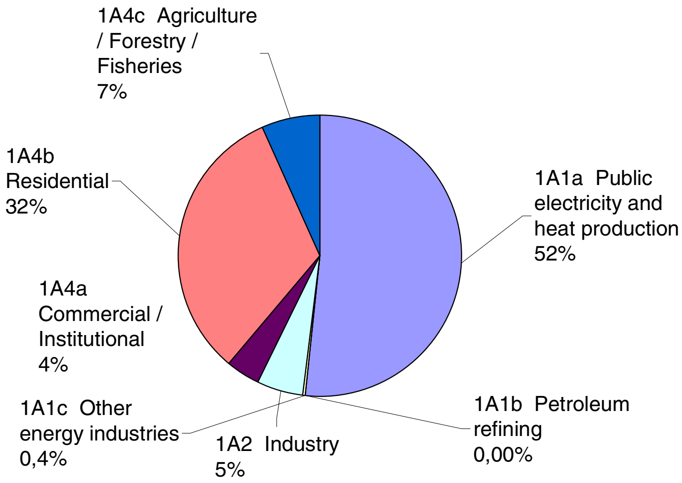


Figure 3.9 CH_4 emission sources, stationary combustion plants, 2006

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 60% 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.

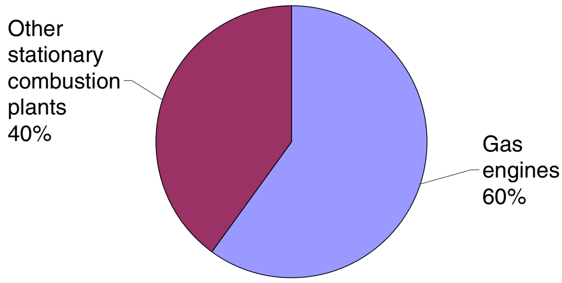


Figure 3.10 Gas engine CH_4 emission share, 2006.

The CH_4 emission from stationary combustion increased by a factor of 3.8 since 1990 (Figure 3.11). This is due to the considerable number of lean-burn gas engines installed in CHP plants in Denmark in this period. 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.

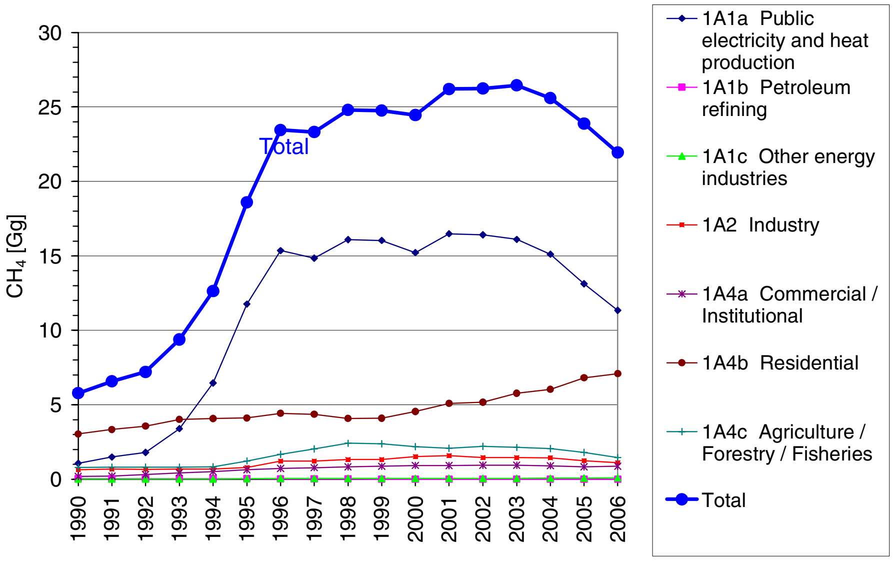


Figure 3.11 CH_4 emission time-series for stationary combustion plants

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

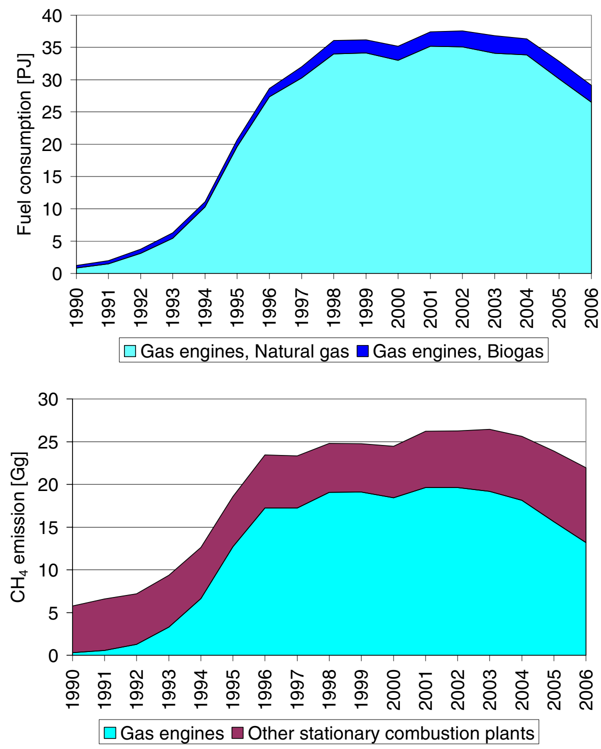


Figure 3.12 Fuel consumption and CH_4 emission from gas engines, time-series.

N_2O

The N_2O emission from stationary combustion plants accounts for 4% of the total Danish N_2O emission. Table 3.8 lists the N_2O emission inventory for stationary combustion plants in the year 2006. Figure 3.13 reveals that *Electricity and heat production* accounts for 47% 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 2006 [1)]

N_2O	2006	
1A1a Public electricity and heat production	445	Mg
1A1b Petroleum refining	34	Mg
1A1c Other energy industries	63	Mg
1A2 Industry	143	Mg
1A4a Commercial / Institutional	29	Mg
1A4b Residential	202	Mg
1A4c Agriculture / Forestry / Fisheries	23	Mg
Total	940	Mg

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

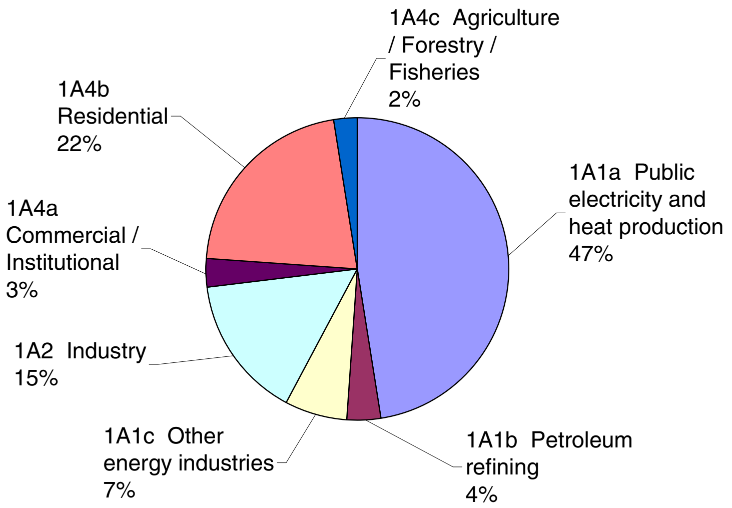


Figure 3.13 N_2O emission sources, stationary combustion plants, 2006

Figure 3.14 shows the time-series for the N_2O emission. The N_2O emission from stationary combustion increased by 10% from 1990 to 2006, but, again, fluctuations in emission level due to electricity import/export are considerable.

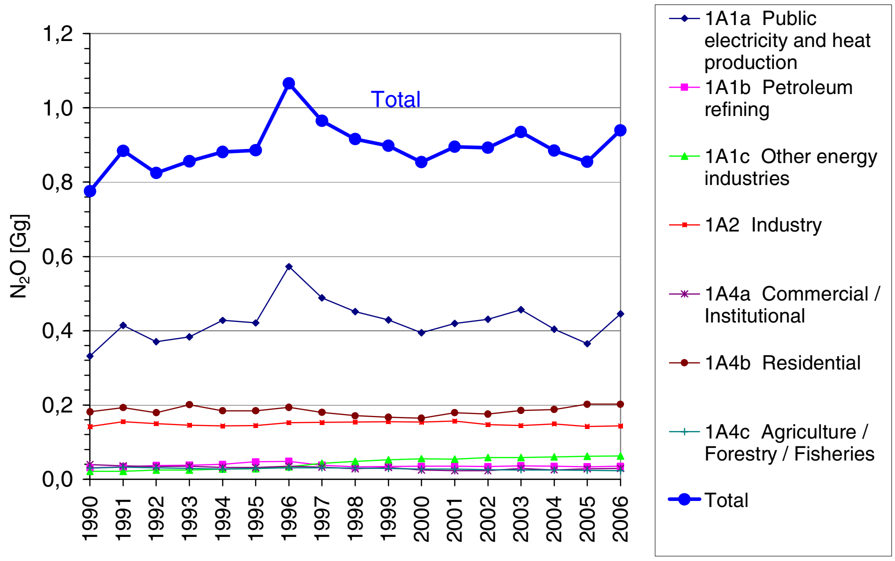


Figure 3.14 N_2O emission time-series for stationary combustion plants

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 2006 are presented in Table 3.9. Further details are shown in Annex 3A. SO_2 from stationary combustion plants accounts for 90% of the total Danish SO_2 emission. NO_X, CO and NMVOC account for 39%, 50% and 21%, respectively, of the total Danish emissions for these substances.

Table 3.9 SO_2, NO_X, NMVOC and CO emission from stationary combustion plants 2006

Pollutant	NO_X	CO	NMVOC	SO_2
	Gg	Gg	Gg	Gg
1A1 Fuel consumption, Energy industries	51.9	10.3	3.3	10.2
1A2 Fuel consumption, Manufacturing industries and Construction (Stationary combustion)	12.5	12.0	0.6	7.9
1A4 Fuel consumption, Other sectors (Stationary combustion)	8.3	275.1	19.3	4.4
Total emission from stationary combustion plants	72.7	297.3	23.2	23.2
Total Danish emission	185.3	590.6	110.0	25.1
			%	
Emission share for stationary combustion	39	50	21	90

1) 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 (COoRdination of INformation on AIR emissions) system, which is a European programme for air emission inventories. CORINAIR includes methodology structure and software for inventories. The methodology is described in the EMEP/CORINAIR Emission Inventory Guidebook 3rd edition, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections (EMEP/CORINAIR, 2004) subsequent newer editions have not changed the methodology used. Emission data are stored in an Access database, from which data are transferred to the reporting formats.

The emissions 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 is 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 2006, 75 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 383 PJ (2006). This corresponds to 62% 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 2006.

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.

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. CO_2 emissions from some plants are available through the EU emission trading scheme (ETS). 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 Elsam and E2, the two major electricity suppliers
- Emission data reported from industrial plants.
- 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 2007a). 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.

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 2007c).

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 have not been included in the Danish inventory, to date, but the non-energy use of fuels is, however, 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 Denmark.

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 EMEP/CORINAIR Guidebook (EMEP/CORIN-AIR, 2004) and IPCC Reference Manual (IPCC, 1997).

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

CO_2

The CO_2 emission factors applied for 2006 are presented in Table 3.11. For municipal waste and natural gas, time-series have been estimated. For all other fuels the same emission factor is applied for 1990-2006.

Data reported under the EU ETS were included directly in the inventory for the first time in 2006. The data were mainly from coal powered central power plants, where measurements of carbon content, oxidation factor etc. have been carried out to estimate the CO_2 emission.

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 3.10. The emission factors are further discussed in Annex 3A.

The CO_2 emission from incineration of municipal waste (94.5 + 17.6 kg/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.

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 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 just adapted legislation (Law no. 493 2004), operators of large power plants are obliged to verify the applied emission factors, the input from the large power plants has not given reason to change the CO_2 emission factors.

Table 3.10 CO_2 emission factors 2006

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

* Data from EU ETS incorporated for individual plants

CH_4

The CH_4 emission factors applied for 2006 are presented in Table 3.11. In general, the same emission factors have been applied for 1990-2006. 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 (EMEP/-CORINAIR, 2004).

Gas engines, combusting natural gas or biogas, contribute much more to the total CH_4 emission than other 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 IEF (implied emission factor) 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 3.11 CH_4 emission factors 1990-2006

Fuel	ipcc_id	SNAP_id	Emission factor [g/GJ]	Reference
COAL	1A1a	010101, 010102, 010103	1.5	EMEP/CORINAIR, 2004
COAL	1A1a, 1A2f, 1A4b, 1A4c	010202, 010203, 0301, 0202, 0203	15	EMEP/CORINAIR, 2004
BROWN COAL BRI.	all	all	15	EMEP/CORINAIR, 2004, assuming same emission factor as for coal
COKE OVEN COKE	all	all	15	EMEP/CORINAIR, 2004, assuming same emission factor as for coal
PETROLEUM COKE	all	all	15	EMEP/CORINAIR, 2004
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	2	Nielsen & Illerup 2003
WOOD AND SIMIL.	1A4a, 1A4b, 1A4c	0201, 0202, 0203	200	EMEP/CORINAIR, 2004
WOOD AND SIMIL.	1A1a, 1A2f	010105, 010202, 010203, 0301, 030102, 030103	32	EMEP/CORINAIR, 2004
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	0.59	Nielsen & Illerup 2003
MUNICIP. WASTES	1A1a, 1A2f, 1A4a	all other	6	EMEP/CORINAIR, 2004
STRAW	1A1a	010102, 010103	0.5	Nielsen & Illerup 2003
STRAW	1A1a, 1A2f, 1A4c	010202, 010203, 020302, 030105	32	EMEP/CORINAIR, 2004
STRAW	1A4b, 1A4c	0202, 0203	200	EMEP/CORINAIR, 2004
RESIDUAL OIL	all	all	3	EMEP/CORINAIR, 2004
GAS OIL	all	all	1.5	EMEP/CORINAIR, 2004
KEROSENE	all	all	7	EMEP/CORINAIR, 2004
FISH & RAPE OIL	all	all	1.5	EMEP/CORINAIR, 2004, assuming same emission factor as gas oil
ORIMULSION	1A1a	010101	3	EMEP/CORINAIR, 2004, assuming same emission factor as residual oil
NATURAL GAS	1A1a	0101, 010101, 010102, 010202	6	DGC 2001
NATURAL GAS	1A1a	010103, 010203	15	Gruijthuijsen & Jensen 2000
NATURAL GAS	1A1a, 1Ac, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010504, 030104, 020104, 020303	1.5	Nielsen & Illerup 2003
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	1) 465	Nielsen et al. 2008
NATURAL GAS	1A1c, 1A2f, 1A4a, 1A4b, 1A4c	010502, 0301, 0201, 0202, 0203	6	DGC 2001
NATURAL GAS	1A2f, 1A4a, 1A4b	030103, 030106, 020103, 020202	15	Gruijthuijsen & Jensen 2000
LPG	all	all	1	EMEP/CORINAIR, 2004
REFINERY GAS	1A1b	010304	1.5	EMEP/CORINAIR, 2004
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010505, 030105, 020105, 020304	1) 323	Nielsen & Illerup 2003
BIOGAS	1A1a, 1A2f, 1A4a, 1A4c	all other	4	EMEP/CORINAIR, 2004

1) 2006 emission factor. Time-series is shown in Annex 3A

N_2O

The N_2O emission factors applied for the 2006 inventory are listed in Table 3.12. The same emission factors have been applied in the period 1990-2006.

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 DONG Energy (Previously Elsam). Other emission factors refer to the EMEP/Corinair Guidebook (EMEP/CORINAIR, 2004).

Table 3.12 N_2O emission factors 1990-2006

Fuel	ipcc_id	SNAP_id	Emission factor [g/GJ]	Reference
COAL	1A1a	0101**	0.8	Elsam 2005
COAL	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	All except 0101**	3	EMEP/CORINAIR, 2004
BROWN COAL BRI.	all	all	3	EMEP/CORINAIR, 2004
COKE OVEN COKE	all	all	3	EMEP/CORINAIR, 2004
PETROLEUM COKE	all	all	3	EMEP/CORINAIR, 2004
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	0.8	Nielsen & Illerup 2003
WOOD AND SIMIL.	1A1a	010105, 010202, 010203	4	EMEP/CORINAIR, 2004
WOOD AND SIMIL.	1A2f, 1A4a, 1A4b, 1A4c	all	4	EMEP/CORINAIR, 2004
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	1.2	Nielsen & Illerup 2003
MUNICIP. WASTES	1A1a	010203	4	EMEP/CORINAIR, 2004
MUNICIP. WASTES	1A2f, 1A4a	030102, 0201, 020103	4	EMEP/CORINAIR, 2004
STRAW	1A1a	010102, 010103	1.4	Nielsen & Illerup 2003
STRAW	1A1a	010202, 010203	4	EMEP/CORINAIR, 2004
STRAW	1A2f, 1A4b, 1A4c	all	4	EMEP/CORINAIR, 2004
RESIDUAL OIL	all	all	2	EMEP/CORINAIR, 2004
GAS OIL	all	all	2	EMEP/CORINAIR, 2004
KEROSENE	all	all	2	EMEP/CORINAIR, 2004
FISH & RAPE OIL	all	all	2	EMEP/CORINAIR, 2004, assuming same emission factor as gas oil
ORIMULSION	1A1a	010101	2	EMEP/CORINAIR, 2004, assuming same emission factor as residual oil
NATURAL GAS	1A1a	0101, 010101, 010102, 010103, 010202, 010203	1	EMEP/CORINAIR, 2004
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010504, 030104, 020104, 020303	2.2	Nielsen & Illerup 2003
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	1.3	Nielsen & Illerup 2003
NATURAL GAS	1A1c, 1A2f, 1A4a, 1A4b, 1A4c	010502, 0301, 030103, 030106, 0201, 020103, 0202, 020202, 0203	1	EMEP/CORINAIR, 2004
LPG	all	all	2	EMEP/CORINAIR, 2004
REFINERY GAS	all	all	2.2	EMEP/CORINAIR, 2004
BIOGAS	1A1a	010102, 010103, 010203	2	EMEP/CORINAIR, 2004
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010505, 030105, 020105, 020304	0.5	Nielsen & Illerup 2003
BIOGAS	1A2f, 1A4a, 1A4c	0301, 030102, 0201, 020103, 0203	2	EMEP/CORINAIR, 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 (EMEP/CORINAIR, 2004)
- 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 programme for decentralised CHP plants (Nielsen & Illerup 2003)
  - An emission measurement programme for natural gas fired gas engines (Nielsen et al., 2008)
  - Research and emission measurements programmes for biomass fuels:
    - Nikolaisen et al., 1998
    - Jensen & Nielsen, 1990
    - Dyrnum et al., 1990
    - Hansen et al., 1994
    - 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 2004).
- 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 ±7.9% and the decrease in the GHG emission since 1990 has been estimated to be 4.9% ± 2.0%-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. 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 3.13 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 3.14. The uncertainty for fuel consumption in stationary combustion plants was assumed to be 2%.

Table 3.14 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 3.15. Detailed calculation sheets are provided in Annex 3A.

The uncertainty interval for GHG is estimated to be ±7.9% and the uncertainty for the trend in GHG emission is ±2.0%-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 the CO_2 emission from the combustion of coal and natural gas.

The total emission uncertainty is 7.1% for SO_2, 16% for NO_X, 42% for NMVOC and 46% for CO.

Table 3.15 Danish uncertainty estimates, 2005

Pollutant	Uncertainty Total emission [%]	Trend 1990-2005 [%]	Uncertainty Trend [%-age points]
GHG	7.9	4.9	± 2.0
CO_2	3.0	3.9	± 1.6
CH_4	47	280	± 222
N_2O	1000	21	± 3.8
SO_2	7.1	-89	±0.8
NO_X	16	-37	±2.5
NMVOC	42	70	±7.9
CO	46	62	±6.4

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.

Table 3.16 List of external data sources for stationary combustion

Dataset	Description	AD or Emf.	Reference	Contact(s)	Data agreement/ Comment
Energiproducenttællingen.xls	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 Elsam & E2	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

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 not been included in the Danish inventory, to date, but 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.

Data for emission of heavy metals and particles from central power plants, Elsam and Energi E2

The two major Danish power plant operators assess heavy metal emissions from their plants using model calculations based on fuel data and type of flue-gas cleaning. NERI's QC of the data consists of a comparison with data from previous years and with data from the plants' annual environmental reports.

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 3.16.

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 3.16 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 3.17

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% (1990-2006). 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 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 2007 emission inventory include:

- Update of fuel rates according to the latest energy statistics. The update included the years 1980-2005.
- For natural gas fired gas engines emission factors for CH_4, NMVOC, CO and NO_x were updated in connection with a research project including the higher emission factor during start-up/shut-down in the total emission factor.
- Data from the ETS has been utilised for the first time in the inventory for 2006. It was mainly coal and residual oil fuelled power plants where detailed information was available.
- Based on the in-country review in April 2007 several improvements have been made to the NIR.
  - The greenhouse gas trend discussion has been modified so that it handles each CRF subsector separately, in addition the references to the SNAP nomenclature has been toned down in favour of the CRF nomenclature.
  - A short description of the Danish energy statistics and the transfer to SNAP codes has been included as appendix.
  - As recommended by the ERT Denmark has included data from the EU ETS in the emission inventory.
  - An improved documentation for the use of town gas has been included in the NIR.

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.

2) QA/QC and validation

The work with implementing and expanding the QA/QC procedures will continue in future years

3) 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.

4) 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.

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 the table below (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 sector Other (1A5), while the Transport-Navigation sector (1A3d) comprises national sea transport (ship movements between two Danish ports) and small boats and pleasure crafts. The working machinery and materiel in industry is grouped in Industry-Other (1A2f), while agricultural and forestry machinery is accounted for in the Agriculture/forestry/fisheries (1A4c) sector together with fishing activities.

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.

Fuel consumption

Table 3.18 Fuel consumption (PJ) for domestic transport in 2006 in CRF sectors

CRF ID	Fuel consumption (PJ)
Industry-Other (1A2f)	13.9
Civil Aviation (1A3a)	2.0
Road (1A3b)	171.5
Railways (1A3c)	3.1
Navigation (1A3d)	6.1
Residential (1A4b)	3.2
Ag./for./fish. (1A4c)	21.6
Military (1A5)	1.7
Total	223.1

Table 3.18 shows the fuel consumption for domestic transport based on DEA statistics for 2006 in CRF sectors. The fuel consumption figures in time-series 1990-2006 are given in Annex 3.B.15 (CRF format) and are shown for 1990 and 2006 in Annex 3.B.14 (CollectER format). Road transport has a major share of the fuel consumption for domestic transport. In 2006 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 2006, diesel and gasoline fuel consumption has increased by 32% and 16%, respectively, and in 2006 the fuel consumption shares for diesel and gasoline were 61% and 37%, respectively (Figures 3.15 and 3.16). Other fuels only have a 2% 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.

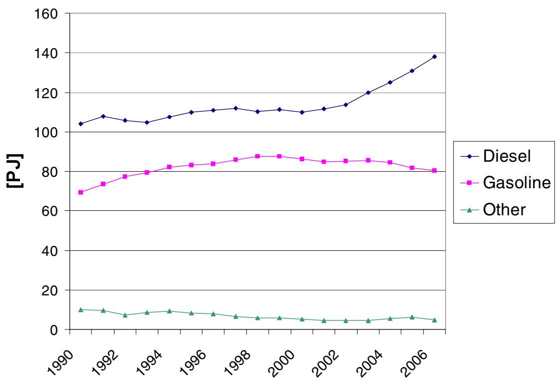


Figure 3.15 Fuel consumption per fuel type for domestic transport 1990-2006

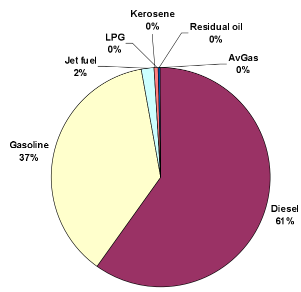


Figure 3.16 Fuel consumption share per fuel type for domestic transport in 2006

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).

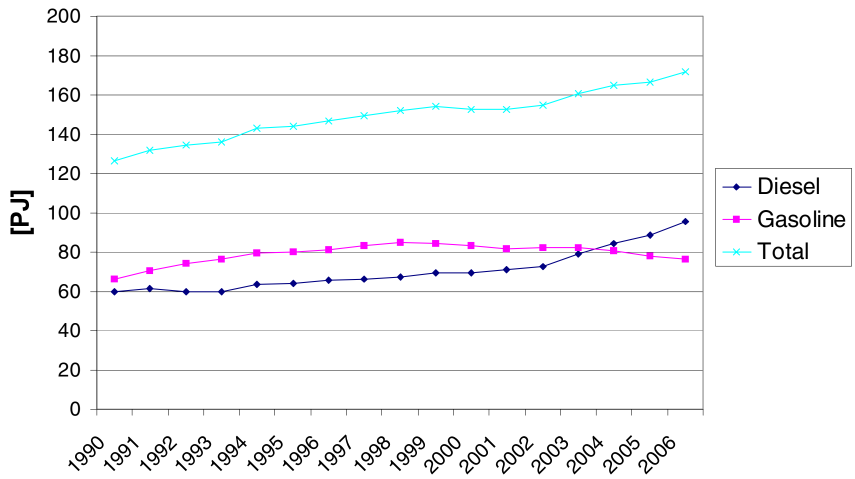


Figure 3.17 Fuel consumption per fuel type and as totals for road transport 1990-2006

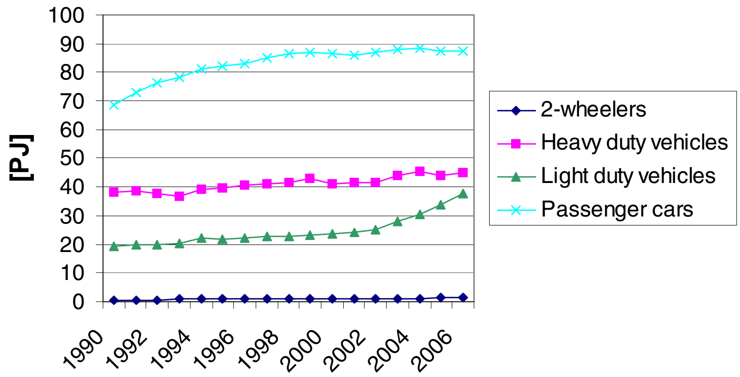


Figure 3.18 Total fuel consumption per vehicle type for road transport 1990-2006

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. The sudden increase in fuel consumption for heavy-duty vehicles in 2003 is, however, significant.

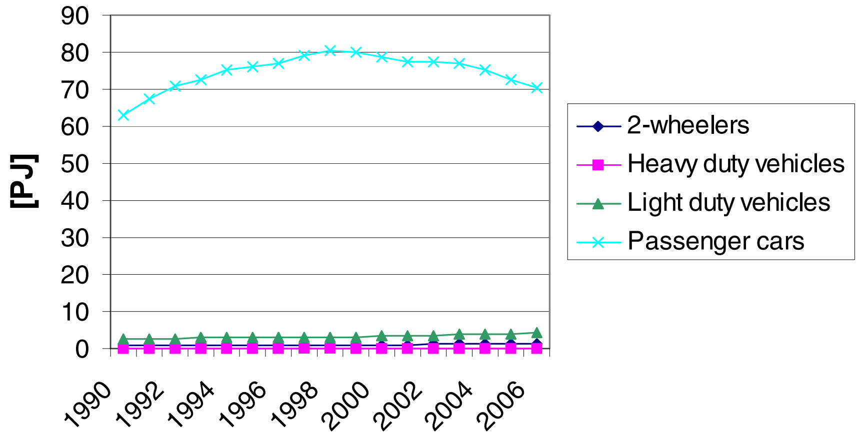


Figure 3.19 Gasoline fuel consumption per vehicle type for road transport 1990-2006

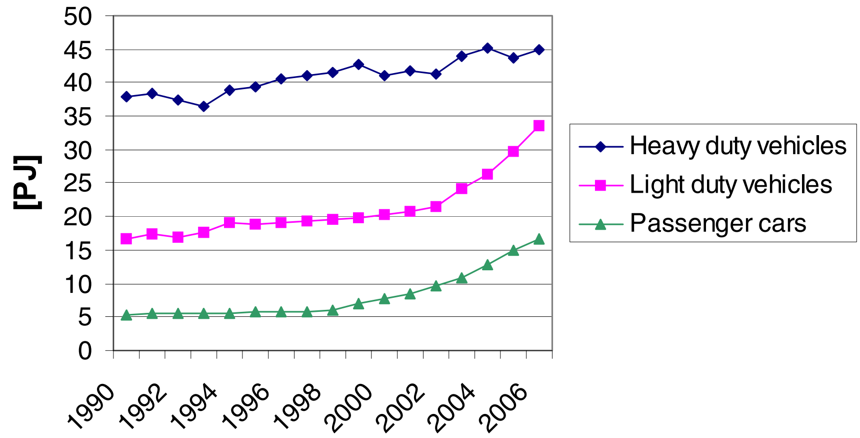


Figure 3.20 Diesel fuel consumption per vehicle type for road transport 1990-2006

In 2006, fuel consumption shares for gasoline passenger cars, heavy-duty vehicles, diesel light duty vehicles, diesel passenger cars and gasoline light duty vehicles were 41, 26, 20, 10 and 2%, respectively (Figure 3.21).

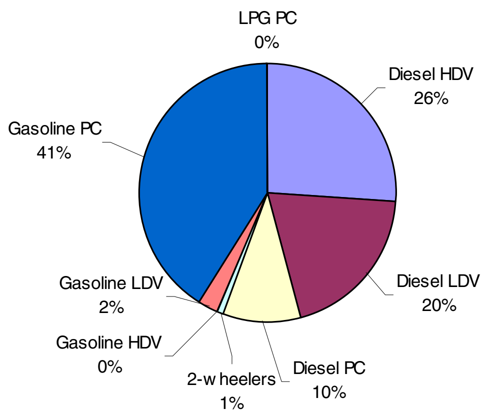


Figure 3.21 Fuel consumption share (PJ) per vehicle type for road transport in 2006

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 2006 no new stock information has been gathered for recreational craft, and thus the 2004 total stock information is repeated for this year.

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 1990-2006 time-series are shown per fuel type in Figures 3.23-3.26 for diesel, gasoline and jet fuel, respectively.

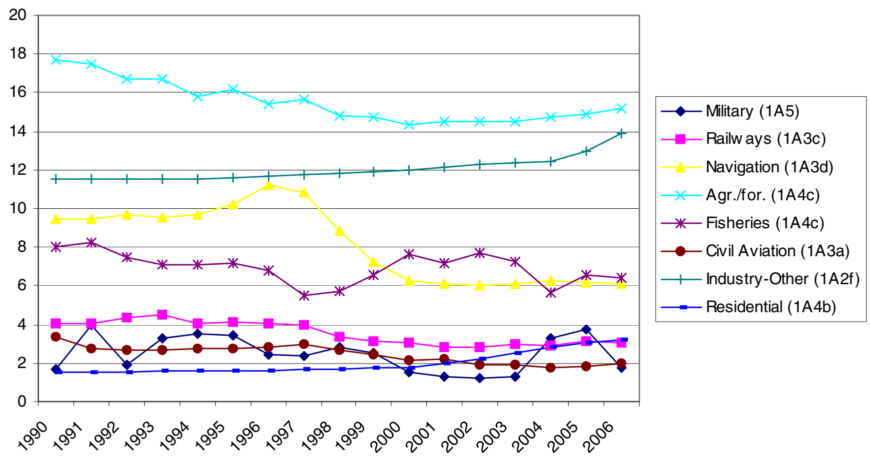


Figure 3.22 Total fuel consumption in CRF sectors for other mobile sources 1990-2006

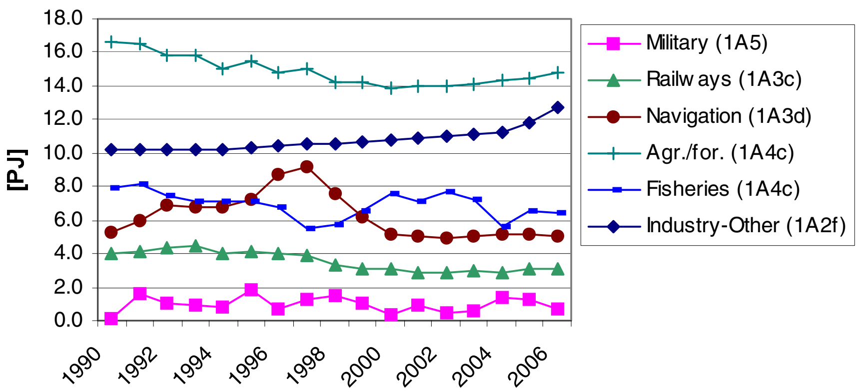


Figure 3.23 Diesel fuel consumption in CRF sectors for other mobile sources 1990-2006

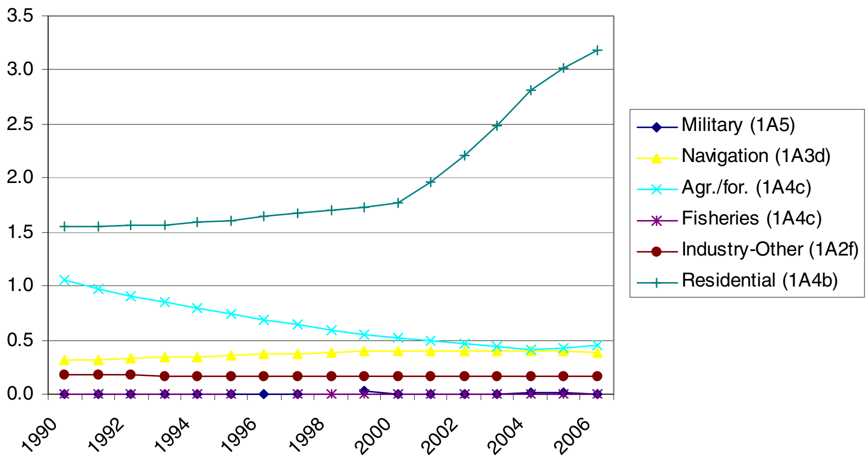


Figure 3.24 Gasoline fuel consumption in CRF sectors for other mobile source 1990-2006

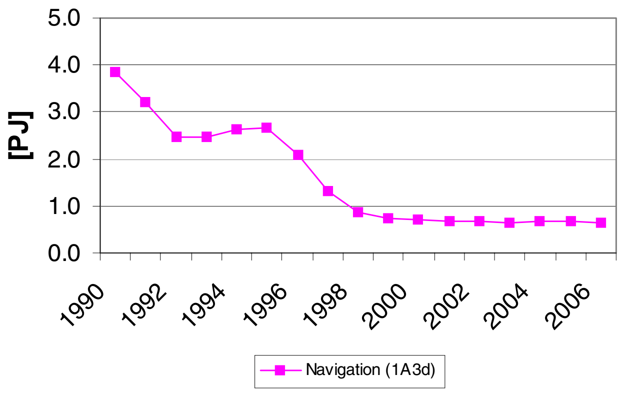


Figure 3.25 Residual oil fuel consumption in CRF sectors for other mobile sources 1990-2006

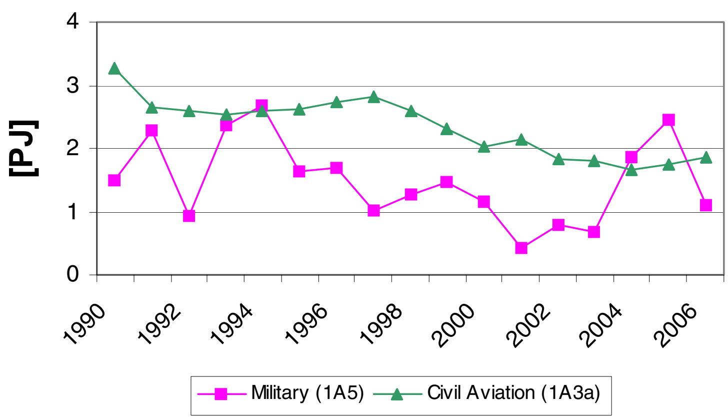


Figure 3.26 Jet fuel consumption in CRF sectors for other mobile sources 1990-2006

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 and 2006. 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.

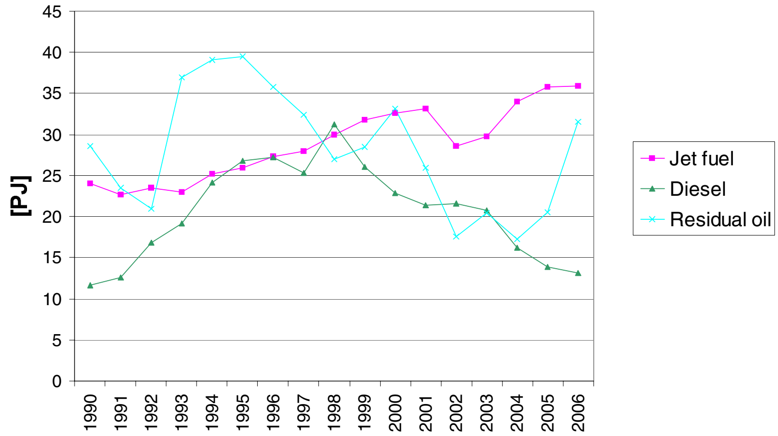


Figure 3.27 Bunker fuel consumption 1990-2006

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 2006 in CRF sectors. The emission figures in time-series 1990-2006 are given in Annex 3:B.13 (CRF format) and are shown for 1990 and 2006 in Annex 3.B.14 (CollectER format).

From 1990 to 2006 the road transport emissions of CO_2 and N_2O have increased by 36 and 29%, respectively, whereas the emissions of CH_4 have decreased by 51% (from Figures 3.28-3.30). From 1990 to 2006 the other mobile CO_2 emissions have decreased by 10 %, (from Figures 3.32-3.34).

Table 3.19 Emissions of CO_2, CH_4 and N_2O in 2006 for road transport and other mobile sources

CRF Sector	CH_4 [tons]	CO_2 [ktons]	N_2O [tons]
Industry-Other (1A2f)	44	1 021	43
Civil Aviation (1A3a)	6	141	8
Railways (1A3c)	9	227	6
Navigation (1A3d)	32	455	26
Residential (1A4b)	233	233	4
Ag./for./fish. (1A4c)	94	1 599	77
Military (1A5)	6	126	4
Total other mobile	425	3 802	168
Road (1A3b)	1 290	12 594	402
Total mobile	1 715	16 397	570

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 2006, the respective emission shares were 51, 26, 22 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 2006 emission shares for CH_4 were 52, 27, 14 and 7% for passenger cars, heavy-duty vehicles, 2-wheelers and light-duty vehicles, respectively (Figure 3.31).

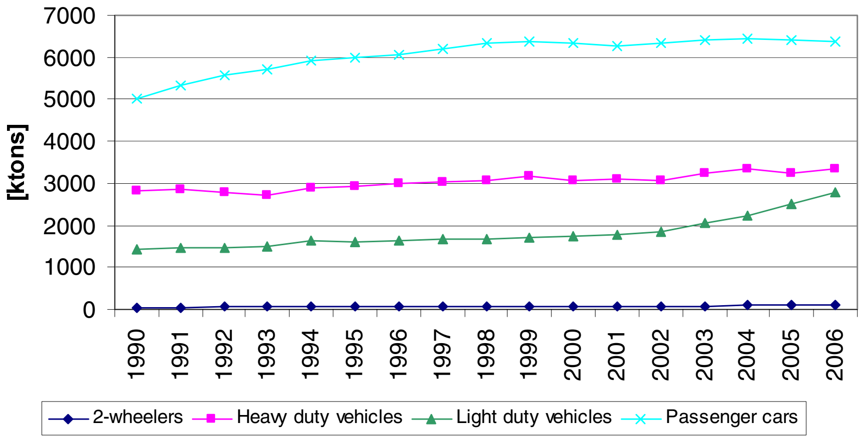


Figure 3.28 CO_2 emissions (k-tonnes) per vehicle type for road transport 1990-2006

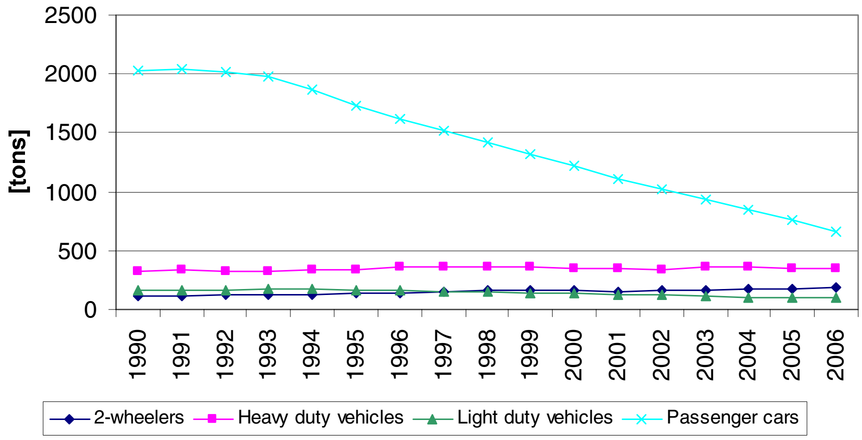


Figure 3.29 CH_4 emissions (tonnes) per vehicle type for road transport 1990-2006

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 2006, emission shares for passenger cars, light and heavy-duty vehicles were 48, 34 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 per vehicle category are almost the same as the CO_2 shares.

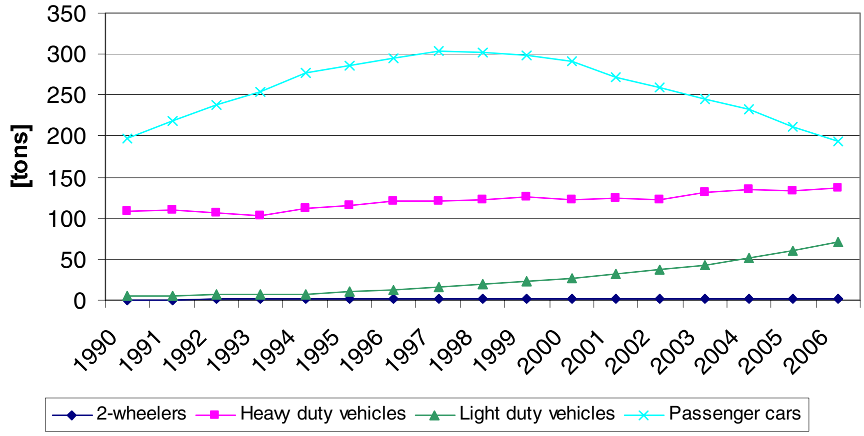


Figure 3.30 N_2O emissions (tonnes) per vehicle type for road transport 1990-2006

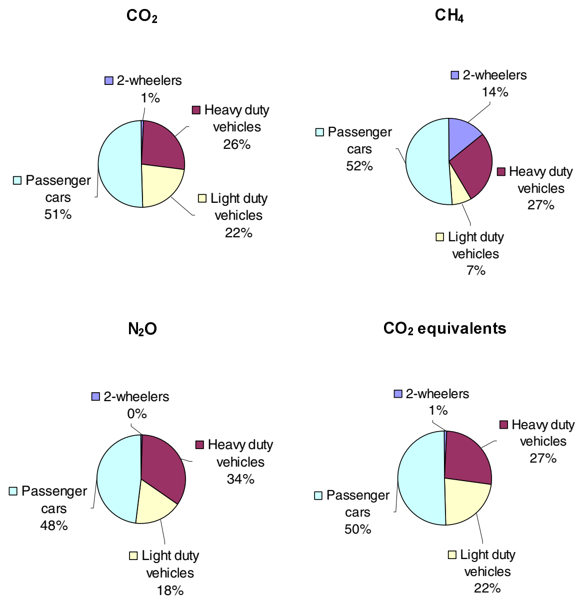


Figure 3.31 CO_2, CH_4 and N_2O emission shares and GHG equivalent emission distribution for road transport in 2006

Other mobile sources

For other mobile sources, the highest CO_2 emissions in 2006 come from Agriculture/forestry/fisheries (1A4c), Industry-other (1A2f), Navigation (1A3d), with shares of 42, 27 and 12%, respectively (Figure 3.35). The 1990-2006 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), Civil Aviation (1A3a) and Military (1A5). In 2006, the CO_2 emission shares for these sectors were 6, 6, 4 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 a relatively large gasoline fuel consumption for gardening machinery. The 2006 emission shares for Agriculture/forestry/fisheries (1A4c), Industry (1A2f) and Navigation (1A3d) are 22, 10 and 8%, respectively, whereas the remaining sectors have emission shares of 2% or less.

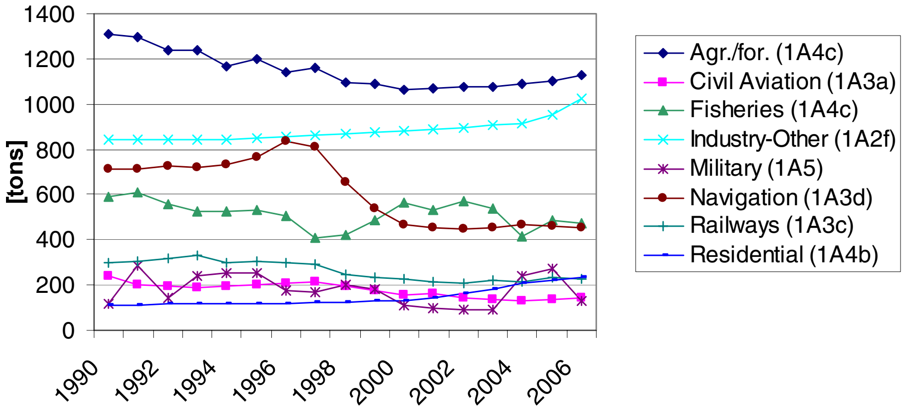


Figure 3.32 CO_2 emissions (k-tonnes) in CRF sectors for other mobile sources 1990-2006

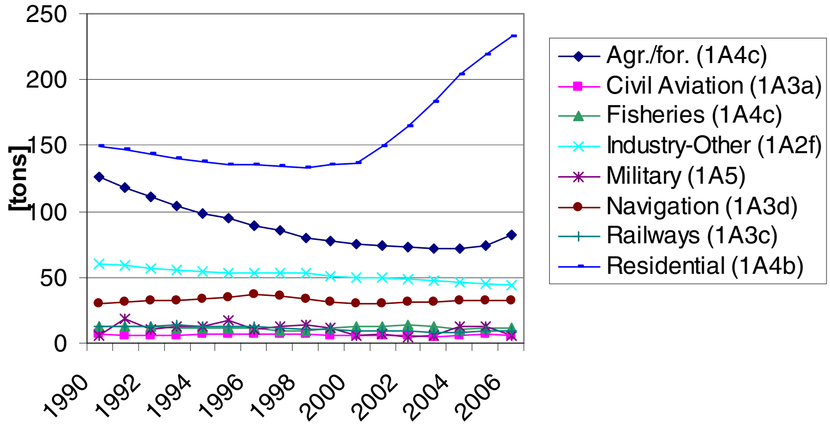


Figure 3.33 CH_4 emissions (tonnes) in CRF sectors for other mobile sources 1990-2006

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 per sector the CO_2 emission equivalent shares are almost the same as those for CO_2, itself (Figure 3.35).

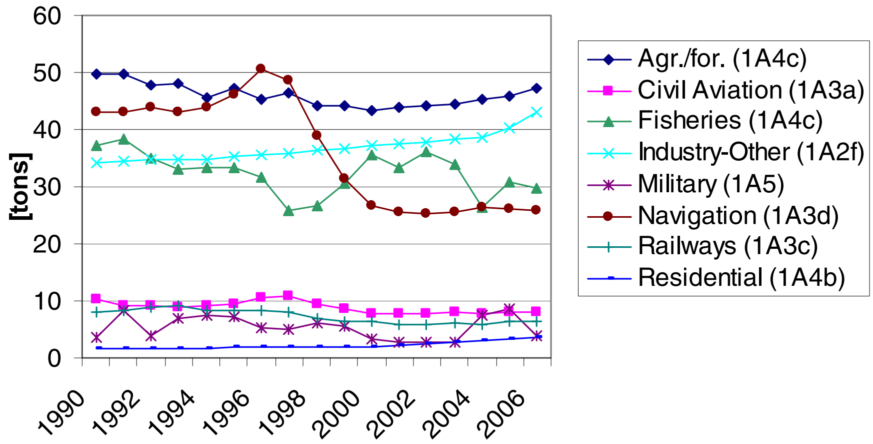


Figure 3.34 N_2O emissions (tonnes) in CRF sectors for other mobile sources 1990-2006

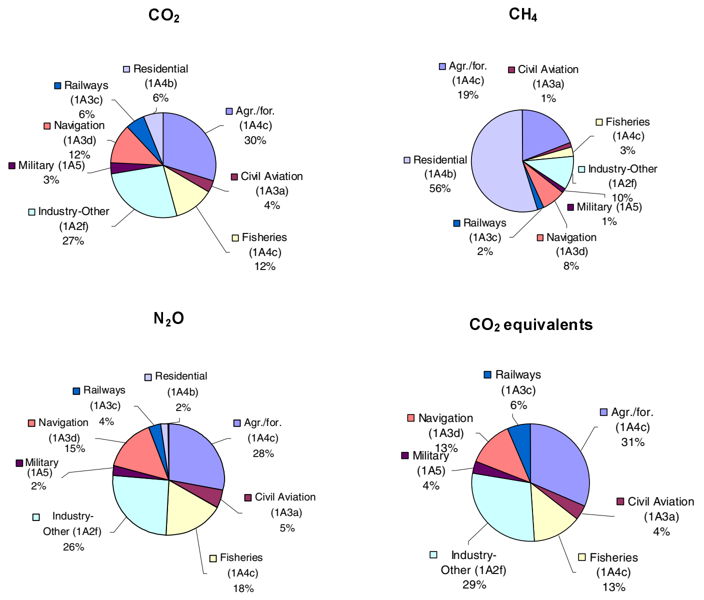


Figure 3.35 CO_2, CH_4 and N_2O emission shares and GHG equivalent emission distribution for other mobile sources in 2006

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 2006 in CRF sectors. The emission figures in the time-series 1990-2006 are given in Annex 3.B.15 (CRF format) and are shown for 1990 and 2006 in Annex 3.B.14 (CollectER format).

From 1990 to 2006, the road transport emissions of NMVOC, CO and NO_X emissions have decreased by 72, 63 and 37%, respectively (Figures 3.37-3.39).

For other mobile sources, the emissions of NO_X decreased by 14% from 1990 to 2006 and for SO_2 the emission drop is as much as 80%. In the same period, the emissions of NMVOC have declined by 6%, whereas the CO emissions have increased by 3% (Figures 3.41-3.44).

Table 3.20 Emissions of SO_2, NO_X, NMVOC and CO in 2006 for road transport and other mobile sources

CRF ID	SO_2 [tons]	NO_X [tons]	NMVOC [tons]	CO [tons]
Industry-Other (1A2f)	30	10 807	1 583	7 515
Civil Aviation (1A3a)	45	596	155	838
Railways (1A3c)	1	3 542	230	626
Navigation (1A3d)	1 089	7 436	1 195	7 192
Residential (1A4b)	1	275	8 037	87 744
Ag./for./fish. (1A4c)	632	20 199	2 541	16 976
Military (1A5)	26	619	56	391
Total other mobile	1 824	43 475	13 796	121 282
Road (1A3b)	79	66 993	23 171	171 521
Total mobile	1 904	110 468	36 967	292 803

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 2006 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: 50, 27, 22 and 1%, respectively (Figure 3.40).

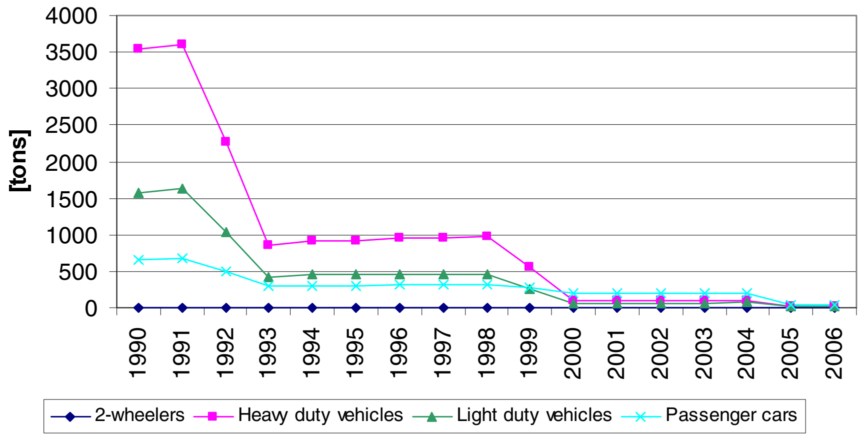


Figure 3.36 SO_2 emissions (tonnes) per vehicle type for road transport 1990-2006

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 and III private cars (introduced in 1997 and 2001, 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.

In 2006, the emission shares for heavy-duty vehicles, passenger cars, light-duty vehicles and 2-wheelers were 54, 29, 17 and 0%, respectively, for NO_X; 7, 63, 7 and 17%, respectively, for NMVOC; and 5, 76, 8 and 11%, respectively, for CO (Figure 3.40).

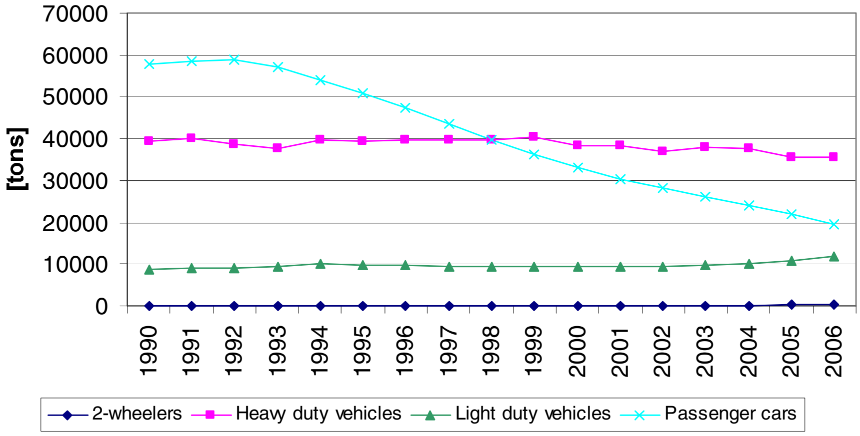


Figure 3.37 NO_X emissions (tonnes) per vehicle type for road transport 1990-2006

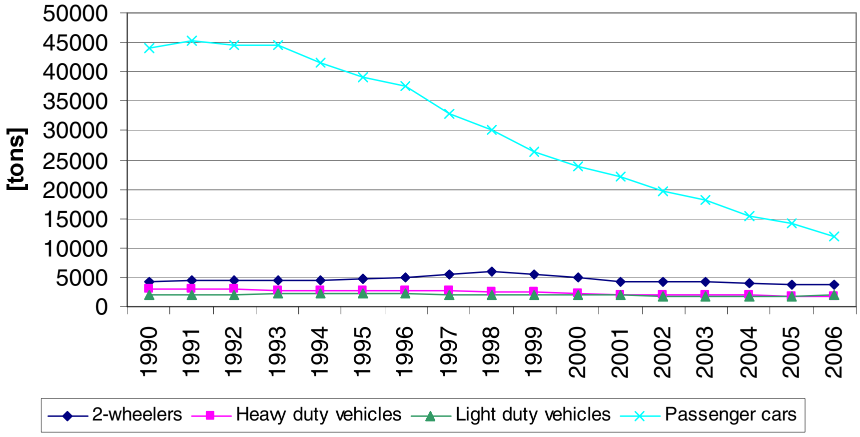


Figure 3.38 NMVOC emissions (tonnes) per vehicle type for road transport 1990-2006

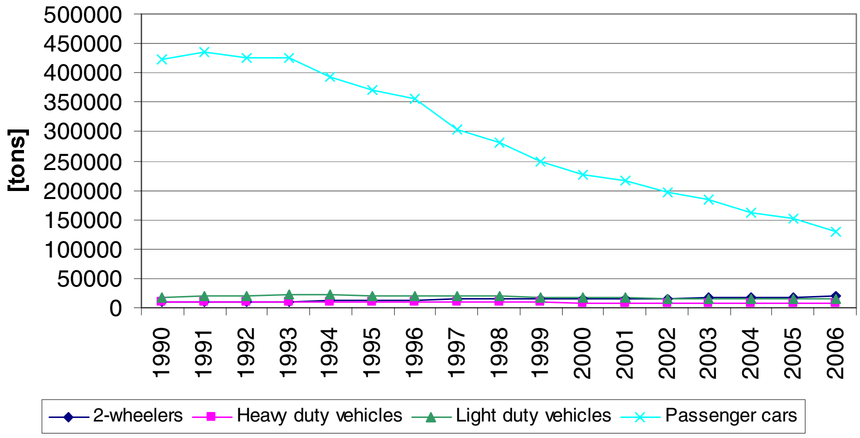


Figure 3.39 CO emissions (tonnes) per vehicle type for road transport 1990-2006

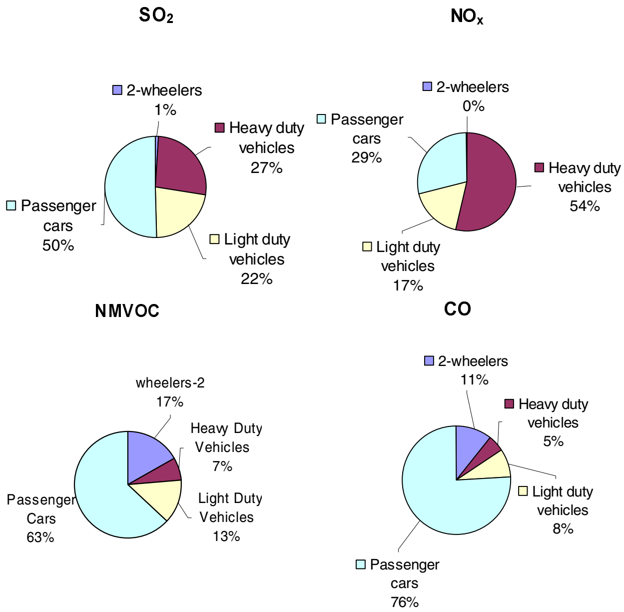


Figure 3.40 SO_2, NO_X, NMVOC and CO emission shares per vehicle type for road transport in 2006

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.

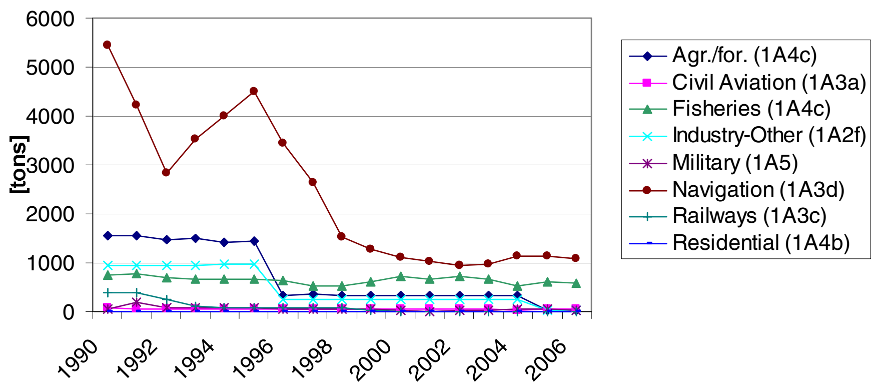


Figure 3.41 SO_2 emissions (k-tonnes) in CRF sectors for other mobile sources 1990-2006

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 47, 25, 17 and 8%, 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 1990's. 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 2006 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.

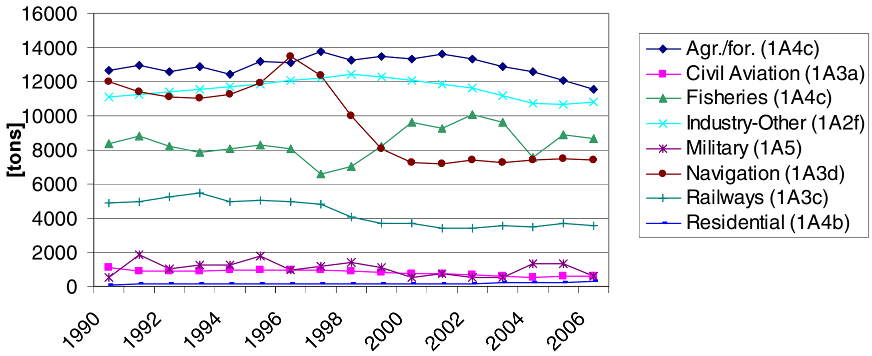


Figure 3.42 NO_X emissions (tonnes) in CRF sectors for other mobile sources 1990-2006

The 1990-2006 time-series of NMVOC and CO emissions are shown in Figures 3.43 and 3.44 for other mobile sources. The 2006 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 2006 emission shares of 58, 19, 11 and 9%, respectively. The same four sectors also contribute with most of the CO emissions in the same consecutive order; the emission shares are 72, 14, 6 and 6%, 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.

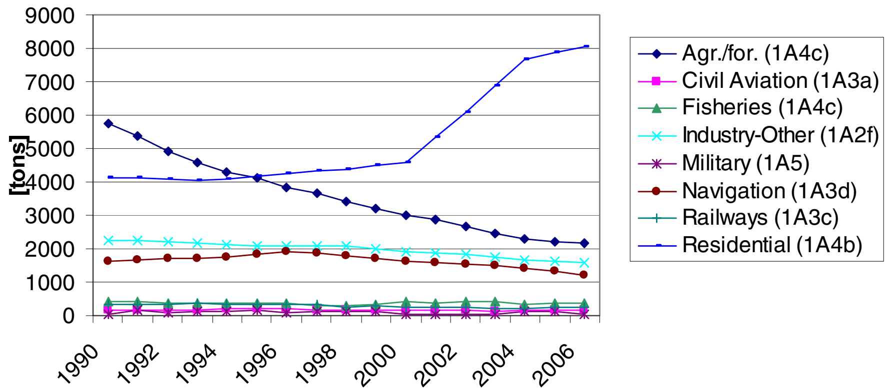


Figure 3.43 NMVOC emissions (tonnes) in CRF sectors for other mobile sources 1990-2006

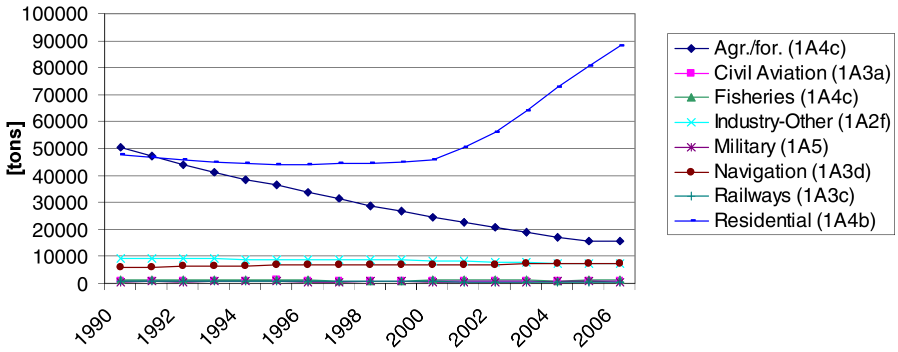


Figure 3.44 CO emissions (tonnes) in CRF sectors for other mobile sources 1990-2006

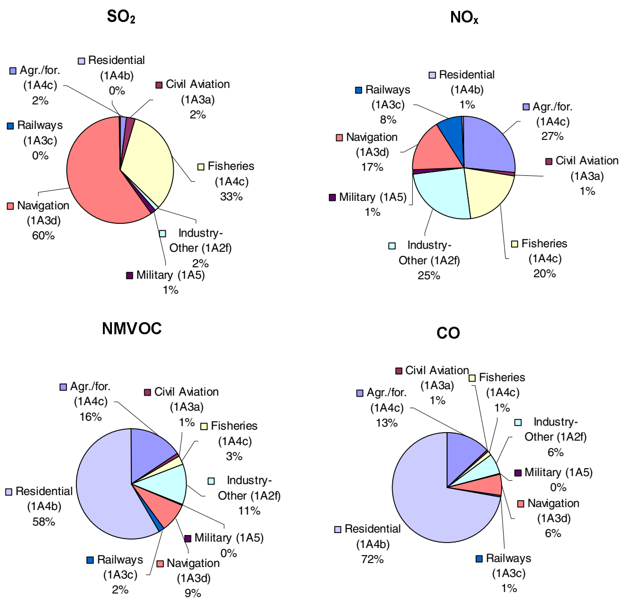


Figure 3.45 SO_2, NO_X, NMVOC and CO emission shares for other mobile sources in 2006

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 3.21 for 2006, split into sea transport and civil aviation. All emission figures in the 1990-2006 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 2006.

Table 3.21 Emissions in 2006 for international transport and national totals

CRF sector	SO_2	NO_X	NMVOC	CH_4	CO	CO_2	N_2O
	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[k-tonnes]	[tonnes]
Navigation int. (1A3d)	52 936	84 716	2 643	82	8 719	3 433	216
Civil Aviation int. (1A3a)	825	11 175	492	52	1 871	2 583	89
International total	53 761	95 891	3 135	134	10 589	6 016	305

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).

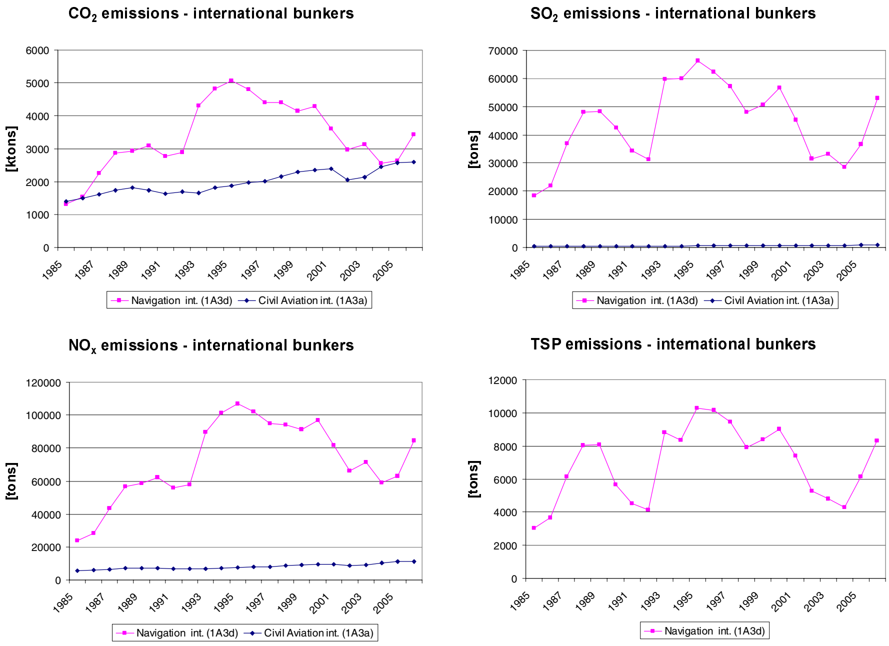


Figure 3.46 CO_2, SO_2, NO_X and TSP emissions for international transport 1990-2006

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/CORIN-AIR, 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, subclasses 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 subclasses, 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/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). For 2006, the information for 2005 is used, due to lack of data.

The new Danish mileage data is distributed into annual mileage per 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 2006 has been obtained from Statistics Denmark (Dalbro, 2007), 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 per 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, 2007).

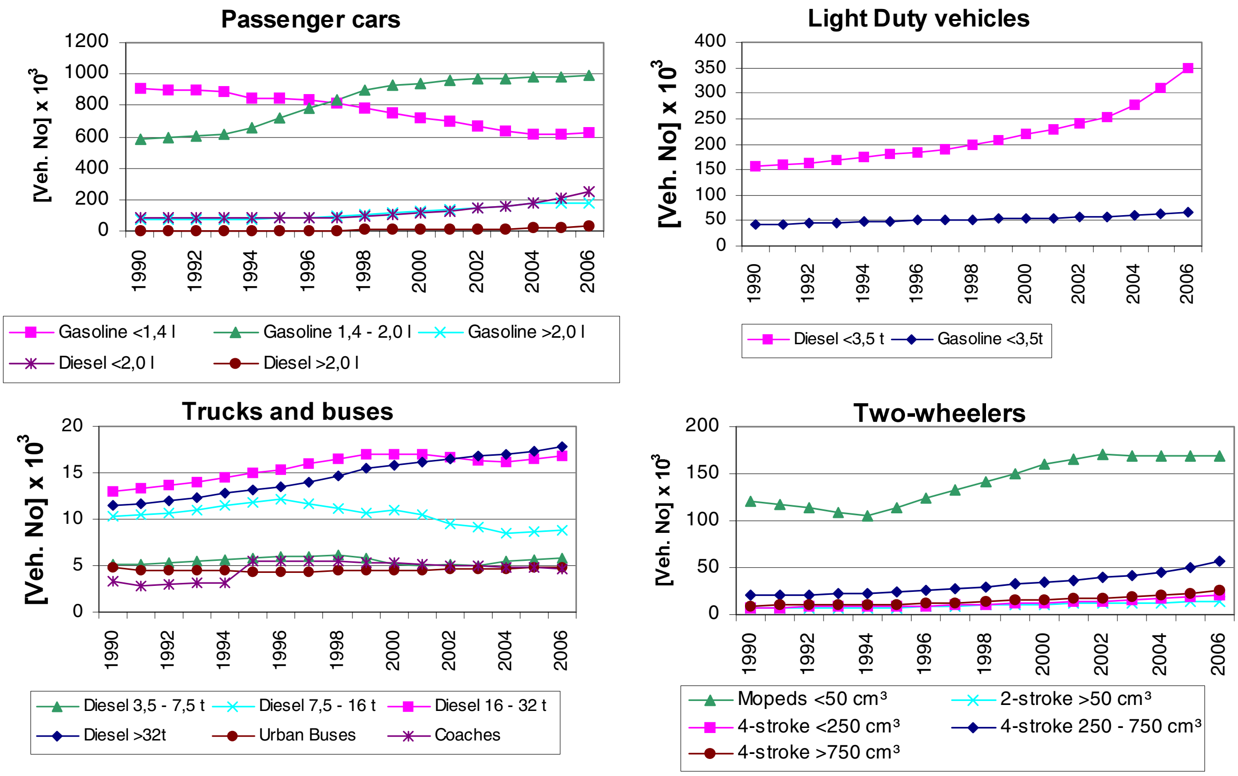


Figure 3.47 Number of vehicles in sub-classes in 1990-2006

The vehicle numbers per sub-class are shown in Figure 3.47. It must be noted that for 2005 and 2006, 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 1990-2006 period. The increase is, however, most visible from the mid-1990s and onwards.

The vehicle numbers are summed up in 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 per layer are calculated as the sum of all mileage driven per first registration year divided by the total number of vehicles in the specific layer.

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

Vehicle numbers and weighted annual mileages per layer are shown in Annex 3.B.1 and 3.B.2 for 1990-2006. The trends in vehicle numbers per 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.

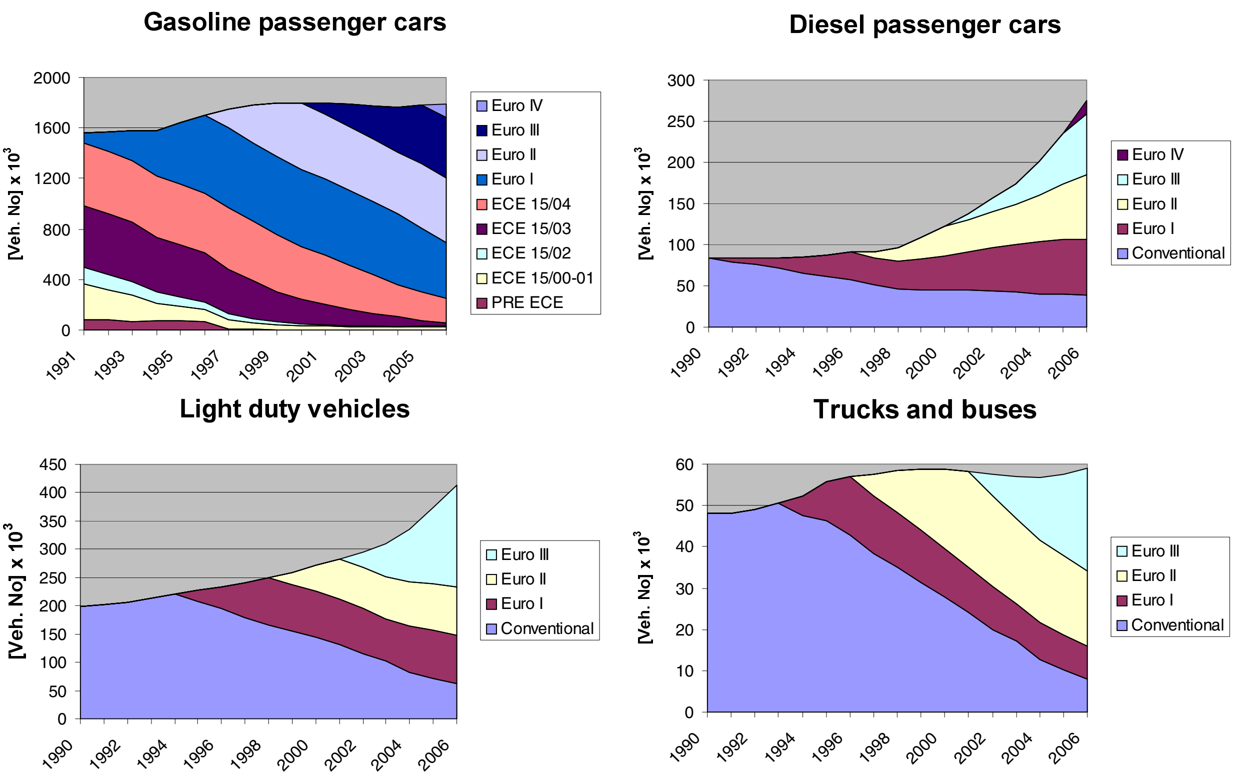


Figure 3.48 Layer distribution of vehicle numbers per vehicle type in 1990-2006

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/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/km by 2012; from 1995 to 2004 average emissions from new cars sold in the EU-15 fell from 186g CO_2/km to 163g CO_2/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/km target by 2012. Improvements in vehicle technology would have to reduce average emissions to no more than 130g/km, while complementary measures would contribute a further emissions cut of up to 10g/km, thus reducing overall emissions to 120g/km. These complementary measures include 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/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 cycle[1] (average speed: 19 km/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/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[2]: 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.

[1] 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.

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

Table 3.23 Simplified overview of the existing EU emission directives for road transport vehicles

Vehicle category	Emission layer	EU directive	First reg. year start
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	1991[e]
	Euro II	94/12	1997
	Euro III	98/69	2001
	Euro IV	98/69	2006
	Euro V	715/2007	2011
	Euro VI	715/2007	2015
Passenger cars (diesel and LPG)		Conventional	0
	ECE 15/04	83/351	1987[d]
	Euro I	91/441	1991[e]
	Euro II	94/12	1997
	Euro III	98/69	2001
	Euro IV	98/69	2006
	Euro V	715/2007	2011
	Euro VI	715/2007	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	1995
	Euro II	96/69	1999
	Euro III	98/69	2002
	Euro IV	98/69	2007
	Euro V	715/2007	2012
	Euro VI	715/2007	2016
Heavy duty vehicles		Conventional	0
	Euro 0	88/77	1991
	Euro I	91/542	1994
	Euro II	91/542	1997
	Euro III	1999/96	2002
	Euro IV	1999/96	2007
	Euro V	1999/96	2010
Mopeds		Conventional	0
	Euro I	97/24	2000
	Euro II	2002/51	2004
Motor cycles		Conventional	0
	Euro I	97/24	2000
	Euro II	2002/51	2004
	Euro III	2002/51	2007

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/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/kWh from emission approval tests cannot be directly used for inventory work. Instead, emission factors used for national estimates must be transformed into g/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 per 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 per 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/h, respectively.

Firstly, the deterioration factors are calculated for the corresponding trip speeds of 19 and 63 km/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/h the deterioration factor, DF, equals UDF, whereas for trip speeds exceeding 63 km/h, DF=EUDF. For trip speeds between 19 and 63 km/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 per 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 per 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, 2007). 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.

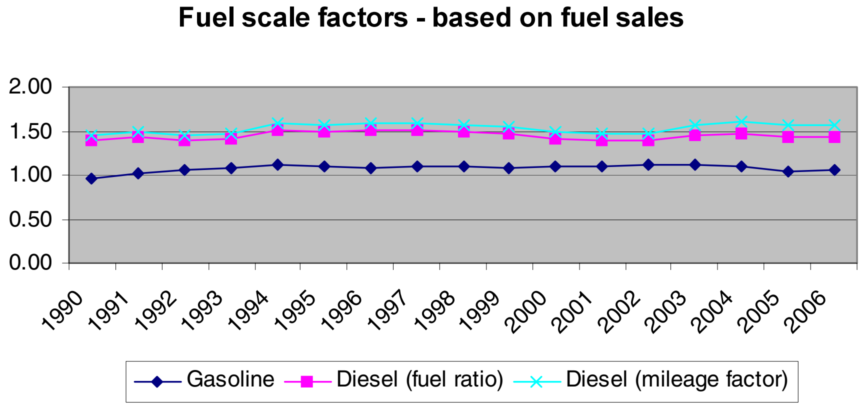


Figure 3.49 DEA:NERI Fuel ratios and diesel mileage adjustment factor based on DEA fuel sales data and NERI fuel consumption estimates

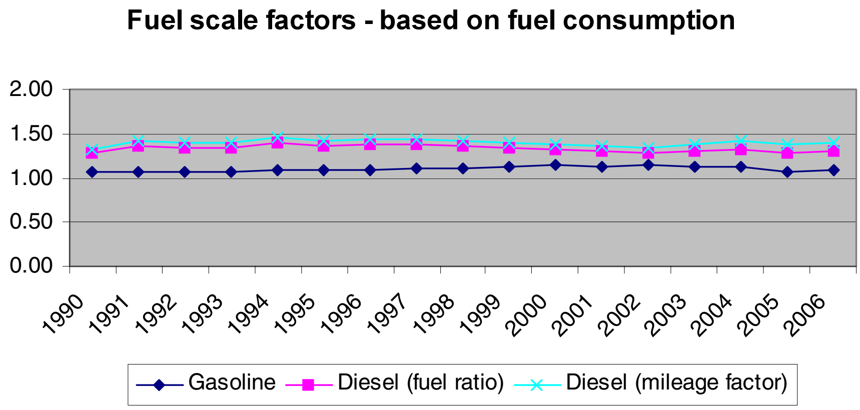


Figure 3.50 DEA:NERI Fuel ratios and diesel mileage adjustment factor based on DEA fuel consumption data and NERI fuel consumption estimates

In the figures 3.49 and 3.50 the COPERT IV:DEA gasoline and diesel fuel consumption ratios are shown for fuel sales and fuel consumption from 1990-2006. 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 per vehicle type are shown in Annex 3.B.6 for 1990-2006. The total fuel consumption and emissions are shown in Annex 3.B.7, per vehicle category and as grand totals, for 1990-2006 (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 2006.

In the following Figures 3.51-3.54, the fuel related emission factors for CH_4 and N_2O are shown per vehicle type for the Danish road transport (from 1990-2006). For CO_2 the emission factors are country specific values, and come from the DEA. The CO_2 factors are shown per fuel type in Table 3.24.

Table 3.24 Fuel-specific emission factors for CO_2, CH_4 and N_2O for road transport in Denmark

Fuel type	CO_2 [kg/GJ]
Gasoline	73
Diesel	74
LPG	65

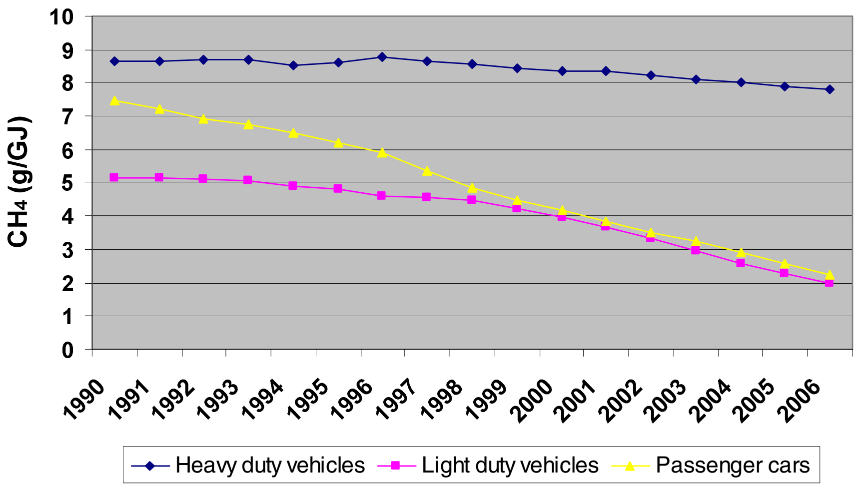


Figure 3.51 Fuel related CH_4 emission factors (diesel) per vehicle type for Danish road transport (1990-2006)

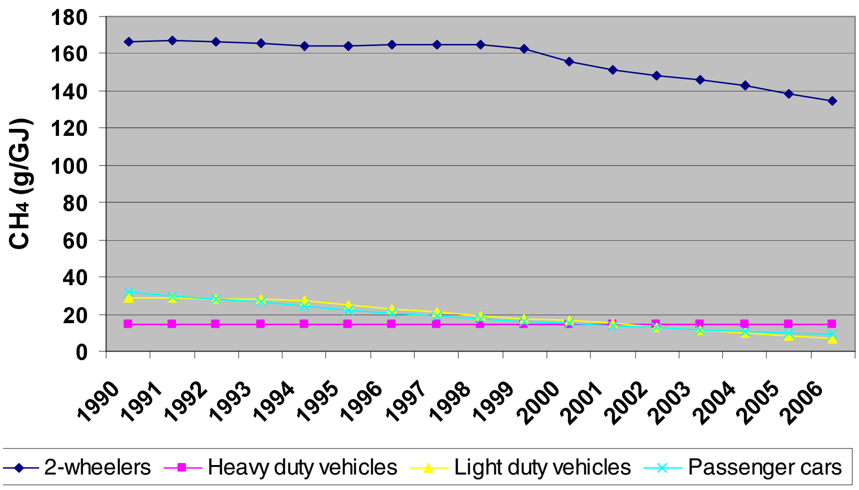


Figure 3.52 Fuel related CH_4 emission factors (gasoline) per vehicle type for Danish road transport (1990-2006)

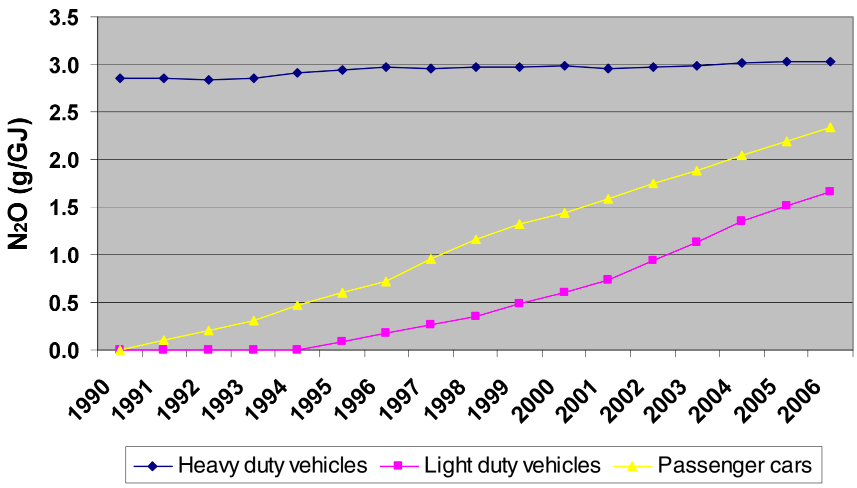


Figure 3.53 Fuel related N_2O emission factors (diesel) per vehicle type for Danish road transport (1990-2006)

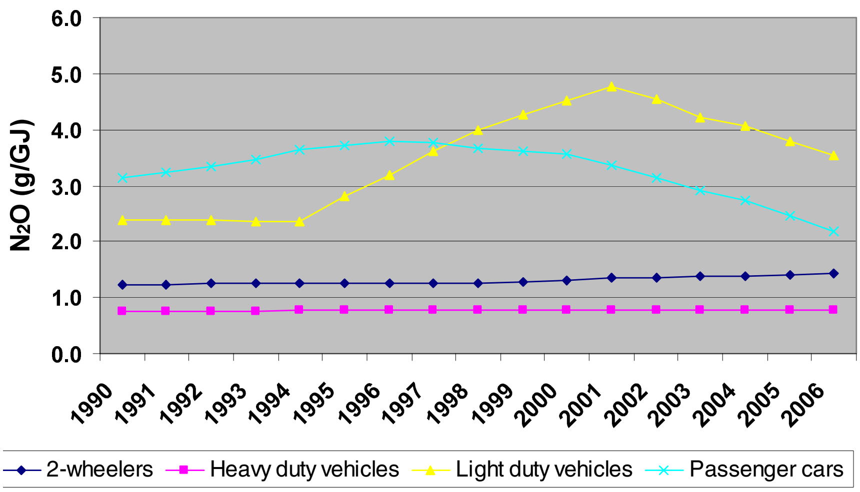


Figure 3.54 Fuel related N_2O emission factors (gasoline) per vehicle type for Danish road transport (1990-2006)

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

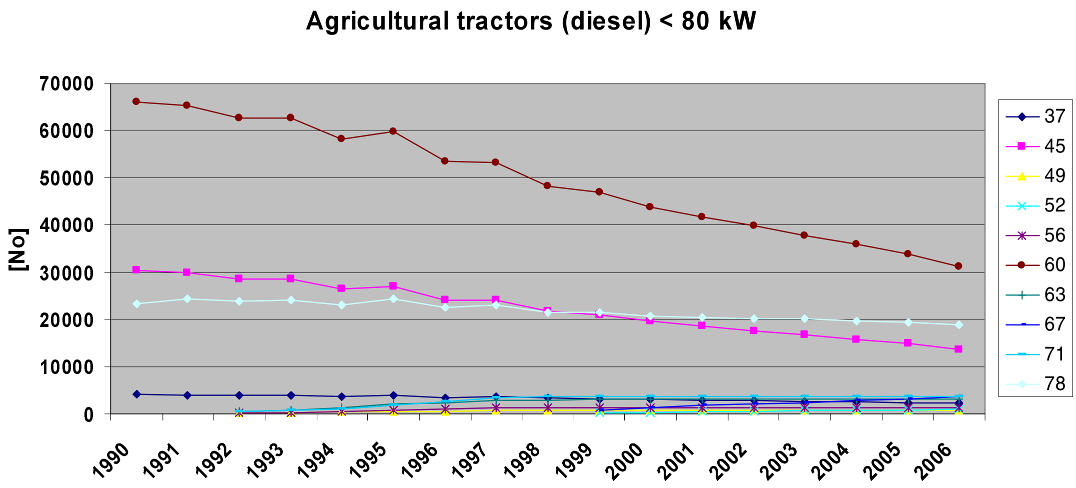
The activity data for air traffic consists of air traffic statistics provided by the Danish Civil Aviation Agency (CAA-DK) and Copenhagen Airport. For 2001 onwards, per flight records are provided by CAA-DK as data for aircraft type, and origin and destination airports. For inventory years prior to 2001, 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. Fuel statistics for jet fuel consumption and aviation gasoline are obtained from the Danish energy statistics (DEA, 2007).

Prior to emission calculations, the aircraft types are grouped into a smaller number of representative aircraft groups, for which fuel consumption and emission data exist in the EMEP/CORINAIR databank. In this procedure, actual aircraft types are classified according to their overall aircraft type (jets, turbo props, helicopters and piston engines). Secondly, information on the aircraft MTOM (Maximum Take Off Mass) and number of engines are used to append a representative aircraft to the aircraft type in question. A more thorough explanation is given in Winther (2001a, b).

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 1990-2006 for the most important types of machinery are shown in Figures 3.51-3.58 below. 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 per year are shown in the Figures 3.55-3.56, respectively. The Figures clearly show a decrease in the number of small machines, these being replaced by machines in the large engine-size ranges.



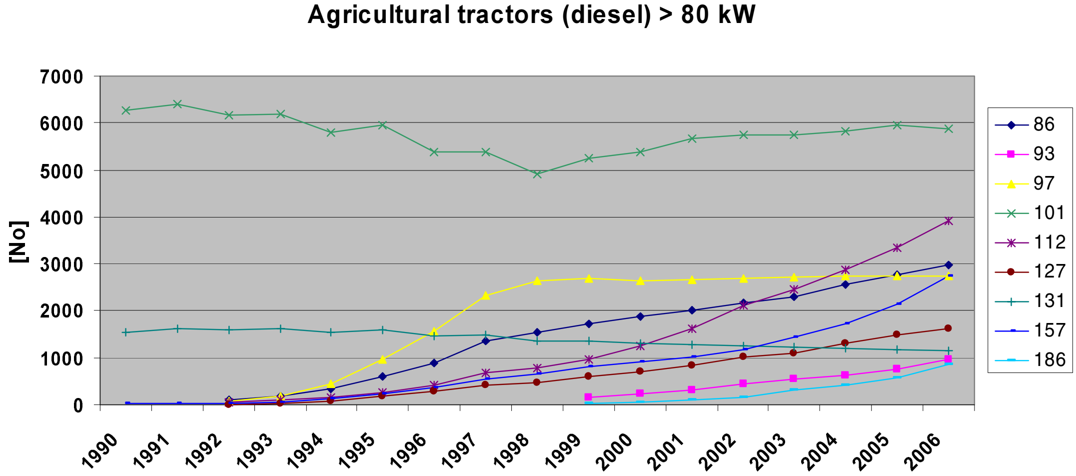


Figure 3.55 Total numbers in kW classes for tractors from 1990 to 2006

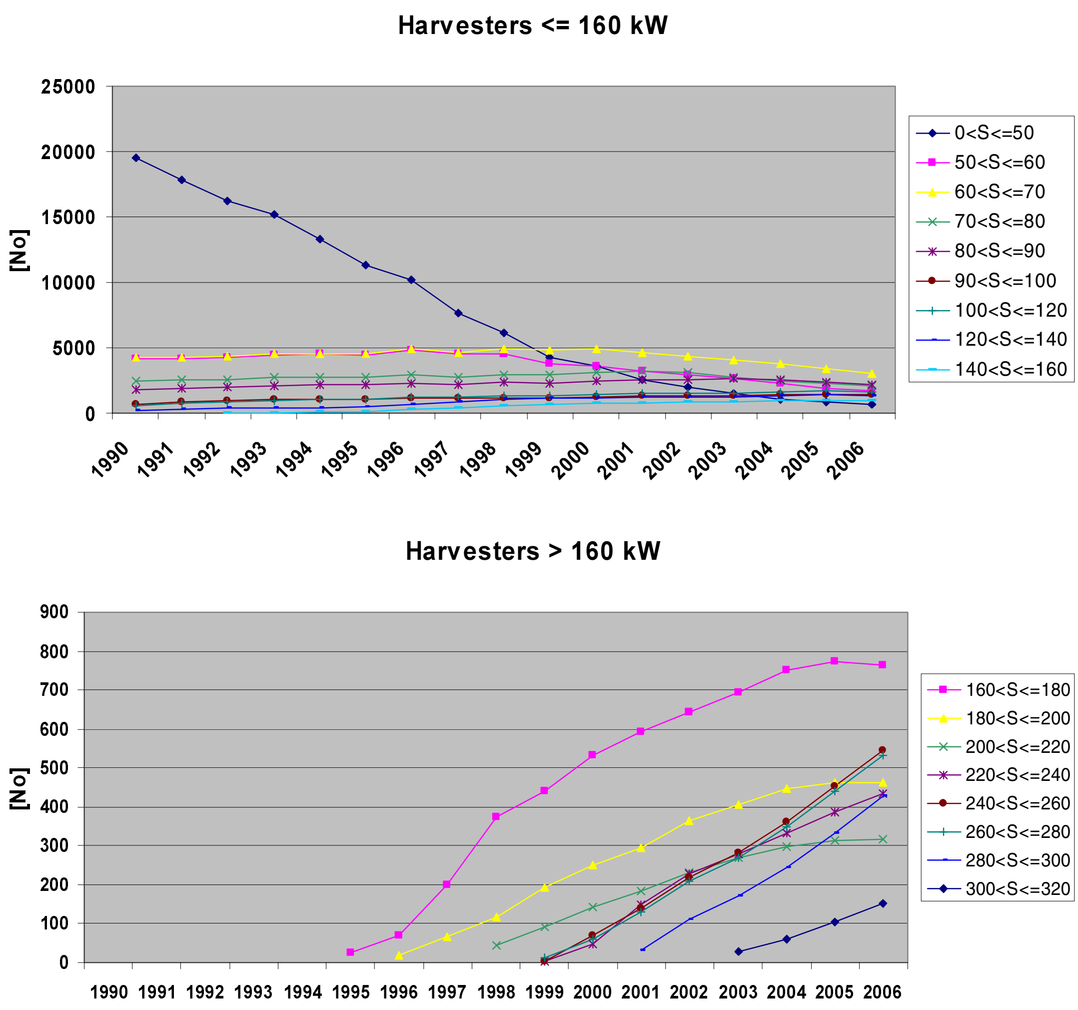


Figure 3.56 Total numbers in kW classes for harvesters from 1990 to 2006

The tractor and harvester developments towards fewer vehicles and larger engines, shown in Figure 3.57, are very clear. From 1990 to 2006, tractor and harvester numbers decrease by around 22 % and 45 %, respectively, whereas the average increase in engine size for tractors is 19 %, and more than 100 % for harvesters, in the same time period.

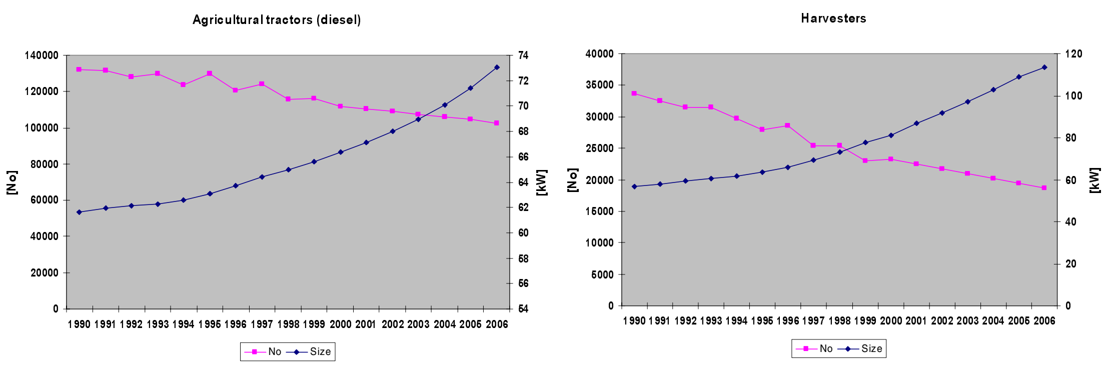
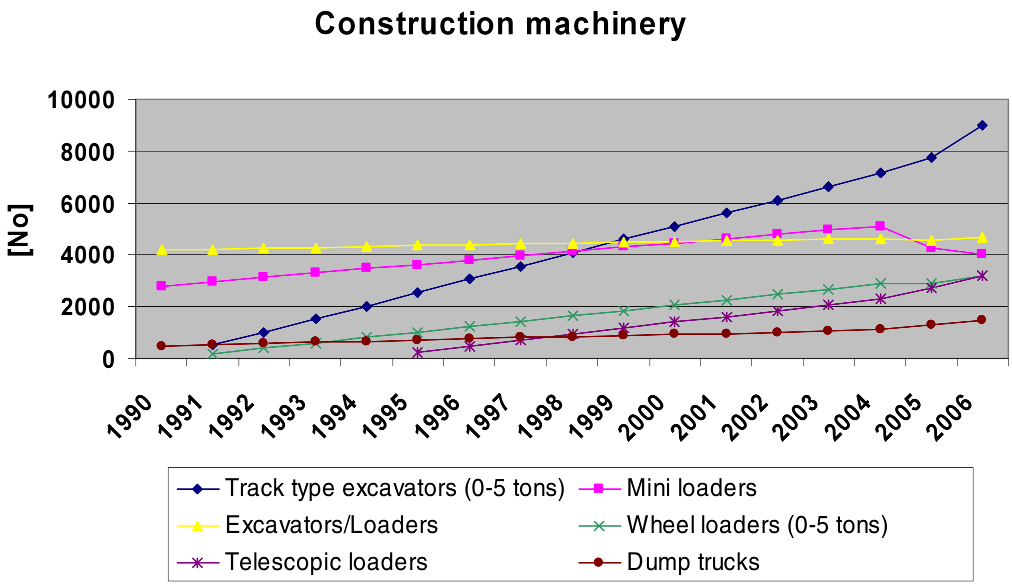


Figure 3.57 Total numbers and average engine size for tractors and harvesters (1990 to 2006)

The most important machinery types for industrial use are different types of construction machinery and fork lifts. The Figures 3.58 and 3.59 show the 1990-2006 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.



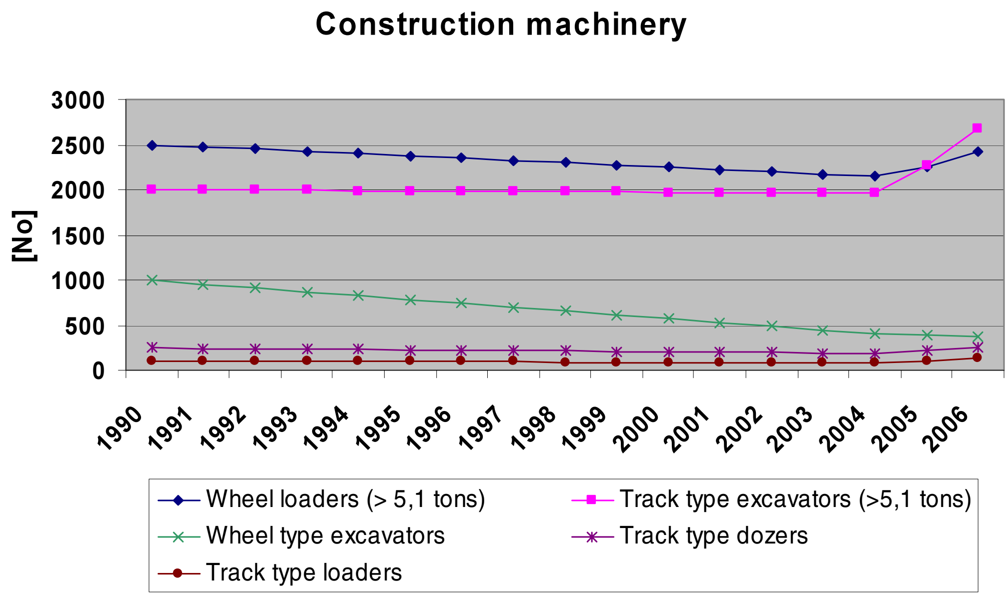


Figure 3.58 1990-2006 stock development for specific types of construction machinery

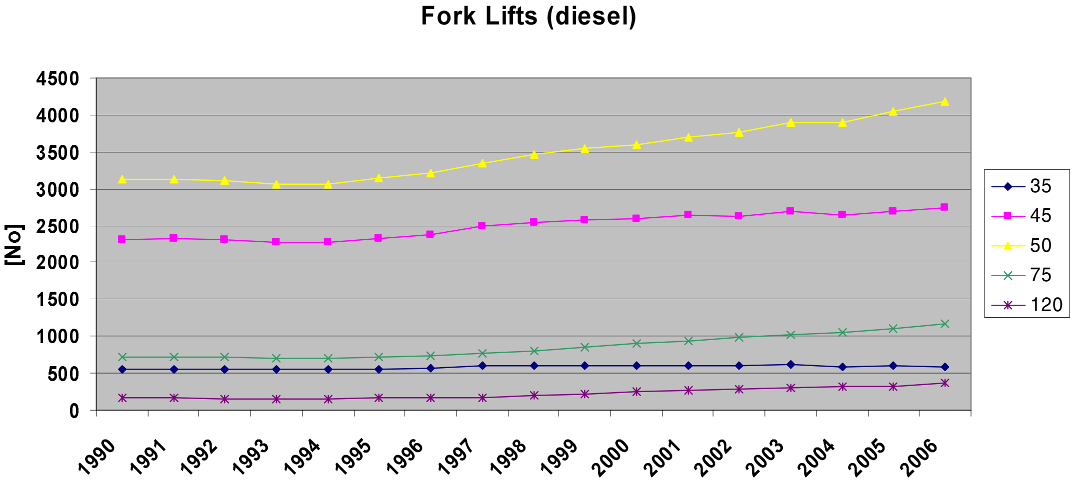


Figure 3.59 Total numbers of diesel fork lifts in kW classes from 1990 to 2006

The emission level shares for tractors, harvesters, construction machinery and diesel fork lifts are shown in Figure 3.60, 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 3.60. 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 3.60.

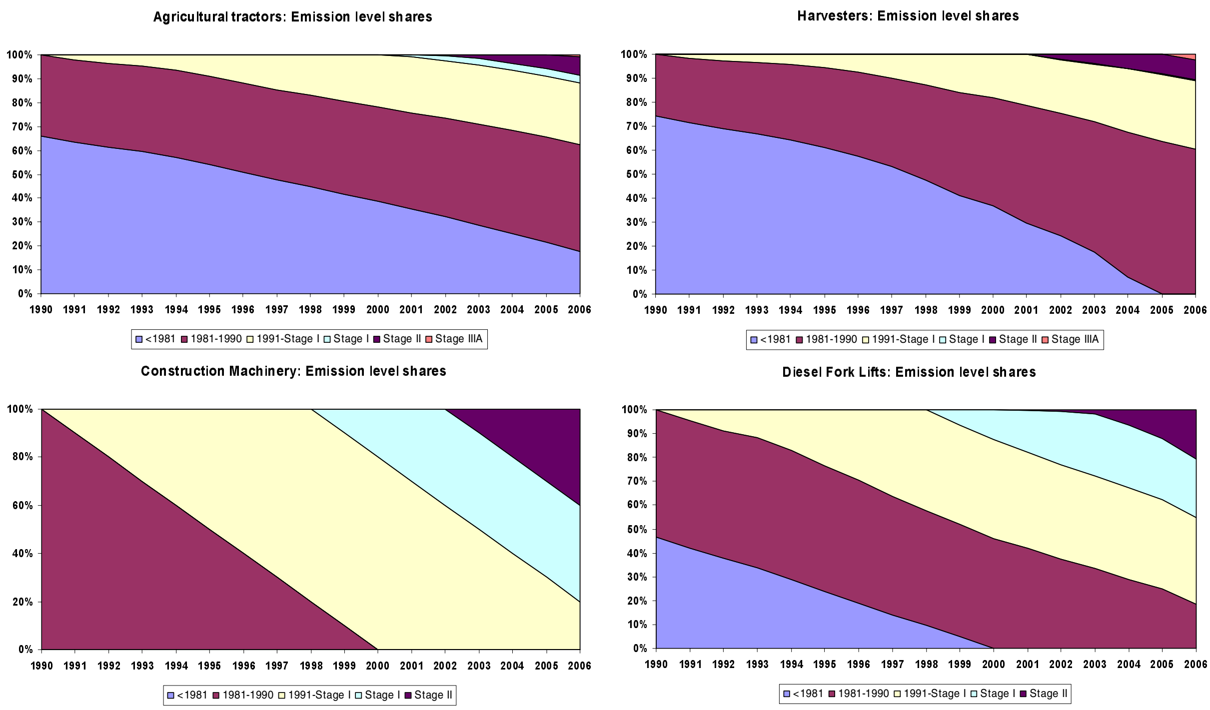


Figure 3.60 Emission level shares for tractors, harvesters, construction machinery and diesel fork lifts (1990 to 2006)

The 1990-2006 stock development for the most important household and gardening machinery types is shown in Figure 3.61.

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.

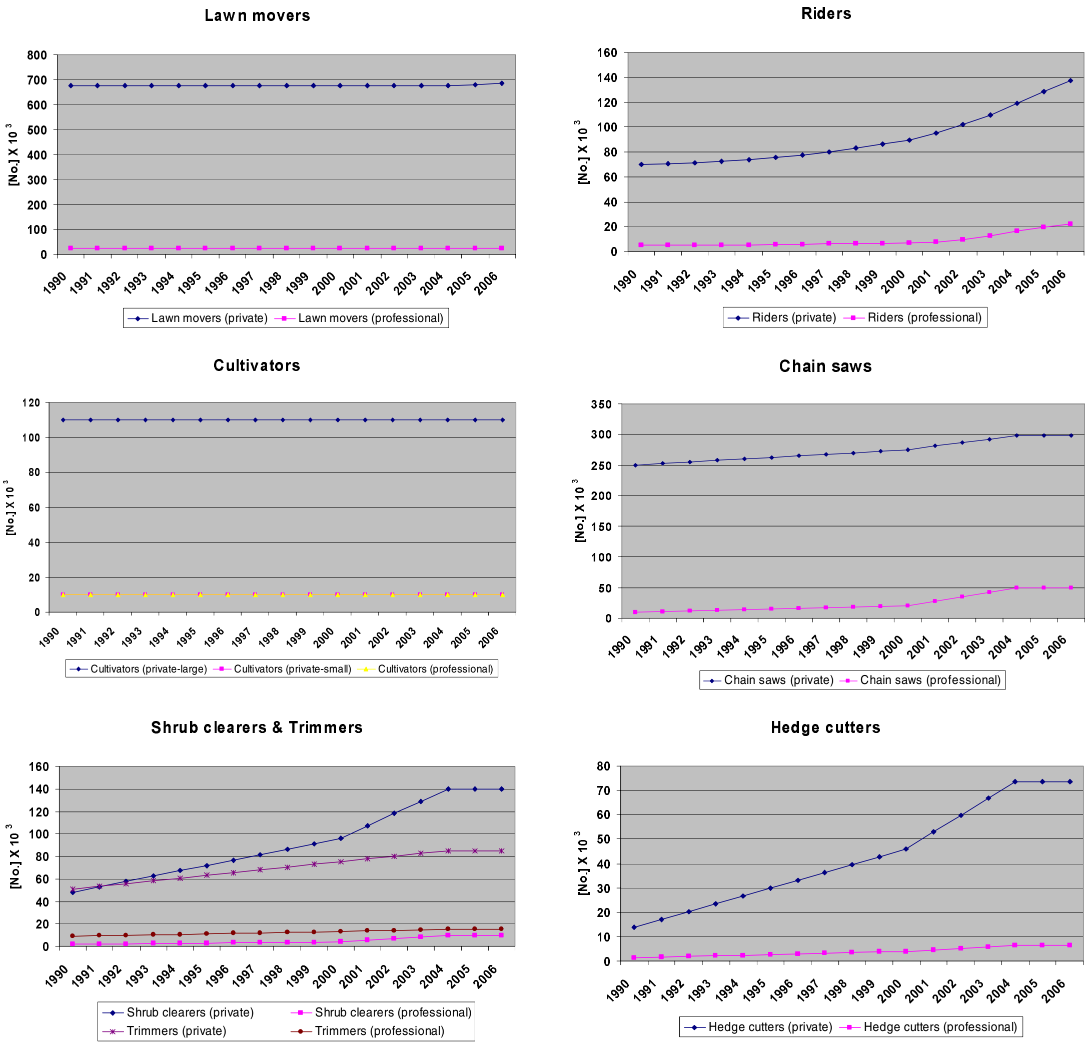


Figure 3.61 Stock development 1990-2006 for the most important household and gardening machinery types

Figure 3.62 shows the development in numbers of different recreational craft from 1990-2006. The 2004 stock data for recreational craft are repeated for 2005-2006, 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).

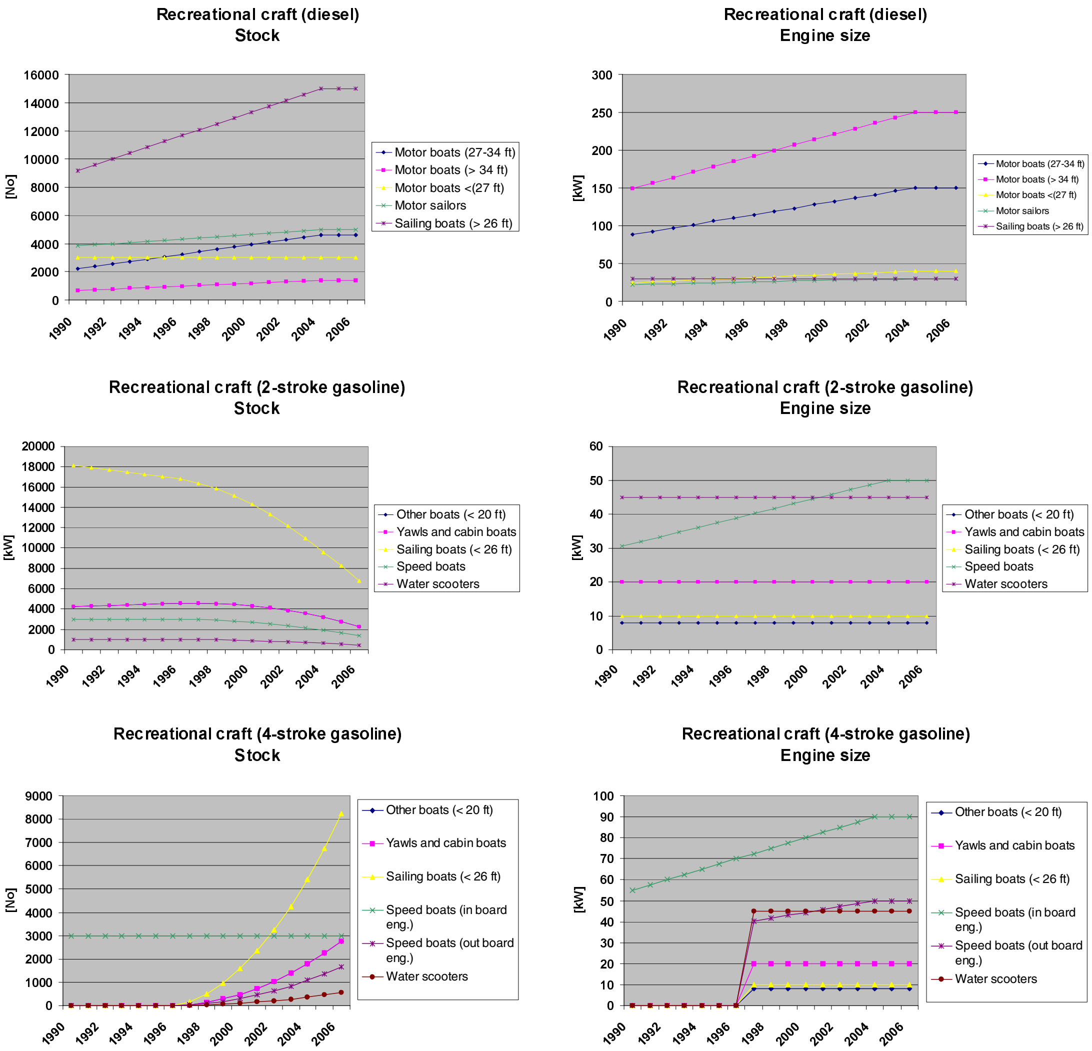


Figure 3.62 1990-2006 Stock and engine size development for recreational craft

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, 2008).

Table 3.26 lists the most important domestic ferry routes in Denmark in the period 1990-2006. For these ferry routes the following detailed traffic and technical data have been gathered: Ferry name, year of service, engine size (MCR), engine type, fuel type, average load factor, auxiliary engine size and sailing time (single trip).

Table 3.25 Ferry routes comprised in the present project

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-

The number of round trips per ferry route is shown in Figure 3.63. 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, auxillary engine size and sailing time (single trip).

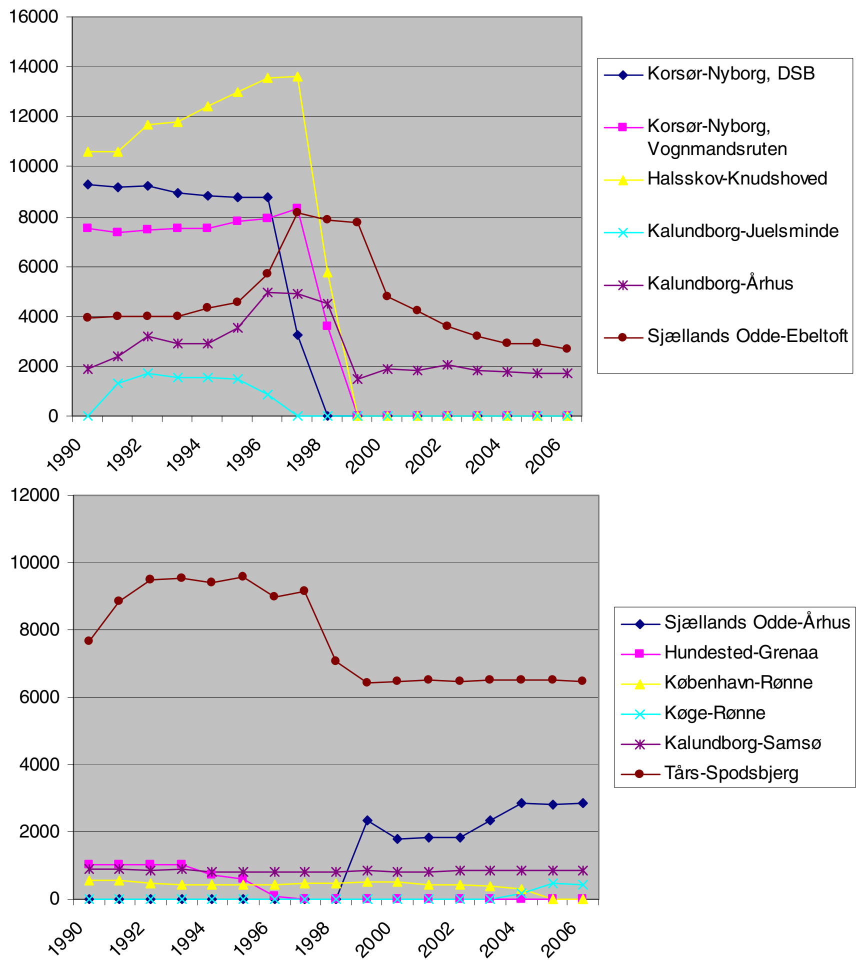


Figure 3.63 No. of round trips for the most important ferry routes in Denmark 1990-2006

It is seen from Table 3.25(and Figure 3.63) 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 (2008).

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 (2008) 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 (2008) 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/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 als o 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 [g/kWh]	VOC	NO_X	$VOC+NO_X$	PM	Diesel machinery EU Directive	Implement. date Transient	Implement. date Constant	Tractors EU directive	Tractors Implement. 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/kWh]	HC [g/kWh]	NO_X [g/kWh]	$HC+NO_X$ [g/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/kWh]	HC [g/kWh]	NO_X [g/kWh]	$HC+NO_x$ [g/kWh]	PM [g/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 1th of 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 1th of 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 31th of December 1995, and for which the production date of the individual engine is on or before 31th December 1999.

b) For engines of a type or model for which the date of manufacture of the first individual production model is after 31th of December 1995, or for individual engines with a production date after 31th December 1999.

c) For engines of a type or model for which the date of manufacture of the first individual production model is after 31th of December 2003.

d) For engines of a type or model for which the date of manufacture of the first individual production model is after 31th of December 2007.

A further description of the technical definitions in relation to engine certification, the emission certification limits, 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, kept 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/kWh, n < 130 RPM
- 45 x n-0.2 g/kWh, 130 ≤ n < 2000 RPM
- 9,8 g/kWh, n ≥ 2000 RPM

Fuel legislation

Table 3.30 shows the current legislation in relation to sulphur content in heavy fuel and marine gas oil used by ship engines.

Table 3.30 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		

[1] Sulphur content limit for fuel sold inside EU

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). The NMVOC/CH_4 split is taken from EMEP/CORINAIR (2007). The baseline 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 3.31 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[3]		
					CH_4 [g/GJ]	CO_2 [kg/GJ]	N_2O [g/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 estimates are made separately for landing and take- off (LTOs < 3000 ft), and cruising (> 3000 ft). From 2001, the estimates are made on a city-pair level by combining activity data and emission factors and subsequently grouping the emission results into domestic and inter-

[3] 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.

national totals. The overall fuel precision in the model is around 0.8, derived as the fuel ratio of model estimates to statistical sales. The fuel difference is accounted for by adjusting the cruise fuel consumption and emissions in the model, according to the domestic and international cruise fuel shares.

Prior to 2001, the calculation scheme involved firstly estimation of each year's fuel consumption and emissions for LTO. Secondly, the total cruise fuel consumption was found, year for year, as the statistical fuel consumption total minus the calculated fuel consumption for LTO. Lastly, the cruise fuel consumption was split into a domestic and an international part, by using the results from a Danish city-pair emission inventory in 1998 (Winther, 2001a). For more details of the 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 consumption and emissions in year X, for a given machinery type, engine size and engine age, are calculated as:

$$E_{Basis}(X)_{i,j,k} = N_{i,j,k} \cdot HRS_{i,j,k} \cdot P \cdot LF_i \cdot EF_{y,z} \quad (13)$$

where E_{Basis} = fuel consumption/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 consumption/emission factor in g/kWh, i = machinery type, j = engine size, k = engine age, y = engine-size class and z = emission level. The basic fuel consumption and emission factors are shown in Annex 3.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:

$$DF_{i,j,k}(X) = \frac{K_{i,j,k}}{LT_i} \cdot DF_{y,z} \quad (14)$$

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:

$$DF_{i,j,k}(X) = \sqrt{\frac{K_{i,j,k}}{LT_i}} \cdot DF_{y,z} \quad (15)$$

The deterioration factors inserted in (14) and (15) are shown in Annex 3.B.9. No deterioration is assumed for fuel consumption (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:

$$TF_{i,j,k}(X) = TF_z \quad (16)$$

Where i = machinery type, j = engine size, k = engine age and z = emission level.

The transient factors inserted in (16) are shown in Annex 3.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 consumption and emissions in year X for a given machinery type, engine size and engine age, is the product of the expressions 13-16:

$$E(X)_{i,j,k} = E_{Basis}(X)_{i,j,k} \cdot TF(X)_{i,j,k} \cdot (1 + DF(X)_{i,j,k}) \quad (17)$$

The evaporative hydrocarbon emissions from fuelling are calculated as:

$$E_{Evap,fueling,i} = FC_i \cdot EF_{Evap,fueling} \quad (18)$$

Where $E_{Evap,fueling}$, = hydrocarbon emissions from fuelling, i = machinery type, FC = fuel consumption in kg, $EF_{Evap,fueling}$ = emission factor in g NMVOC/kg fuel.

For tank evaporation, the hydrocarbon emissions are found from:

$$E_{Evap,\tan k,i} = N_i \cdot EF_{Evap,\tan k,i} \quad (19)$$

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/year.

Ferries, other national sea transport and fisheries

The fuel consumption and emissions in year X, for ferries are calculated as:

$$E(X) = \sum_i N_i \cdot T_i \cdot S_{i,j} \cdot P_i \cdot LF_j \cdot EF_{k,l,y} \quad (20)$$

Where E = fuel consumption/emissions, N = number of round trips, T = sailing time per round trip in hours, S = ferry share of ferry service round trips, P = engine size in kW, LF = engine load factor, EF = fuel consumption/emission factor in g/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:

$$E(X) = \sum_i EC_{i,k} EF_{k,l,y} \quad (21)$$

Where E = fuel consumption/emissions, EC = energy consumption, EF = fuel consumption/emission factor in g/kg fuel, i = category (ferry boats, other national sea, fishery, international sea), k = fuel type, l = engine type, y = average engine year.

The emission factor inserted in (21) 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:

$$EF_{k,l,y} = \frac{\sum_{year=X}^{year=X-LT} EF_{k,l}}{LT_{k,l}} \quad (22)$$

Other sectors

For military and railways, the emissions are estimated with the simple method using fuel-related emission factors and fuel consumption from the DEA:

$$E = FC \cdot EF \quad (23)$$

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 2006 and as time-series 1990-2006 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, 2008) 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 (2008) 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, 2008). 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 3.32 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	62

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 a sector report for road transport and other mobile sources every second year. The last sector report prepared concerned the 2004 inventory.

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, 2008), 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 per 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 (2008). 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 per 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, 2008). 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 (2008), 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 per year (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 2006.

Road transport

An error in the distribution of the total mileage between passenger cars and vans has been corrected, and this change in input data has given slight emission changes. The mileage for passenger cars has been reduced in the new situation, and due to the fuel balance in the calculation model for diesel, more fuel has been allocated to vans and heavy duty vehicles.

Also changes have been made to the gasoline fuel consumption input data for the NERI model, throughout the 1990-2005 periods. The gasoline fuel consumption generally increases, due to a reduced gasoline consumption calculated for non road working machinery in the same years. This latter fuel amount is being subtracted from the road transport sales of gasoline reported by the DEA, prior to NERI road transport model input.

Moreover, the emission factors of CH_4 and N_2O have been updated due to new emission data provided by the COPERT IV model developers.

The changes in fuel consumption figures and emission factors cause the emissions from road transport to change in the 1990-2005 time series.

National sea transport

Based on new research findings, the fuel consumption of heavy oil and gas oil for national sea transport is now calculated directly by NERI. Fuel adjustments are made in the fishery sector (gas oil) and stationary industry sources (heavy fuel oil) in order to maintain the grand national energy balance. The fuel consumption changes for national sea transport cause the CO_2, CH_4 and N_2O emissions to change from 1990 to 2005.

Fisheries

Fuel adjustments are made for gas oil, which affects the emissions of CO_2, CH_4 and N_2O for this sector. The emission changes for fisheries are followed by the opposite emission changes in national sea transport of approximately the same absolute values.

Military

Emission factors derived from the new road transport simulations have caused minor emission changes of CH_4 and N_2O from 1990-2005.

Residential

The emissions somewhat decrease due to a smaller amount of fuel used by gasoline fuelled working machinery.

Agriculture

Updated stock information for ATV's 2002-2005, has given a small fuel use and emissions increase for these years.

Railways

No changes have been made.

Inland waterways

No changes have been made.

Aviation

No changes have been made.

Uncertainties

The uncertainty factors for activity data have been changed to reflect specific national knowledge (Winther, 2008) in national sea transport (a part of 1A3d: Navigation).

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 source 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.

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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, 2007b). 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 – 12.3 PJ in 2006.

In 2006 the fuel consumption rates in the two approaches differ by -1.44% and the CO_2 emission differs by -0.30%. In the period 1990-2006 both the fuel consumption and the CO_2 emission differ by less than 1.6%. 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.

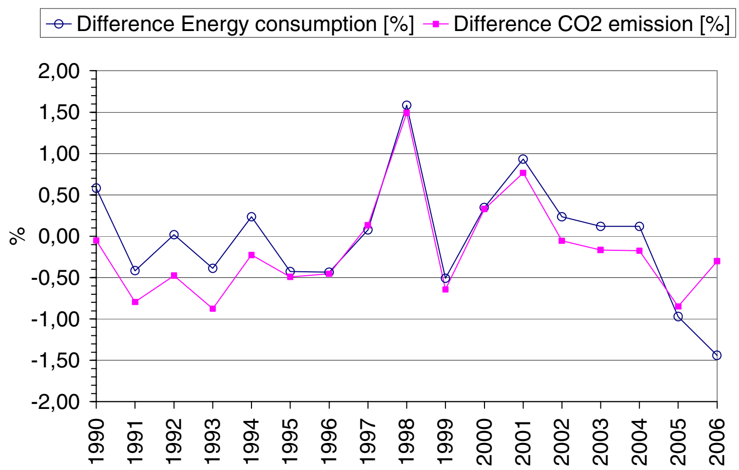

Figure 3.61 Comparison of the reference approach and the national approach.

3.5 Fugitive emissions (CRF sector 1B)

3.5.1 Source category description

Fugitive emission from solid fuels, CRF sector 1B1c

Coal mining is not occurring in Denmark and no emissions are estimated for solid fuel.

Fugitive emissions from oil (1B2a)

The category "Fugitive emissions from oil (1B2a)" includes emissions from offshore activities and refineries.

Fugitive emissions from natural gas, transmission and distribution (CRF sector 1B2b)

In the year 2006, the length of transmission pipelines excluding offshore pipelines was 860 km. The length of distribution pipelines was 18959 km in 2006 (cast iron 0 km, steel 1896 km, plastics 17063 km). Two natural gas storage facilities are in operation in Denmark. In 2006 the gas input was 727 Mm^3 and the withdrawal was 596 Mm^3. Emission from gas storage is included in transmission. The transmission and distribution data are based on information from the Danish gas transmission company DONG (Oertenblad, 2007).

Flaring, gas (CRF sector 1B2c, Flaring ii)

Offshore flaring of natural gas is the main source of emissions in the Fugitive emission sector. Flaring in gas treatment and gas storage plants are, however, also included in the sector.

3.5.2 Methodological issues

Fugitive emissions from oil (1B2a)

Offshore activities

Emissions from offshore activities include emissions from extraction of oil and gas, onshore oil tanks, onshore and offshore loading of ships.

The total emission can then be expressed as:

$$E_{total} = E_{extraction} + E_{ship} + E_{oil\ tanks} \qquad (3.5.1)$$

Fugitive emissions from extraction

According to the EMEP/CORINAIR Guidebook (EMEP/CORINAIR, 2007) the total fugitive emissions of VOC from extraction can be estimated by means of Equation 3.5.2.

$$E_{VOC,fugitive} = 40.2 \cdot N_P + 1.1 \cdot 10^{-2} P_{gas} + 8.5 \cdot 10^{-6} \cdot P_{oil} \qquad (3.5.2)$$

where N_P is the number of platforms, P_{gas} (10^6 Nm^3) is the production of gas and P_{oil} (10^6 tons) is the production of oil.

It is assumed that the VOC contains 75% methane and 25% NMVOC, meaning that the total emission of CH_4 and NMVOC for extraction of oil and gas can be calculated as:

$$\begin{aligned} E_{extraction,NMVOC} &= E_{fugitive,NMVOC} + E_{flaring,NMVOC} \\ &= 0.25(40.2 \cdot N_P + 1.1 \cdot 10^{-2} P_{gas} + 8.5 \cdot 10^{-6} \cdot P_{oil}) + F_P \cdot EMF_{flaring,NMVOC} \end{aligned} \qquad (3.5.3)$$

$$\begin{aligned} E_{extraction,CH4} &= E_{fugitive;CH4} + E_{flaring,CH4} \\ &= 0.75(40.2 \cdot N_P + 1.1 \cdot 10^{-2} P_{gas} + 8.5 \cdot 10^{-6} \cdot P_{oil}) + F_P \cdot EMF_{flaring,CH4} \end{aligned} \qquad (3.5.4)$$

In Denmark, the venting of gas is assumed to be negligible because controlled venting enters the gas flare system.

Ships

This source includes the transfer of oil from storage tanks or directly from the well into a ship. This 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.

$$E_{ships} = EMF_{ships} \cdot L_{oil} \qquad (3.5.5)$$

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 from storage of raw oil are calculated by equation 3.5.6.

$$E_{tanks} = EMF_{tanks} \cdot T_{oil} \qquad (3.5.6)$$

where EMF_{tanks} is the emission factor for storage of raw oil in tanks and T_{oil} is the amount of oil transported in pipelines.

Activity data

Activity data used in the calculations of the emissions is shown in Table 3.34 and is based on information from the Danish Energy Authority (Danish Energy Authority, 2007d) or from the green accounts from the Danish gas transmission company DONG (DONG, 2007).

Table 3.34 Activity data for 2006

Activity	Symbols	Year	
		2006	Ref.
Number of platforms	N_p	50	Danish Energy Authority (2007d)
Produced gas (10^6Nm3)	P_{gas}	10 878	Danish Energy Authority (2007d)
Produced oil(10^3m3)	$P_{oil,vol}$	19 847	Danish Energy Authority (2007d)
Produced oil (10^3ton)	P_{oil}	17 068	Danish Energy Authority (2007d)
Oil loaded (10^3m3)	$L_{oil\ off\text{-}shore}$	2 957	Danish Energy Authority (2007d)
Oil loaded (10^3ton)	$L_{oil\ off\text{-}shore}$	2 543	Danish Energy Authority (2007d)
Oil loaded (10^3m3)	$L_{oil\ on\text{-}shore}$	13 100	DONG (2007)
Oil loaded (10^3ton)	$L_{oil\ on\text{-}shore}$	11 266	DONG (2007)

Mass weight raw oil = 0.86 ton/m^3

In the EMEP/CORINAIR Guidebook (EMEP/CORINAIR, 2007) emission factors for different countries are given. In the Danish emission inventory the Norwegian emission factors are used (EMEP/CORIN-AIR, 2007, Table 8.15). The emissions for storage of oil are given in the green accounts from DONG for 2006 (DONG, 2007) and the emission factor is calculated on the basis of the amount of oil transported in pipeline.

Table 3.35 Emission factors.

	CH_4	NMVOC	Unit	Reference.
Ships off-shore	0.00005	0.001	Fraction of loaded	EMEP/CORINAIR, 2007
Ships on-shore	0.000002	0.0002	Fraction of loaded	EMEP/CORINAIR, 2007
Oil tanks	112.43	245.56	$kg/10^3m^3$	DONG, 2007

From the activity data in Table 3.34 and the emission factors in Table 3.35 the emissions for NMVOC and CH_4 according to loading of ships are calculated in Table 3.36.

Table 3.36 CH_4 emissions for 2006 (tonnes)

	CH_4	NMVOC
Extraction (fugitive)	1 589	530
Oil tanks	1 900	4 150
Offshore loading of ships	127	2 543
Onshore loading of ships	23	2 253
Total	3 639	9 476

Oil Refineries

Petroleum products processing: in the production process at refineries, a part of the volatile hydrocarbons (VOC) is emitted to the atmosphere. It is assumed that CH_4 accounts for 1% and NMVOC for 99% of the emissions. The VOC emissions from the 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 products processing and sulphur recovery plants. The emission calculations are based on information from the Danish refineries and the energy statistics.

Table 3.37 Oil Refineries. Processed crude oil, 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
CH_4 emission (Mg)	37	39	42	43	57	48	62	45	45	45
CH_4 emission factor (g/Mg)	5	5	5	5	6	5	6	6	6	6
NMVOC emission (Mg)	3 667	3 937	4 203	4 219	5 855	4 546	5 875	4 547	4 558	4 558
NMVOC emission factor (g/Mg)	505	505	511	505	657	464	558	575	577	562

Continued	2000	2001	2002	2003	2004	2005	2006
Crude oil (1000 Mg)	8 406	8 284	8 045	8 350	8 264	8 264	8 020
CH_4 emission (Mg)	50	44	43	37	613	613	636
CH_4 emission factor (g/Mg)	6	5	5	4	74	74	79
NMVOC emission (Mg)	4 983	4 338	4 302	3 708	3 732	3 732	3 563
NMVOC emission factor (g/Mg)	593	524	535	444	451	451	444

Fugitive emissions from natural gas, transmission and distribution (CRF sector 1B2b)

Inventories of CH_4 emission from gas transmission and distribution are based on annual environmental reports from DONG and on a Danish emission inventory for the years 1999-2006 reported by the Danish gas sector (transmission and distribution companies) (Karll 2003, Karll 2005, Oertenblad 2006 & Oertenblad 2007). The inventories estimated by the

Danish gas sector are based on the work carried out by Marcogaz and the International Gas Union (IGU).

In the 1990-1999 inventories, fugitive CH_4 emissions from storage facilities and the gas treatment plant are included in the emission factor for transmission. In the 2000-2006, emission inventories transmission, gas storage and gas treatment are registered separately and added.

Gas transmission data are shown in Table 3.38. Emissions from gas storage facilities and venting in the gas treatment plant are shown in Table 3.39. Gas distribution data are shown in Table 3.39.

Table 3.38 CH_4 emission from natural gas transmission

TRANSMISSION		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Transmission rate Mm^3	1)	2 739	3 496	3 616	3 992	4 321	4 689	5 705	6 956	6 641	6 795
CH_4 emission Mg	2)		310	93	186	151	536	183	235	156	191
CH_4 IEF kg/Mm^3	3)	88.62	88.62	25.65	46.64	34.98	114.27	36.00	33.78	23.49	28.11
Continued											
TRANSMISSION		2000	2001	2002	2003	2004	2005	2006			
Transmission rate Mm^3	1)	7 079	7 289	7 287	7 275	7 384	7 600	7 600			
CH_4 emission Mg	2)	86	157	78	88	85	141	152			
CH_4 IEF kg/Mm^3	3)	12.15	21.54	10.70	12.10	11.51	18.55	20.00			

1) 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)

2) 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)

3) IEF=Emission/transmission_rate. In 1990 the IEF is assumed to be the same as in 1991.

Table 3.39 Additional fugitive CH_4 emissions from natural gas storage facilities and venting in gas treatment plant (Mg)

<table>
<tr><th></th><th>2000</th><th>2001</th><th>2002</th><th>2003</th><th>2004</th><th>2005</th><th>2006</th></tr>
<tr><td>Gas treatment plant</td><td>7.55</td><td>0</td><td rowspan="2">67</td><td rowspan="2">68</td><td rowspan="2">86</td><td rowspan="2">54</td><td rowspan="2">67</td></tr>
<tr><td>Gas storage facilities</td><td>76.48</td><td>72.68</td></tr>
</table>

Table 3.40 CH_4 emission from natural gas distribution

DISTRIBUTION		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Distribution rate Mm^3	1)	1 574	1 814	1 921	2 185	2 362	2 758	3 254	3 276	3 403	3 297
CH_4 emission Mg	2)										43
CH_4 IEF kg/Mm^3	3)	14.56	14.56	14.56	14.56	14.56	14.56	14.56	14.56	14.56	13.04
Continued		2000	2001	2002	2003[4)5)]	2004[4)]	2005[4)]	2006[4)]			
Distribution rate Mm^3	1)	3 181	3 675	3 420	3 420	3 248	2 983	3 319			
CH_4 emission Mg	2)	49	56	38.9	38.9	142	61.6	96.5			
CH_4 IEF kg/Mm^3	3)	15.40	15.24	11.37	11.37	43.7	20.64	29.06			

1) 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.

2) Danish Gas Technology Centre / DONG/ Danish gas distribution companies (Karll 2003, Karll 2005, Oertenblad 2006, Oertenblad 2007)

3) In the years 1999-2006 IEF=CH_4 emission / distribution rate. In 1990-1998 an average of the IEF in 1999-2001 is assumed.

4) Data from Naturgas Fyn not included (data not complete)

5) Assumed same emission as in 2002

The methane emission from the Danish gas distribution system is measured and calculated in accordance with the scheme prepared by the international working group, Marcogaz, realising the particular characteristics of the Danish distribution system.

The methane emission factor is found to be significantly lower in Denmark than in any other European country; the reason being that the distribution system in Denmark is relatively new.

In contrast to other countries with old distribution systems, partially made of cast ion pipes, the Danish Polyethylene (PE) distribution system is basically tight with minimal fugitive losses. The PE pipes, however, are vulnerable. Therefore, the methane emission in Denmark is largely caused by excavation damages, but emissions also occur in connection with construction and maintenance activities performed by the gas companies. These losses are measured or estimated by calculation in each case.

The Danish emission figures are produced by the individual gas companies and are collected, reviewed and reported by the Danish Gas Technology Centre (Oertenblad, 2007).

According to the environmental report of Nybro gas treatment plant desulphurisation of the natural gas produced in Denmark takes place off shore. Therefore, usually no desulphurisation takes place in the gas treatment plant Nybro. However, in 2004, the desulphurisation plant operated for a total of 30 hours. So far the inventories has not included off shore desulphurisation. This might be relevant for future inventories.

Flaring, gas (CRF sector 1B2c, Flaring ii)

Emissions from offshore flaring are estimated based on data for fuel consumption from the Danish Energy Authority (2007d) and emission factors for flaring. The emissions from flaring in gas treatment and gas storage plants are estimated based on the annual environmental reports of the plants.

The fuel consumption rates are shown in Table 3.41. Flaring rates in gas treatment and gas storage plants are not available until 1995.

The emission factors for offshore flaring are shown in Table 3.42. The CO_2 emission factor follows the same time-series as natural gas combusted in stationary combustion plants. All other emission factors are constant in 1990-2006.

The time-series for the CO_2 emission from gas flaring fluctuates due to the fluctuation of offshore flaring rates as shown in Figure 3.61.

Table 3.41 Natural gas flaring rate (Danish Energy Authority, 2007d & DONG 2007).

Year	Flaring, offshore [TJ]	Gas treatment and gas storage [TJ]
1990	4 218	-
1991	8 692	-
1992	8 977	-
1993	7 819	-
1994	7 709	-
1995	5 964	43
1996	6 595	30
1997	9 629	35
1998	7 053	29
1999	15 509	32
2000	10 023	29
2001	10 806	36
2002	8 901	44
2003	9 333	33
2004	10 299	25
2005	7 269	42
2006	7 157	39

Table 3.42 Emission factors for offshore flaring of natural gas

Pollutant	Emission factor	Unit
CO_2	56.78	kg/GJ
CH_4	5	g/GJ
N_2O	1	g/GJ
SO_2	0.3	g/GJ
NO_x	300	g/GJ
NMVOC	3	g/GJ
CO	25	g/GJ

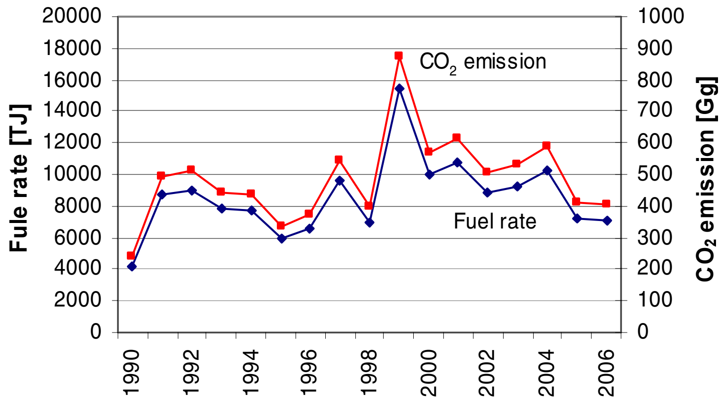

Figure 3.61 Time-series for off shore gas flaring and the CO_2 emission in sector 1B2c ii Flaring, gas

The fuel consumption for offshore flaring was higher in 1999 due to the opening of new gas fields.

Besides 1999, consumption has been fairly stable for a number of years. The decrease from 15390 TJ in 1999 to 7157 TJ in 2006 represents a decrease of around 53%.

3.5.3 Uncertainties and time-series consistency

Estimation of uncertainty is based on the Tier 1 methodology in IPCC Good Practice Guidance (IPCC, 2000). The results of the uncertainty estimates are shown in Table 3.43.

Table 3.43 Uncertainty, CRF sector 1B Fugitive emissions

Pollutant	Uncertainty of emission inventory [%]	Uncertainty of emission trend [%]
CO_2	16	33
CH_4	52	52
N_2O	52	33
GHG	16	30

Uncertainty of activity rates for oil and gas activities is 15%, referring to the GPG. The uncertainty of emission factors for CO_2 is the uncertainty of emission factors for flaring. This emission factor uncertainty is 5% (GPG). Uncertainty with regard to CH_4 and N_2O emission factors is assumed to be 50% in both cases.

Table 3.44 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

3.5.4 Source specific QA/QC and verification

Please see Section 1.6 for the general description of QA/QC. 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).

Data storage level 1

Table 3.45 List of external data sources

Dataset	Description	AD or Emf.	Reference	Contact(s)	Data agreement/ Comment
Data for offshore	Gas and oil production. Dataset for production of oil, gas and number of platforms. CRF 1B2a	Activity data	The Danish Energy Authority (DEA)	Katja Scharmann	No formal data agreement.
Environmental report from DONG	Gas and oil production. The amount of oil loaded onshore and emissions from raw oil tanks. CRF 1B2a	Activity data/emissions	DONG, 2007	Mike Robson	No formal data agreement.
Air emissions from refinery (Statoil)	Fuel consumption and emission data. CRF 1B2a.	Activity data/emissions	Statoil	Anik Olesen/Dan Juul Andersen	No formal data agreement.
Shell refinery, Fredericia, SO_2 andNO_X emissons as well as fuel consumption	Fuel consumption and emission data. CRF 1B2a	Activity data/emissions	Shell	Lis Rønnow Rasmussen	No formal data agreement.
Electricity and heat production survey) (Energiproducenttællingen.xls	Energy consumption data for the refineries in Denmark. CRF 1B2a	Activity data	DEA	Peter Dal	Formal data agreement.
Environmental indicators of the gas industry	Data for natural gas transmission/distribution and storage. CRF 1B2b.	Activity data and emissions	DGC	Michael Oertenblad/ Jan K. Jensen	No formal data agreement.
Energy statistics	The Danish energy statistics on SNAP level. CRF 1B2c.	Activity data	DEA	Peter Dal	Data agreement in place
Emission factors	Emission factors stems from a large number of sources	Emission factors	See chapter regarding emission factors		

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 3.5.3.

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 3.5.3.

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.

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. 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 1.1.9.

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. 3.45

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 3.45 for general references. The references are available in the inventory file system. Refer to Section 1.1.9.

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

Refer to Table 3.45

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 3.5.3.

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 sources.

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.

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 will be worked out for all 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	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.

Suggested QA/QC plan for fugitive emissions

A list of QA/QC tasks to be performed directly in relation to the fugitive emission part of the Danish emission inventories will be prepared in 2007/2008, together with a time-table for the individual tasks.

3.5.5 Recalculations

Flaring, gas (CRF sector 1B2c, Flaring ii)

Recalculation has been carried out according to the energy statistics published in 2006.

3.5.6 Source-specific planned improvements

No improvements are planned in this sector.

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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 2006. The emissions are extracted from the CRF tables.

Table 4.1 Overview of industrial greenhouse gas sources (2006).

Process	IPCC Code	Substance	Emission kton CO_2-eq.	%
Cement	2A		1395	55.9%
Refrigeration	2F	HFCs+PFCs	703	28.2%
Foam blowing	2F	HFCs	127	5.07%
Limestone and dolomite use	2A		73.8	2.96%
Lime	2A		69	2.77%
Other (yellow bricks)	2A		36.8	1.47%
Other (laboratories, double glaze windows)	2F	SF_6	23.0	0.92%
Other (expanded clay products)	2A		18.5	0.74%
Aerosols / Metered dose inhalers	2F	HFCs	16.1	0.65%
Other (container glass, glass wool)	2A		13.5	0.54%
Electrical equipment	2F	SF_6	12.9	0.52%
Other (fibre optics)	2F	HFCs+PFCs	4.31	0.17%
Catalysts / fertilisers	2B		2.18	0.09%
Road paving	2A		1.84	0.07%
Asphalt roofing	2A		0.024	0.0009%
Metal production	2C		0	0%
Nitric acid	2B	N_2O	0	0%
Total			2498	100%

The subsectors *Mineral products*, including the estimates (2A), constitutes 64.4%, *Chemical industry* (2B) constitutes below 1%, *Metal production* constitutes 0%, and *Consumption of halocarbons and* SF_6 (2F) constitutes 35.5% of the industrial emission of greenhouse gases. The total emission of greenhouse gases (excl. LUCF) in Denmark is estimated to 70.47 Mt CO_2-eq., of which industrial processes contribute with 2.50 Mt CO_2-eq. (3.5%). The emission of greenhouse gases from industrial processes from 1990-2006 are presented in Figure 4.1.

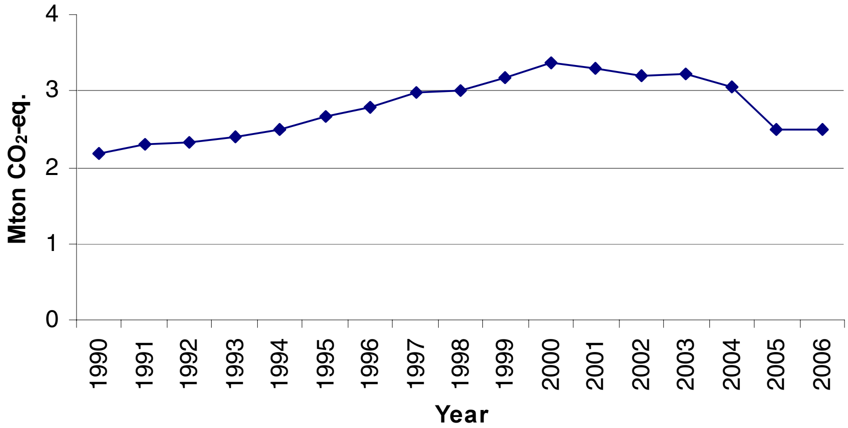

Figure 4.1 Emission of greenhouse gases from industrial processes (CRF Sector 2) from 1990-2006.

The key sources in the industrial sector constitute 0.9 and 1.9% of the total emission of greenhouse gases. The trends in greenhouse gases from the industrial sector/subsectors are presented in Table 4.1 and they will be discussed subsector by subsector below. The emissions are extracted from the CRF tables.

Table 4.1 Emission of greenhouse gases from industrial processes in different subsectors from 1990-2005.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CO_2 (kt CO_2)										
A. Mineral Products	1 072	1 246	1 366	1 383	1 406	1 407	1 517	1 685	1 682	1 610
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
Total	1 101	1 275	1 395	1 415	1 441	1 446	1 554	1 721	1 725	1 654
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	412	504
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
CO_2 (kt CO_2)							
A. Mineral Products	1 640	1 660	1 696	1 571	1 728	1 641	1 609
B. Chemical Industry	0.65	0.83	0.55	1.05	3.01	3.01	2.18
C. Metal Production	40.7	46.7	NA,NO	NA,NO	NA,NO	15.6	NA,NO
Total	1 682	1 708	1 697	1 572	1 731	1 659	1 611
CH_4							
	-	-	-	-	-	-	-
N_2O (kt N_2O)							
B. Chemical Industry	3.24	2.86	2.50	2.89	1.71	0.00	0.00
HFCs (kt CO_2 eq.)							
F. Consumption of Halocarbons and SF_6	606	650	676	700	754	606	835
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
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

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 source; see *Annex 1: Key sources*.

The time-series for the emission of CO_2 from *Mineral products* (2A) are presented in Table 4.2. The emissions are extracted from the CRF tables and the values are rounded.

Table 4.2 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	1 452	1 365
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	1 683	1 610

Continued	2000	2001	2002	2003	2004	2005	2006
1. Production of Cement	1 406	1 432	1 452	1 370	1 539	1 456	1 395
2. Production of Lime	76.7	80.7	103	75.1	67.9	63.5	69.2
3. Limestone and dolomite use	93.6	92.2	85.4	74.5	64.2	60.7	73.8
5. Asphalt roofing	0.032	0.025	0.017	0.018	0.020	0.024	0.024
6. Road paving	1.72	1.66	1.66	1.67	1.85	1.84	1.84
7. Other							
Glass and Glass wool	15.9	16.0	16.3	13.5	13.3	12.6	13.5
Yellow Bricks	32.8	27.8	27.0	27.0	28.9	32.2	36.8
Expanded Clay	14.2	10.5	10.8	9.53	12.7	14.0	18.5
Total	1 641	1 660	1 696	1 571	1 728	1 641	1 609

The increase in CO_2 emission is most significant for the production of cement. From 1990 to 2006, the CO_2 emission increased from 882 to 1395 kt CO_2, i.e. by 58%. The maximum emission occurred in 2004 and constituted 1539 kt CO_2; see Figure 4.2.

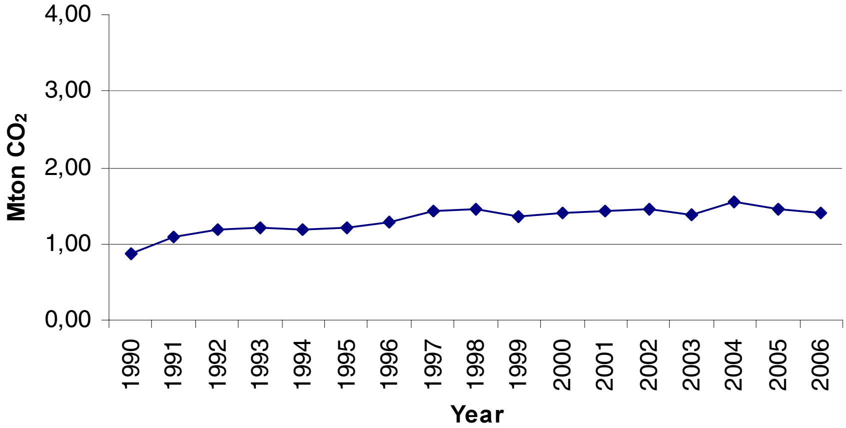

Figure 4.2 Emission of CO_2 from cement production.

The increase can be explained by the increase in the annual 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

The CO_2 emission from the production of cement has been estimated from the annual production of cement expressed as TCE (total cement equivalents[4]) and an emission factor estimated by the company (Aalborg Portland, 2006, 2007b). 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, 2006). However, from the year 2006 the CO_2 emission compiled by Aalborg Portland for EU-ETS is used in the inventory (Aalborg Portland, 2007a). Activity data, applied and implied emission factors for cement production are presented in Table 4.3.

[4] 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.

Table 4.3 Activity data, applied and implied emission factors for cement production.

	1990[1]	1991	1992	1993	1994	1995	1996	1997	1998	1999[2]
Ton TCE	1619976	1998674	2214104	2244329	2242409	2273775	2418988	2718923	2754405	2559575
EF ton CO_2/ton TCE										0.538
IEF ton CO_2/ton TCE	0.545	0.544	0.539	0.537	0.532	0.529	0.530	0.530	0.527	
Ton CO_2	882402	1087816	1192336	1206093	1192196	1203777	1282064	1441029	1452480	1365098
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006[3]**			
Ton TCE	2612721	2660972	2698459	2546295	2861471	2706371	2842282			
EF ton CO_2/ton TCE	0.538	0.538	0.538	0.538	0.538	0.538				
IEF ton CO_2/ton TCE							0.491			
Ton CO_2	1405644	1431603	1451771	1369907	1539471	1456028	1395466			

1. 1990-1998: Emission is based on information provided by Aalborg Portland.
2. 1999-2005: EF from Environmental report (Aalborg Portland, 2007b).
3. 2006: Emission based on report to EU-ETS (Aalborg Portland, 2007a)

The CO_2 emission from the production of burnt lime (quicklime) as well as hydrated lime (slaked lime) has been estimated from the annual production figures, registered by Statistics Denmark - see Table 4.4, and emission factors.

Table 4.4 Statistics for production of lime and slaked lime (tonnes) (Statistics Denmark, 2007).

	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**			
Lime	92 002	96 486	122 641	87 549	77 844	71 239	78 652			
Slaked lime	8 159	9 012	12 006	11 721	12 532	13 839	13 731			

The emission factors applied are 0.785 kg CO_2/kg CaO as recommended by IPCC (IPCC, 1997, vol. 3, p. 2.8) and 0.541 kg CO_2/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 4.5.

Table 4.5 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**			
Yellow bricks	414 791	351 955	342 179	341 981	365 388	407 940	465 504			
Expanded clay products	316 174	232 289	239 664	211 794	281 828	310 901	411 869			

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 (0.44 kg CO_2/kg $CaCO_3$) is based on stoichiometric determination.

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 Holmegaard, 2007; Saint-Gobain Isover, 2007) and emission factors based on release of CO_2 from specific raw materials (stoichiometric determination).

The CO_2 emission from consumption of limestone for fluegas 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:

$$SO_2\,(g) + \tfrac{1}{2}O_2\,(g) + CaCO_3\,(s) + 2H_2O \rightarrow CaSO_4{,}2H_2O\,(s) + CO_2\,(g)$$

and the emission factor is: 0.2325 ton CO_2/tonne gypsum.

Statistics on the generation of gypsum from power plants are compiled by Energinet.dk (2007). However, for 2006 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 fluegas cleaning.

Information on the generation of gypsum at waste incineration plants does not explicitly appear in the Danish waste statistics (Miljøstyrelsen, 2008). 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/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 $CaCO_3$/tonne sugar and precipitation of 90% CaO resulting in an emission factor at 0.0088 tonne CO_2/tonne sugar. However, from the year 2006 the CO_2 emission compiled by the company for EU-ETS is used in the inventory (Danisco, 2007).

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 4.6.

Table 4.6 Default emission factors for application of asphalt products.

		Road paving with asphalt	Use of cutback asphalt	Asphalt roofing
CH_4	g/tonnes	5	0	0
CO	g/tonnes	75	0	10
NMVOC	g/tonnes	15	64 935	80
Carbon content fraction of NMVOC	%	0.667	0.667	0.8
Indirect CO_2	kg/tonnes	0.168	159	0.250

4.2.3 Uncertainties and time-series consistency

The time-series are presented in Table 4.2. The methodology applied for the years 1990-2006 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 4.7. The overall uncertainty estimate is presented in Section 1.7.

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) (Danish Energy Authority, 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.

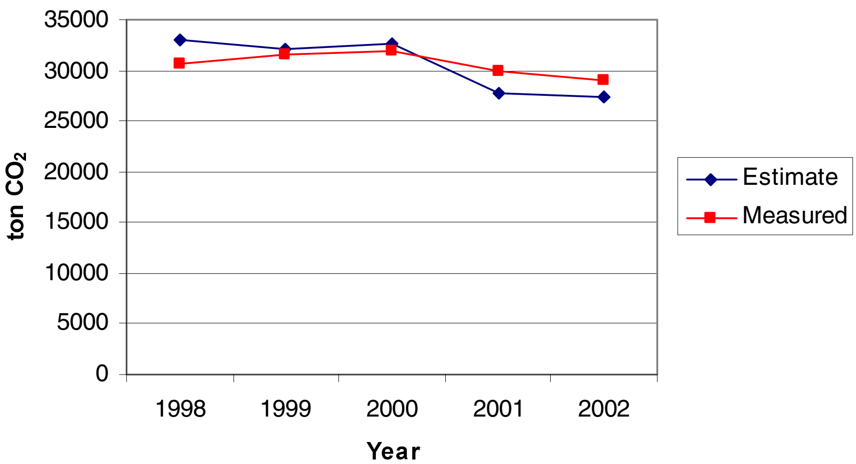

Figure 4.3 Estimated and "measured" CO_2 emission from tile-/brickworks; "measured" means information provided to the Danish Energy Authority by the individual companies (Danish Energy Authority, 2004).

Figure 4.3 shows a reasonable correlation between the estimated and measured CO_2 emission.

4.2.5 Recalculations

For 2006 information prepared for EU-ETS has been implemented for cement production and sugar production. For the relevant power plants specific information on $CaCO_3$ consumption has been included in the calculation of CO_2-emission. The category 040614 has in the CRF-tables been split up in calcination of limestone, production of yellow bricks and expanded clay products. In the data treatment calcination of limestone has been split up in production of lime and hydrated lime with specific emission factors instead of a weighted emission factor. These changes may have caused a slight difference compared to the previous years.

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 source.

The time-series for emission of CO_2 and N_2O from *Chemical industry* (2B) are presented in Table 4.7.

Table 4.7 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**			
2. Nitric acid production (kt N_2O)	3.24	2.86	2.50	2.89	1.71	0	0			
2. Nitric acid production (kt CO_2 eq.)	1 004	885	774	895	531	0	0			
5. Other (kt CO_2)	0.65	0.83	0.55	1.05	3.01	3.01	2.18			
Total (kt CO_2 eq.)	1 004	886	775	896	534	3.01	2.18			

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 2006, the emission of CO_2 from the production of catalysts/fertilisers has increased from 0.80 to 2.18 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/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, 2007), 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 4.7. 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 4.7. The overall uncertainty estimate is presented in Section 1.7.

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 4.8. The emissions are extracted from the CRF tables and the values presented are rounded.

Table 4.8 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**			
1. Iron and steel production	40.7	46.7	NA,NO	NA,NO	NA,NO	15.6	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 per 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 per 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/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 4.8) 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 per 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 4.7. The overall uncertainty estimate is presented in Section 1.7.

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 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 4.9
- 2F1: Refrigeration: HFC32, 125, 134a, 152a, 143a, PFC (C_3F_8); see Table 4.10
- 2F2: Foam blowing: HFC134a, 152a; see Table 4.11
- 2F4: Aerosols/Metered dose inhalers SNAP 060506: HFC134a; see Table 4.12
- 2F8: Production of electrical equipment: SF_6; see Table 4.13
- 2F9: Other processes (laboratories, dobble glaze windows, fibre optics): SF_6, HFC23, CF_4, C_3F_8, C_4F_8; see Table 4.14

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 4.9 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**			
SF_6 used in magnesium foundries	0.89	NO	NO	NO	NO	NO	NO			

Table 4.10 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**			
HFC32	5.75	7.33	8.44	10.1	12.0	13.7	14.5			
HFC125	43.1	45.1	48.5	54.9	59.9	67.7	70.6			
HFC134a	112	128	151	162	169	172	188			
HFC152a	0.58	0.58	0.51	0.41	0.33	0.094	0.21			
HFC143a	39.6	40.1	43.2	49.0	52.8	60.3	63.0			
PFC (C_3F_8)	2.29	2.64	2.67	2.51	2.27	1.99	1.76			

Table 4.11 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**			
HFC32	NA	3.72	NA	NA	NA	NA	NA			
HFC125	NA	3.72	NA	NA	NA	NA	NA			
HFC134a	127	132	122	98.8	110	112	97			
HFC152a	16.2	12.8	12.5	1.63	5.81	1.66	2.56			

Table 4.12 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**			
HFC134a	12.9	9.24	7.59	7.40	6.65	6.75	12.4			

Table 4.13 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**			
SF_6	0.47	0.53	0.37	0.40	0.43	0.52	0.54			

Table 4.14 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**			
SF_6	1.12	0.75	0.68	0.91	0.96	0.39	0.96			
HFC23	NO	NO	NO	NO	NO	NO	0.08			
CF_4	NO	NO	NO	NO	NO	NO	0.25			
C_3F_8	0.27	0.52	0.50	0.25	NA,NO	NA,NO	NO			
C_4F_8	NO	NO	NO	NO	NO	NO	0.20			

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.

Table 4.15 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 2006.

Table 4.15 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	412	504
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	89.2	195	257	326	392	401	480	581
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
HFCs	606	650	676	700	754	805	835			
PFCs	17.9	22.1	22.2	19.3	15.9	13.9	15.7			
SF_6	59.2	30.4	25.0	31.4	33.1	21.8	36.0			
Total	682	700	719	746	798	841	887			

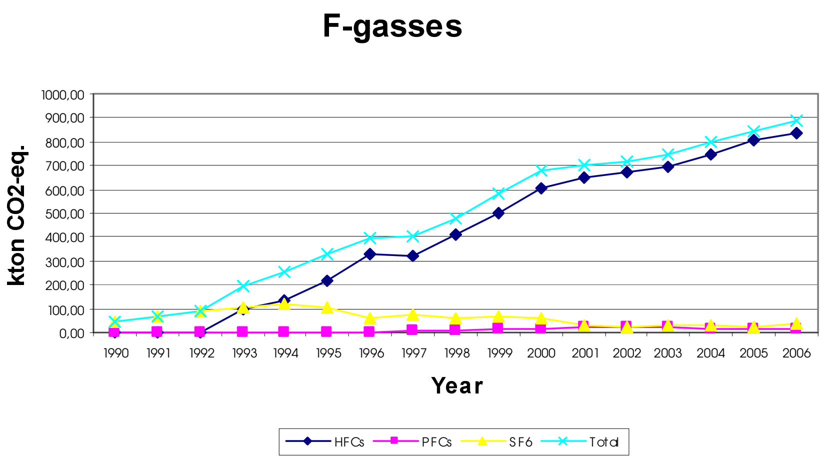

Figure 4.4 Time-series for emission of HFCs, PFCs and SF_6 (kt CO_2-eq.).

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 source, both with regard to the key source level and trend analysis. In the level analysis, the HFC group is number 18 out of 23 key sources and contributed, in 2006, 0.9% to the national total.

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 2006 (Danish Environmental Protection Agency, 2007), 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 per 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 4.16 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 4.16.

The national inventories for F-gases are provided and documented in a yearly report (Environmental Protection Agency, 2008). 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 4.7. 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 Uncertainty

The source-specific uncertainties for industrial processes are presented in Table 4.17. 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 Section Table 4.17). 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 4.17 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.

4.8 Quality assurance/quality control (QA/QC)

The approach used for quality assurance/quality control (QA/QC) is presented in Chapter 1.6. The present chapter presents QA/QC considerations for industrial processes based on a series of Points of Measuring (PMs); see Section 1.6.

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 4.16.

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 4.18.

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 4.18 Applied data sets.

File or folder name	Description	AD or E	Reference	Contact(s)	Comment
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 gr2006.pdf		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		
Rexam Glas Holmegaard gr2006.pdf		E	www.cvr.dk		
Rockwool mr2006 I.pdf Rockwool mr2006 II.pdf		AD	www.cvr.dk		
Saint Gobain – Miljøredegørelse 2006.pdf		AD,E	Saint-Gobain Isover www.isover.dk	Anette Åkesson	
Stålvalseværket (2002) – paper version.		AD, E	Stålvalseværket		
Aalborg Portland miljoredegorelse_2006.pdf		AD, E	www.aalborg-portland.dk		
Aalborg Portland energy 2000-2004 answer.xls		AD	Aalborg Portland	Henrik Møller Thomsen	
DS produktion af aluminium I.xls		AD	Danmarks Statistik; www.statistikbanken.dk		
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 1990-2006. 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 refinning.

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 4.18. 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 4.18.

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 4.18.

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.

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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 compounds 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 – 2006 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 2006, 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 - 2006 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 2006 is split into individual chemicals. The most abundantly used solvents are methanol, propylalcohol and turpentine, or white spirit defined as a mixture of stoddard solvent and solvent naphtha. Methanol is primarily used as intermediate (monomer), solvent in thinners, degreasers et al. and as disinfecting and conserving agent. Propylalcohol is used as flux agents for soldering, as solvent and thinner and as windscreen washing agent. Turpentine is used as thinner for paints, lacquers and adhesives. 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 most chemicals they are rough estimates from SFT (1994) and from various other sources. High emission factors are assumed for use of chemicals (products) and lower factors for industrial production processes.

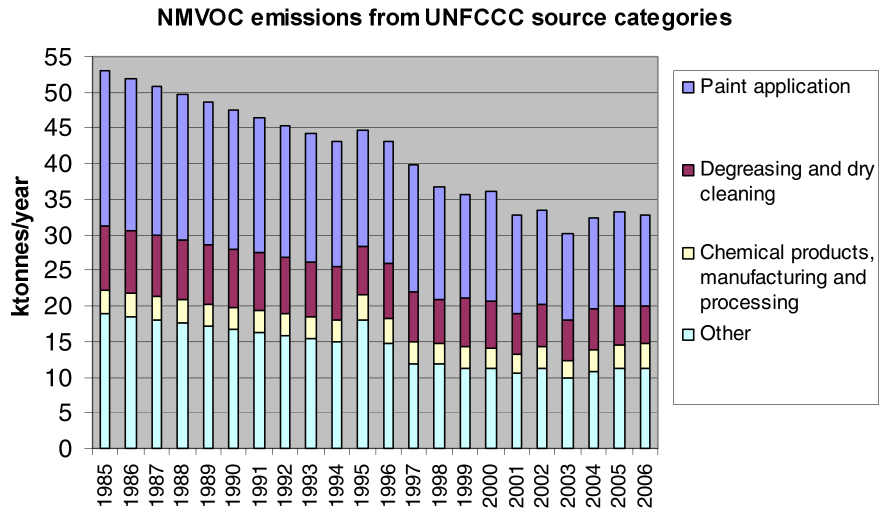

Figure 5.1 Emissions of chemicals in ktonnes pr year (equal to Gg pr year). The methodological approach for finding emissions in the period 1995 – 2006 is described in the text, and a linear extrapolation is made for 1985 – 1994. Figures can be seen in Table 5.1

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	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Paint application (3A)	21.8	21.3	20.9	20.4	19.9	19.5	19.0	18.6	18.1	17.6	16.1	17.2	17.9	15.7	14.6	15.5	14.0	13.1	12.1	12.9	13.1	12.7
Degreasing and dry cleaning (3B)	9.04	8.87	8.69	8.51	8.33	8.15	7.97	7.80	7.62	7.44	6.86	7.63	6.91	6.24	6.82	6.60	5.65	6.06	5.73	5.71	5.46	5.29
Chemical products, manufacturing and processing (3C)	3.34	3.32	3.31	3.29	3.27	3.25	3.24	3.22	3.20	3.18	3.55	3.50	3.04	2.95	3.01	2.83	2.76	3.07	2.37	3.06	3.31	3.49
Other (3D)	18.8	18.4	17.9	17.5	17.1	16.6	16.2	15.8	15.3	14.9	18.1	14.8	12.0	11.8	11.3	11.2	10.5	11.2	10.0	10.8	11.3	11.2
Total NMVOC	53.0	51.9	50.8	49.7	48.6	47.5	46.4	45.3	44.2	43.1	44.6	43.1	39.8	36.7	35.7	36.1	32.9	33.4	30.1	32.4	33.1	32.7
Total CO_2 [a]	165	162	158	155	152	148	145	141	138	134	139	134	124	114	111	113	102	104	94	101	103	102

[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	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Paint application (3A)	45.2	46.6	48.0	49.4	50.8	52.1	53.5	54.9	56.3	57.7	57.1	61.5	96.2	60.5	53.8	57.4	52.3	52.6	58.4	77.9	90.5	82.9
Degreasing and dry cleaning (3B)	27.2	27.3	27.3	27.4	27.5	27.5	27.6	27.7	27.7	27.8	28.6	29.5	28.7	25.4	29.0	28.5	26.1	27.5	26.5	28.8	29.3	30.5
Chemical products, manufacturing and processing (3C)	68.9	71.9	74.8	77.8	80.7	83.7	86.6	89.6	92.5	95.5	105	103	108	102	107	114	116	117	101	122	136	144
Other (3D)	27.6	28.6	29.6	30.6	31.6	32.6	33.6	34.6	35.6	36.6	46.7	40.4	42.1	37.0	36.4	39.1	39.6	38.3	39.1	49.2	51.5	57.4
Total NMVOC	169.0	174.4	179.8	185.2	190.6	196.0	201.3	206.7	212.1	217.5	237	235	275	225	226	239	234	236	225	277	307	315

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	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Paint application (3A)	301	311	320	329	338	348	357	366	375	385	381	410	642	403	359	383	349	351	389	519	603	553
Degreasing and dry cleaning (3B)	54	55	55	55	55	55	55	55	55	56	57	59	57	51	58	57	52	55	53	58	59	61
Chemical products, manufacturing and processing (3C)	345	359	374	389	404	418	433	448	463	477	524	517	540	512	536	569	580	586	504	608	678	722
Other (3D)	138	143	148	153	158	163	168	173	178	183	234	202	210	185	182	196	198	191	195	246	257	287
Total products	839	868	897	926	955	984	1 013	1 042	1 071	1 100	1 195	1 188	1 449	1 152	1 134	1 204	1 179	1 184	1 142	1 431	1 597	1 622

Table 5.4 Chemicals with highest emissions 2006

Chemical	Emissions 2006 (tonnes/year)
methanol	4 777
propylalcohol	4 167
turpentine (white spirit: stoddard solvent and solvent naphtha)	3 940
aminooxygengroups	2 865
glycerol	2 630
pentane	2 331
ethanol	2 166
naphthalene	1 768
acetone	1 297
propane	1 000
butane	1 000
butanone	676
glycolethers	622
ethylenglycol	610
formaldehyde	503
cyclohexanones	482
propylenglycol	479
1-butanol	240
butanoles	227
xylene	202
toluendiisocyanate	199
phenol	129
methyl methacrylate	74.8
toluene	66.6
acyclic aldehydes	65.1
dioctylphthalate	60.6
acyclic monoamines	51.3
styrene	49.6
tetrachloroethylene	26.1
triethylamine	11.9
diethylenglycol	10.3
diamines	0.018
Total 2006	**32 726**

5.2.2 Other use (N_2O)

This year's solvent use emission inventory includes N_2O emissions for the first time. 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.

Three companies have reported their sale and the sale for one company has been estimated. The total sold (emitted) amounts are:

2005: 0.045 Gg N_2O

2006: 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

$$use = production + import - export - destruction/disposal - hold\ up \quad \text{(Eq.1)}$$

$$emission = use * emission\ factor \quad \text{Eq.2)}$$

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 indepth 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.

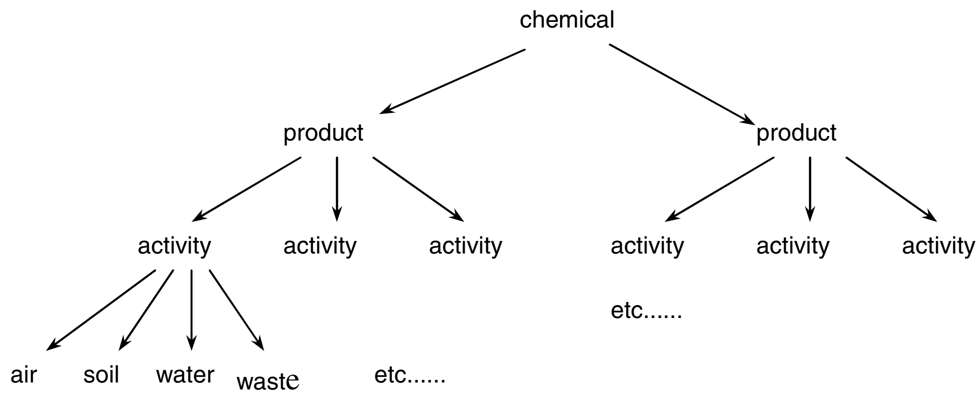

Figure 5.2 Methodological flow in a chemical based emission inventory.

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 of NMVOC is, however, not consistent; In the EMEP-guidelines for calculation and reporting of emissions, NMVOC is defined as "all hydrocarbons and hydrocarbons where hydrogen atoms are partly or fully replaced by other atoms, e.g. S, N, O, halogens, which are volatile under ambient air conditions, excluding CO, CO_2, CH_4, CFCs and halons". The amount of chemicals that fulfil these criteria is large and a list of 650 single chemicals and a few chemical groups described in "National Atmospheric Emission Inventory", cf. Annex 3.F, is used. It is probable that the major part will be insignificant in a mass balance, but it is not correct to exclude any chemicals before a more detailed investigation has been made. 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. di-ethylhexyl–phthalate (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 overestimate the use.

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. year (from 1995 to 2006) 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.

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 coding system 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 therefore be associated with two emission factors, one for production processes and one for use.

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 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. The definition is vague, and no approved list of agreed NMVOCs is available. 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.

(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 many compounds. For some compounds 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

1) File or folder name	2) Description	3) AD or Emf.	4) Reference	5) Contact(s)	6) Data agreement/ Comment
7) "Emissioner NMVOC" folder	8) Production, import and export data from Statistics Denmark	9) Activity data	10) Statistics Denmark	11) Patrik Fauser	12)
13) NMVOC emissions.xls	14) Calculations, emissionfactors, SPIN data. For industrial branches	15) Activity data and emissionfactors	16) Statistics Denmark, 17) SPIN, reports, personal communication	18) Patrik Fauser	19)
20) Use Category National.xls	21) Calculations, emissionfactors, SPIN data. For CRF	22) Activity data and emissionfactors	23) Statistics Denmark, SPIN, reports, personal communication	24) Patrik Fauser	25)

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. The emission factors stated in the Norwegian solvent inventory are rough estimates, given either as single values or as ranges, for groups of chemicals. 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) The Norwegian solvent inventory has been used for input on methodological issues and for estimates on emission factors. The methodology has been adjusted for Danish conditions, while many emission factors are identical to the emission factors suggested in the Norwegian inventory.

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 (PRO-

BAS) 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 the Norwegian solvent inventory has been used for input on methodological issues and for estimates on emission factors.

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 is vague, and no approved list of agreed NMVOCs is available. 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. (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 2006 reporting include revisions of the following

- Propane and butane is used as aerosol in spraying cans primarily in households. The mean volume of a can is set to 200 ml according to information from e.g. trade associations. This reduces the propane and butane emissions compared to previous inventories.
- Propylalcohol used as windscreen washing agent is reallocated from autopaint and repair to household use.
- Emission factor for propylalcohol used as windscreen washing agent, corresponding to approximately 80% of the annually used amount, is changed to 1.0 for use. Approximately 20% of the annual propylalcohol use is used in closed industrial processes. This amount is assigned a low emission factor of 0.01.
- N_2O emission is introduced in the solvents emission inventory. N_2O is used mainly in anaesthesia.

5.2.8 Planned improvements

Selected branches will be addressed for further adjustments in the following inventory. More detailed information will be obtained for selected industries with respects to used products and chemicals and emission factors related to the activities.

References

Statistics Denmark, http://www.dst.dk/HomeUK.aspx

SPIN on the Internet. Substances in Preparations in Nordic Countries, 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 on the Internet at http://reports.eea.eu.int/EMEP-CORINAIR3/en (07-11-2003)

Solvent Balance for Norway, 1994. Statens Forurensningstilsyn, rapport 95:02

6 The emission of greenhouse gases from the agricultural sector (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 14% of the overall greenhouse gas emission (GHG) in 2006. 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 2006.

From 1990 to 2006, the emissions decreased from 13.0 Gg CO_2 eqv. to 9.6 Gg CO_2 eqv., which corresponds to a 26% reduction (Table 6.1). Since the previous reporting, there have been some small changes. The change has affected the total 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 – 2006

	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	3 983	4 002	3 906	3 942	3 803
N_2O (Gg CO_2-eqv.)	9 033	8 880	8 576	8 388	8 162	7 955	7 613	7 524	7 491	7 053
Total (Gg CO_2-eqv.)	13 044	12 931	12 637	12 540	12 180	11 938	11 615	11 430	11 433	10 856
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
CH_4 (Gg CO_2-eqv.)	3 816	3 907	3 845	3 810	3 738	3 686	3 645			
N_2O (Gg CO_2-eqv.)	6 791	6 642	6 403	6 186	6 289	6 266	5 960			
Total (Gg CO_2-eqv.)	10 607	10 549	10 248	9 997	10 027	9 952	9 605			

Figure 6.1 shows the distribution of the greenhouse gas emission across the main agricultural sources. The total N_2O emission from 1990-2006 has decreased by 34%. The decrease in total 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 per hectare 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 per produced animal and a fall in use of mineral fertilizer, which all has reduced the overall GHG emission.

From 1990 to 2006, only a slight reduction in the total CH_4 emission has occurred. The emission from enteric fermentation has decreased due to a reduction in the number of cattle. On the other hand, 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 2006 has decreased by 9%.

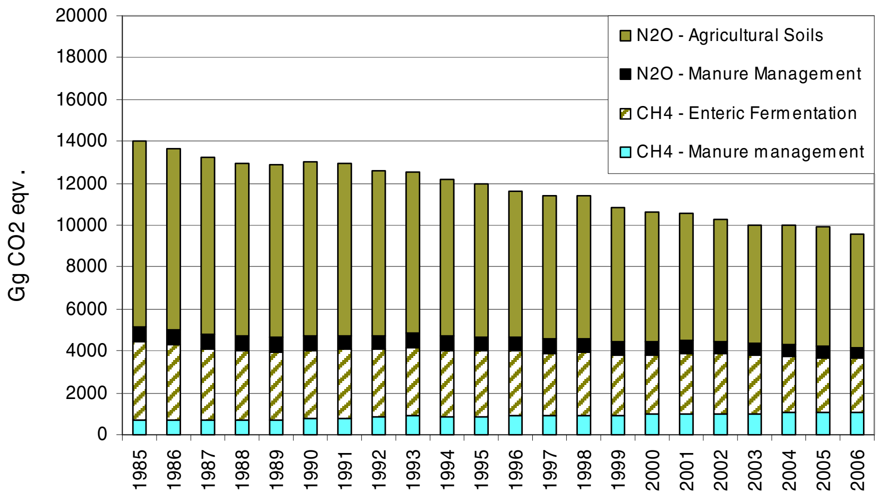

Figure 6.1 Danish greenhouse gas emissions 1990 – 2006

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
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.plantedirektoratet.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 DIEMA (Danish Integrated Emission Model for Agriculture). 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 has been published (Mikkelsen et al. 2006).

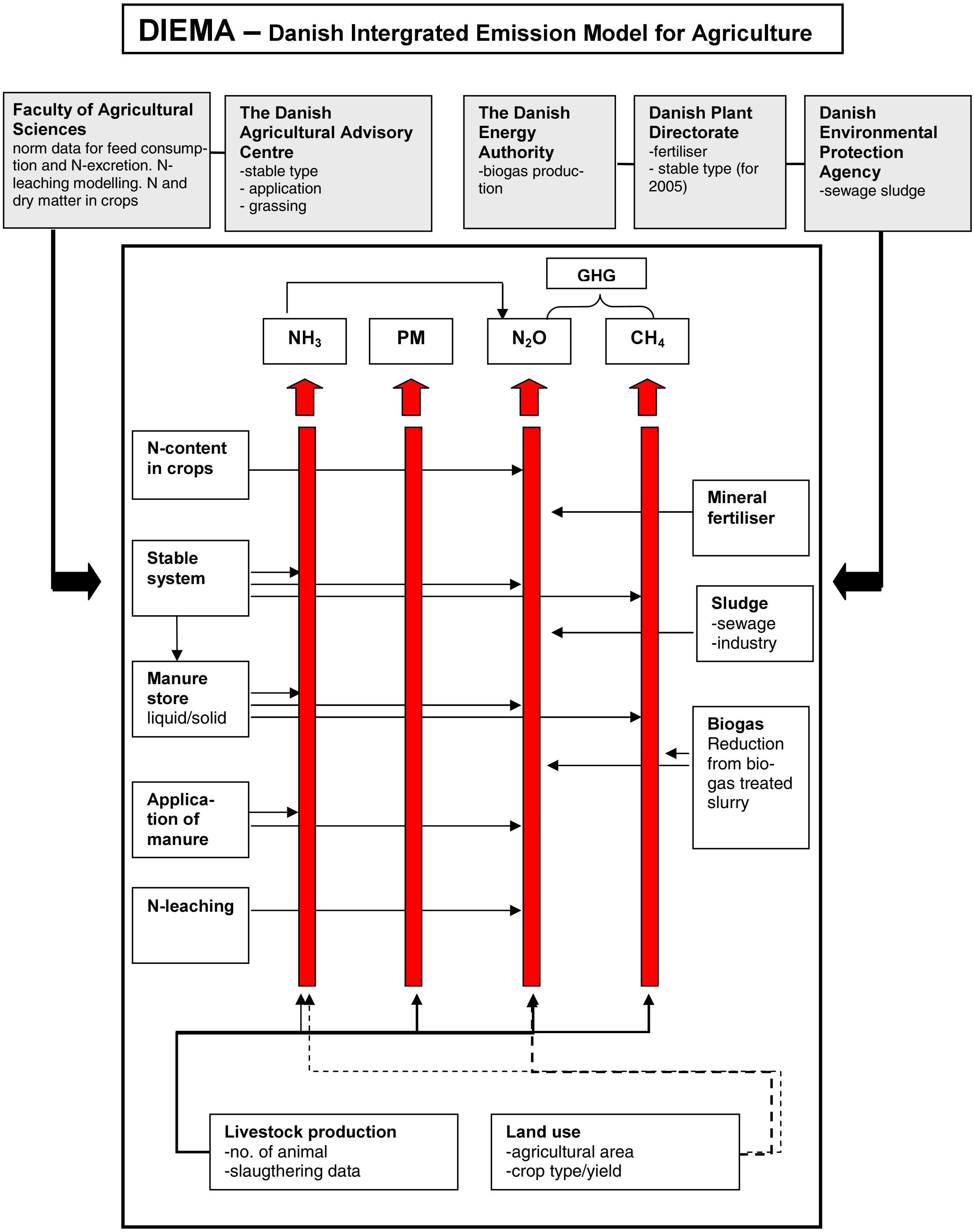

Figure 6.2 DIEMA – Danish Integrated Emission Model for Agriculture

The DIEMA model complex is build up as a number of spreadsheets, where data is linked between the sheets. 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.

DIEMA operates with 30 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 100 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		9
Non-Dairy Cattle	Calves < ½ yr (bull)	2
	Calves < ½ yr (heifer)	2
	Bull > ½ yr to slaughter	8
	Heifer > ½ yr to calving	9
	Cattle for suckling	3
Swine	Sows	7
	Piglets	5
	Slaughter pigs	5

[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 total 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 hectares. 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 2006 the number of horses is estimated to be 38 100. Including horses on small farms and riding schools, however, the number of horses rises to approximately 157 000. 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.

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). 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 – 2006.

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/media/webdav/filer/sve/hem/normtal_2007

6.1.2 Key source identification

Most of the agricultural emission sources can be considered as key sources for both the emission level and trend (Table 6.4). The same emission sources are identified as level for the base year 1990.

The most important key source is the N_2O emission from agricultural soils, which contributes with 9% of the total national GHG emission in 2006.

Table 6.4 Key source identification from the agricultural sector 1990 and 2006

CRF table	Compounds	Emission source	Key source identification
2006			
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/trend
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 2006, this source accounts for 27% of the total GHG emission from agricultural activities. The emission is primarily related to ruminants and, in Denmark, particularly to cattle, which, in 2006, contributed with 84% of the emission from enteric fermentation. The emission from pig production is the second largest source and covers 12% of the total emission from enteric fermentation (Figure 6.3), followed by horses (3%) and sheep and goats (2%).

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 and Gyldenkærne (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 2006, 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 3). 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 2006.

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 (Danfær, A. 2005). FAS have estimated the CH_4 emission for two years, 1991 (Y_m=6.7) and 2002 (Y_m=6.0). The years between 1991 and 2002 and the following years are estimated by interpolation where the actual sugar beet area is taken into account. It is assumed that winter feeding plan covers 200 days.

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 all other categories the IEF is constant for all years.

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 – 2006 [Kg CH_4/head/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	34.58	35.02	35.28	35.19	35.45
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
1. Cattle							
a. Dairy	117.21	119.31	121.46	124.12	126.18	128.09	126.22
b. Non-Dairy	35.55	35.73	35.85	35.72	35.09	34.94	35.06
3. Sheep	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
6. Horses	21.34	21.34	21.34	21.34	21.34	21.34	21.34
8. Swine	1.11	1.09	1.09	1.09	1.11	1.05	1.10
9. Poultry	NE	NE	NE	NE	NE	NE	NE
10. Other (fur farming)	NE	NE	NE	NE	NE	NE	NE

The increase in the IEF for dairy cattle from 1990-2006 is the result of increasing feed consumption due to rising milk yields. On average, the milk yield has increased from 6200 litre per cow per year in 1990 to approximately 8500 litre per cow per year in 2006 (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 suckler 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. 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 2006 – enteric fermentation

Non Dairy Cattle – subcategories (Based on an one year production)		Energy intake [MJ/day]	Methane conversion rate (Ym) [%]	IEF [kg CH_4/head/yr]
Calves, bull (0-6 month)		61.4	4.00	16.11
Calves, heifer (0-6 month)		85.6	6.00	33.02
Bull (6 month to slaughter)	large breed: 440 kg sl. weight jersey: 330 kg sl. weight	115.9	4.00	30.42
Heifer (6 month to calving)		105.4	5.93	41.05
Suckling cattle		160.9	6.00	62.48
Average - Non-Dairy Cattle				**35.06**
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 increased while the feed intake for slaughtering pigs has decreased as a result of improved fodder efficacy (Annex 3D table 1b).

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 2006 – enteric fermentation

Swine – subcategories (Based on an one year production)	Energy intake [MJ/day]	Methane conversion rate (Ym) [%]	IEF – kg [CH_4/head/yr]
Sows (incl. piglets until 7.5 kg)	70	0.60	2.8
Piglets (7.5 – 30 kg)	14	0.60	0.5
Slaugther pigs (30 – 105 kg)	39	0.60	1.5
Average - Swine			**1.1**
IPCC – default value			**1.5**

The same feed intake for sheep, goats and horses are used for all years, which results in an unaltered IEF. 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 2006 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 yiled. Buffalo, camels and llamas, mules and donkeys are not relevant for Denmark.

Table 6.9 Number of animals from 1990 to 2006 [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**			
IPCC livestock categories:										
Dairy Cattle	636	623	610	596	563	564	550			
Non-Dairy Cattle	1 232	1 284	1 187	1 128	1 082	1 006	984			
Sheep*	81	92	74	83	79	94	102			
Goats*	10	11	11	12	12	14	13			
Horses*	150	152	153	155	155	156	157			
Swine	11 922	12 608	12 732	12 949	13 233	13 534	13 361			
Poultry	21 830	21 236	20 580	17 796	16 598	17 530	17 249			
Other; fur farming	2 199	2 304	2 422	2 361	2 471	2 552	2 708			

* Including animals on small farms (less than 5 ha), which are not covered by the Statistics Denmark.

6.2.3 Time-series consistency

The total emission from enteric fermentation is given in Table 6.10. From 1990 to 2006, the emission has decreased by 20%, which is primarily related to a decrease in the number of dairy cattle from 753 000 in 1990 to 550 000 in 2006. The number of pigs has increased from 9.5 M in 1990 to 13.4 M in 2006, 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 – 2006 [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	47.99	48.76	47.05	46.04	44.21
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	148.37	148.63	143.39	143.30	137.33
Total (Gg CO_2 eqv.)	3 259	3 262	3 216	3 253	3 148	3 116	3 121	3 011	3 009	2 884
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
Dairy Cattle	74.49	74.38	74.04	73.98	71.10	72.28	69.46			
Non-Dairy Cattle	43.82	45.87	42.54	40.31	37.98	35.14	34.52			
Sheep	1.40	1.59	1.27	1.43	1.36	1.62	1.75			
Goats	0.13	0.14	0.14	0.15	0.16	0.18	0.16			
Horses	3.20	3.23	3.26	3.30	3.31	3.33	3.34			
Swine	13.26	13.69	13.94	14.05	14.62	14.16	14.69			
Poultry	NE	NE	NE	NE	NE	NE	NE			
Other - fur farming	NE	NE	NE	NE	NE	NE	NE			
Total (Gg CH_4)	136.28	138.89	135.20	133.21	128.53	126.71	123.93			
Total (Gg CO_2 eqv.)	2 862	2 917	2 839	2 797	2 699	2 661	2 602			

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 total emission from the agricultural sector in 2006 and the major part of the emission originates from the production of swine (57%) followed by cattle production (32%). 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 percent for ruminants and 2 percent 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. ERT has accepted 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 2006, approximately 8% (0.96 M tonnes of cattle slurry and 1.18 M tonnes of pig slurry) were treated in biogas plants (DEA 2007). 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 per day. The reduced CH_4 emission is calculated as:

$$\mathrm{CH4}_{reduction,i} = \mathrm{VS}_{treatedslurry,i} * \mathrm{B}_{\mathrm{o,i}} * \mathrm{MCF} * 0.67 * \mathrm{R}_{CH4-potetial,i}$$

Where; $CH_{4\ reduction}$ 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 (IPCC default: cattle = 0.24, swine = 0.45), MCF is the methane conversion factor (IPCC default: 10%) and $R_{CH4\text{-}potential}$ is the reduction potential. A reduction potential of 30% for cattle slurry and 50% for pig slurry is obtained (Nielsen et al. 2002, Sommer et al. 2001).

Due to the biogas plants, the total emission of CH_4 is reduced by 1.25 Gg CH_4 (Table 6.9), which correspond a 3% reduction of the CH_4 emission from manure management in 2006.

Table 6.11 Reduced CH_4 emissions from biogas treated slurry 1990 – 2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
No. of biogas plants	230	388	473	556	658	772	830	1005	1222	1253
Amount of treated slurry (M tonnes)										
- 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**			
No. of biogas plants	1 253	1 408	1 524	1 747	2 133	2 276	2 338			
Amount of treated slurry (M tonnes)										
- cattle	0.47	0.52	0.57	0.65	0.79	0.85	0.87			
- swine	0.57	0.64	0.69	0.79	0.97	1.03	1.06			
VS total in treated slurry										
- cattle	0.04	0.04	0.05	0.05	0.07	0.07	0.07			
- swine	0.03	0.03	0.03	0.04	0.05	0.05	0.05			
Total reduced emission (Gg CH_4)	0.68	0.74	0.84	1.03	1.10	1.13	1.25			

CH_4–implied emission factor

Table 6.12 shows the development in the implied emission factors from 1990 to 2006. 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. The IEF for sheep and goats includes lambs and kids, which corresponds the Danish normative data. This explains why the Danish IEF is nearly twice as high as the IPCC default value

Table 6.12 Implied emission factor – Manure Management 1990 – 2006 [Kg CH_4/head/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**			
1a. Dairy Cattle	16.06	16.97	17.88	19.03	19.73	18.97	18.61			
1b. Non-Dairy Cattle	1.74	1.79	1.78	1.77	1.70	1.71	1.72			
3. Sheep	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			
6. Horses	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			
9. Poultry	0.01	0.01	0.01	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			

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 2006. 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 2006 (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 2.7 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 2006 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 6.13 and 6.14. 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 "other 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 6.13 Cattle – important parameters for calculation of the average implied emission factor for manure management 2006

	IPCC				DK - 2006			
	VS [kg dm/hd/day]	Digestibility [%]	Liquid/slurry [%]	IEF [kg CH4/hd/yr]	VS [kg dm/hd/day]	Digestibility [%]	Liquid/slurry [%]	IEF [kg CH4/hd/yr]
Dairy	5.1	60	40	14	4.8	71 (78)	75	19
Non-dairy	2.7	60-65	50	6	0.3 - 3.7	67-79 (78)	24	2
Calves, bull					0.6	79 (79)	0	0.3
Calves, heifer					0.5	78 (78)	0	0.2
Bulls > ½ yr					0.8	75 (78)	35	2.5
Heifer > ½ yr					1.4	71 (78)	57	2.5
Suckling cattle					3.7	67 (77)	0	1.1

Table 6.14 Swine – important parameters for calculation of the average implied emission factor for manure management 2006

	IPCC				DK - 2006			
	VS [kg dm/hd/day]	Digestibility [%]	Liquid/slurry [%]	IEF [kgCH_4/hd/day]	VS [kg dm/hd/yr]	Digestibility [%]	Liquid/slurry [%]	IEF [kg CH_4/hd/yr]
Swine	0.5	75		3.0			92	2.7
Sows (incl. piglets until 7 kg)					0.70	81		6.7
Piglets (7-30 kg)					0.14	81		1.5
Slaugther pigs (30-104kg)					0.39	81		3.9

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 11% from 1990 to 2006 (Table 6.15), 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 6.15 are values weighted for the subcategories (Table 6.3). N-excretion reflects nitrogen excreted per animal per year. The variations in N-excretion in the time-series reflect changes in feed intake, fodder efficiency and allocation of subcategories.

Table 6.15 Nitrogen excretion, annual average 1990 – 2006 [kg N/head/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	36.77	37.00
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	4.80	5.04	4.64	6.77	5.65	5.53	5.34	4.64	4.37	4.87
N-excretion, total (M kg N/yr)	292	292	293	296	285	276	276	274	278	270
N-excretion, stable (M kg N/yr)	258	256	257	260	250	240	240	239	243	236
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
Livestock category										
Non-dairy	37.15	37.77	37.77	37.70	38.64	39.36	38.63			
Dairy cattle	125.31	124.88	126.71	129.31	131.07	132.19	133.53			
Sheep	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			
Swine	9.63	9.18	9.58	9.25	9.48	8.97	8.55			
Poultry	0.55	0.57	0.59	0.66	0.75	0.72	0.62			
Horses	43.31	43.31	43.31	43.31	43.31	43.31	43.31			
Fur farming	4.63	4.62	4.61	4.61	5.09	5.38	5.18			
N-excretion, total (M kg N/yr)	270	273	275	270	274	271	259			
N-excretion, stable (M kg N/yr)	237	239	242	238	243	239	229			

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:

$$N_2O - N_{reduction} = N_{i,slurry,treated} * N_{content} * R_{N_2O,potential} * EF_{N_2O}$$

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* (cattle = 0.538%   swine = 0.541%), R $_{N20,\ potential}$ is the reduction potential (cattle = 36%, swine = 40%). For the emission factor for N_2O emission EF_{N2O} IPCC default is used (1.25 percent).

Due to the biogas plants, the total emission of N_2O is reduced by 0.06 Gg N_2O (Table 6.16), which correspond a 3% reduction of the N_2O emission from manure management in 2006.

Table 6.16 Reduced N_2O emissions from biogas-treated slurry 1990 – 2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
No. of biogas plants	230	388	473	556	658	772	830	1 005	1 222	1 253
Amount of treated slurry (M tonnes)										
- 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_20)	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**			
No. of biogas plants	1 253	1 408	1 524	1 747	2 133	2 276	2 338			
Amount of treated slurry (M tonnes)										
- cattle	0.47	0.52	0.57	0.65	0.79	0.85	0.87			
- swine	0.57	0.64	0.69	0.79	0.97	1.03	1.06			
Total reduced emission (Gg N_20)	0.03	0.03	0.04	0.05	0.05	0.05	0.06			

6.3.3 Time-series consistency

In Table 6.17, the total emission from manure management from 1990 to 2006 is shown. The N_2O emission has decreased by 24%. The total emission from manure management has, nevertheless, increased by 10% in CO_2 equivalents due to the increase in the CH_4 emission.

Table 6.17 Emissions of N_2O and CH_4 from Manure Management 1990 – 2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N_2O emission										
Liquid manure (Gg N_2O)	0.31	0.30	0.30	0.30	0.28	0.27	0.27	0.26	0.26	0.25
Solid manure (Gg N_2O)	1.90	1.90	1.91	1.92	1.87	1.81	1.81	1.81	1.84	1.78
Total Gg N_2O	2.21	2.20	2.20	2.22	2.15	2.08	2.08	2.07	2.10	2.04
Total Gg CO_2 eqv.	684	682	683	690	667	645	645	643	651	632
CH_4 emission										
Total Gg CH_4	35.88	37.81	40.49	43.08	41.72	41.68	42.36	43.09	45.00	44.38
Total Gg CO_2 eqv.	754	794	850	905	876	875	890	905	945	932
Total Manure Management (Gg CO_2 eqv.*)	1 438	1 476	1 534	1 594	1 543	1 521	1 535	1 548	1 596	1 564
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
N_2O emission										
Liquid manure (Gg N_2O)	0.26	0.26	0.26	0.25	0.25	0.25	0.23			
Solid manure (Gg N_2O)	1.68	1.69	1.63	1.56	1.58	1.55	1.44			
Total Gg N_2O	1.94	1.94	1.89	1.81	1.83	1.80	1.67			
Total Gg CO_2 eqv.	601	603	587	560	568	558	519			
CH_4 emission										
Total Gg CH_4	46.12	47.90	48.75	49.26	50.57	49.9	50.88			
Total Gg CO_2 eqv.	968	1 006	1 024	1 034	1 062	1 049	1 069			
Total Manure Management (Gg CO_2 eqv.*)	1 570	1 608	1 610	1 595	1 630	1 606	1 587			

* Incl. the reduction from biogas treated slurry.

N_2O emission from Agricultural Soils (CRF Sector 4D)

6.3.4 Description

The N_2O emissions from agricultural soils, CRF Table 4.D, contribute, in 2006 with 62% of the total emission from the agricultural sector. Figure 6.6 shows the distribution and the development from 1990 to 2006 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.

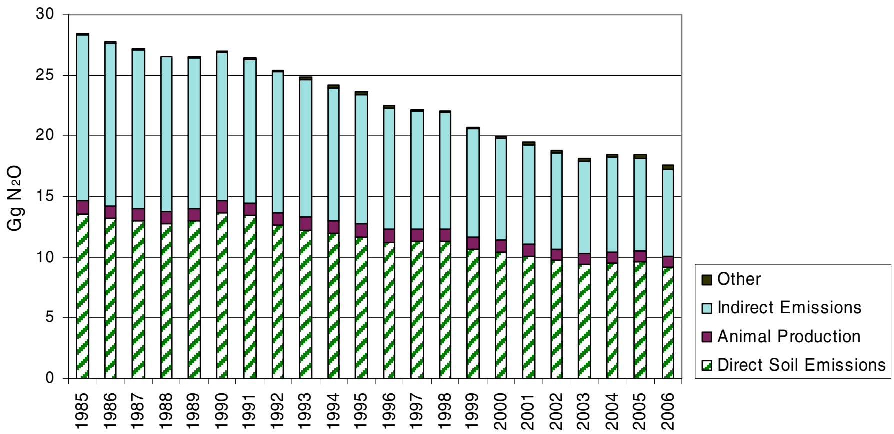

Figure 6.3 N_2O emissions from agricultural soils 1990 - 2006.

6.3.5 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 (Illerup et al. 2005). These reports are available on the internet. A N_2O emission factor survey is presented in Table 6.18. The estimated emissions from the different sub-sources are described in brief in the text which follows.

Table 6.18 Emissions factor - N_2O emission from the Agricultural Soils 1990 - 2006

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/kg N
1. Direct Soil Emissions			
Synthetic Fertiliser Applied to Soils	NH_3 emission = 2%		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/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 6.19 shows the consumption of each fertiliser type. Furthermore, the ammonia emission factor for each fertiliser is given, based on national estimates from FAS (Sommer and Christensen 1992, Sommer and Jensen 1994, Sommer and Ersbøll 1996). These emission factors are also in accordance with the emission factors recommended in the inventory guidebook for CLRTAP Emission Inventories – Table 5.1. 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 0.02 kg NH_3-N/kg N. The low Danish FracGASF is also probably due to the small consumption of urea (<1%), which has a high emission factor.

Table 6.19 Synthetic fertiliser consumption 2006 and the NH_3 emission factors.

Synthetic fertiliser year 2006	**NH_3 Emission factor**[1] (Kg NH_3-N / kg N)	**Consumption**[2] (M kg N)
Fertiliser type		
Calcium and boron calcium nitrate	0.02	0.3
Ammonium sulphate	0.05	2.9
Calcium ammonium nitrate and other nitrate types	0.02	83.2
Ammonium nitrate	0.02	7.5
Liquid ammonia	0.01	4.7
Urea	0.15	0.6
Other nitrogen fertiliser	0.05	16.4
Magnesium fertiliser	0.02	0.0
NPK-fertiliser	0.02	60.8
Diammonphosphate	0.05	0.6
Other NP fertiliser types	0.02	3.4
NK fertiliser	0.02	5.5
Total consumption of N in synthetic fertiliser		191.8
Total emission of NH_3-N (M kg)	4.56	
Average NH_3-N emission (FracGASF)	0.02	

[1] Danish Institute of Agricultural Sciences (Sommer and Christensen 1992, Sommer and Jensen1994, Sommer and Ersbøll 1996)

[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 2006 (Table 6.20).

Table 6.20 Nitrogen applied as manure to agricultural soils 1990 - 2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N content in synthetic fertiliser (kt N)	400	395	370	333	326	316	291	288	283	263
NH_3-N emission (kt NH_3-N)	9	8	8	8	8	8	7	6	6	6
N in fertiliser applied on soil (kt N)	392	386	362	325	318	308	284	281	277	257
N_2O emission (Gg N_2O)	7.69	7.59	7.10	6.39	6.25	6.06	5.58	5.53	5.44	5.05
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
N content in synthetic fertiliser (kt N)	251	234	211	201	207	206	192			
NH_3-N emission(kt NH_3-N)	6	5	5	4	5	5	4			
N in fertiliser applied on soil (kt N)	246	229	206	197	202	202	187			
N_2O emission (Gg N_2O)	4.83	4.49	4.05	3.87	3.97	3.96	3.68			

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 6.21). The total N-excretion in stables from 1990 to 2006 has decreased by 11%. 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 6.21 Nitrogen applied as fertiliser to agricultural soils 1990 - 2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N-excretion, stable (t N)	258	256	257	260	250	240	240	239	243	236
N ab Storage (kt N)	214	213	214	217	208	201	201	199	203	200
NH_3-N emission from application (kt NH_3-N)	35	34	33	32	29	27	25	25	25	25
N in manure applied on soil (kt N)	179	179	181	185	179	174	176	174	178	175
N_2O emission (Gg N_2O)	3.52	3.56	3.63	3.51	3.42	3.45	3.42	3.49	3.44	3.52
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
N-excretion, stable (kt N)	237	239	242	238	243	239	229			
N ab Storage (kt N)	198	200	203	200	202	201	194			
NH_3-N emission from application (kt NH_3-N)	24	24	22	20	20	20	19			
N in manure applied on soil (kt N)	173	176	181	180	182	182	175			
N_2O emission (Gg N_2O)	3.40	3.45	3.55	3.54	3.58	3.57	3.43			

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 2006 (Table 6.22). This is the result of an active strategy to improve the utilisation of the nitrogen in manure.

Table 6.22 FracGASM 1990 - 2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total N-excretion (kt N)	292	292	293	296	285	276	276	274	278	270
NH_3-N emission from manure (kt NH_3-N)	79	78	77	77	72	68	67	66	68	66
FracGASM	0.26	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.23	0.24
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
Total N-excretion (kt N)	270	273	275	270	274	271	259			
NH_3-N emission from manure (kt NH_3-N)	65	65	64	60	62	58	55			
FracGASM	0.23	0.23	0.22	0.22	0.22	0.21	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).

$$N_2O\text{-}N_{\text{N-fix}} = \sum (Ts_{\text{i, yield}} * N_{\text{i, pct}} * (1 + N_{\text{i, pct in root and stubble}}) * A_{\text{pct fix}}) * EF_{\text{N2O}}$$

Where; $N_2O\text{-}N$ is the nitrous oxide emission, Ts_{iyield} is the dry matter, yield, kg per 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 2006 and, for this reason, represents an important contributor to the total emission from N-fixing crops.

In Table 6.23 the background data for estimating the N-fixing is listed. The emission from N-fixing crops decreases from 1990-2006, largely due to a reduction in agricultural area.

Table 6.23 Emissions from N-fixing crops 2006

N_2O emission from nitrogen fixing crops	Dry matter Fraction [%]	N-Fraction [% of DM]	N-fixing variations 1990-2006 [kg N/ha]	N-fixing 2006 [kg N/ha]	N-fixing total 2006 [kg N fix]
Pulses*	0.85	0.0337	96-179	106	1 200
Lucerne	0.21	0.0064	307-517	417	1 661
Cereals and pulses for green fodder	0.23	0.0061	14-38	22	1 380
Pulses, fodder cabbage etc.	0.23	0.0061	0-1	NO	NO
Peas for canning*	0.85	0.0337	76-144	85	240
Seeds for sowing	NE	NE	181-186*	181	1 138
Grass and clover field in rotation	0.13	0.0052	40-96	95	25 693
Grass and clover outside rotation	0.13	0.0052	6-11	8	1 502
Aftermath	0.13	0.0052	6-16	16	1 827
Total N-fix					34 641

* 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/ha and 180 kg N/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.

$$N_2O - N_{crop\ residue,j} = \sum_{1}^{N} ha_{i,j} * ((\frac{N_{i,stubble}}{N_{i,ploughing\ frequency.}}) + N_{husks} + N_{i,tops} + N_{i,leafs}) * EF_{N2O}$$

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 total emission from crop residues has decreased 9% from 1990 to 2006 (Table 6.24). 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 – 48% in 1990 and 57% in 2006.

Table 6.24 Emissions from crop residue 1990 – 2006.

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 (M kg 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**			
Stubble	18.6	18.6	18.3	17.6	17.0	17.6	17.8			
Husks	12.0	12.3	11.5	12.0	12.0	12.3	12.4			
Top of beets and potatoes	5.3	5.2	5.5	4.9	5.0	4.9	4.4			
Leafs	9.0	9.2	9.1	9.1	8.5	9.4	9.4			
Straw	10.8	11.6	9.0	9.0	10.7	10.2	10.0			
Crop residue, total (M kg N)	55.7	57.0	53.4	52.5	53.3	54.4	54.1			
N_2O emission (Gg)	1.09	1.12	1.05	1.03	1.05	1.07	1.06			
$Frac_R$	0.27	0.24	0.27	0.26	0.23	0.24	0.23			

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 6.25 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**			
Cultivated histosols	78 412	79 665	78 688	78 992	77 420	82 187	82 309			

Animal Production

The amount of nitrogen deposited on grass is based on estimations from the ammonia inventory. It is assumed that 15%, on average, of the nitrogen from dairy cattle is excreted on grass (expert judgement from the Danish Institute of Agricultural Science – Poulsen et al. 2001). 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 6.26 Nitrogen excreted on grass 1990 - 2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
N-excretion, grass (kt N)	34	35	35	36	35	36	36	35	35	34
NH_3-N emission (kt NH_3-N)	2	2	2	3	2	2	3	2	2	2
N deposited on grass (kt 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**			
N-excretion, grass (kt N)	34	34	33	32	32	31	31			
NH_3-N emission (kt NH_3-N)	2	2	2	2	2	2	2			
N deposited on grass (kt N)	31	32	31	30	30	29	29			
N_2O emission (Gg)	0.99	1.01	0.97	0.95	0.93	0.91	0.90			
FracGRAZ	0.13	0.13	0.12	0.12	0.12	0.12	0.12			

$Frac_{GRAZ}$ is estimated as the volatile fraction from grazing animals compared with the total excreted nitrogen (N ab animal) (Table 6.23). The decrease in $Frac_{GRAZ}$ is due to fall in the production of grassing animals e.g. cattle. A still increasing part of the total N-excretion is related to the production of swine – 44% in 2006 compared with 38% in 1990.

Indirect Emissions

Atmospheric Deposition

To estimate the emission from N-fixing crops, IPCC Tier 1b is applied Atmospheric deposition includes all ammonia emissions sources included in the Danish ammonia emission inventory (Illerup et al. 2005). 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 – 2006 as a result of the reduction in the total ammonia emission, from 109300 tonnes of NH_3-N in 1990 to 71600 in 2006.

Table 6.27 Ammonia emission 2006 (DIEMA)

Ammonia emission	2006
	Tonnes NH_3-N
Manure	55 200
Synthetic fertiliser	4 500
Crops	11 800
NH_3 treated straw*	NO
Sewage sludge and sludge from the industrial production	100
Emission total	71 600
N_2O emission (Gg)	1.12

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. The results of the two models differ only marginally. The average of the two model predictions is used in the emission inventory.

Figure 6.8 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. 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 52% from 1990 to 2006.

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.

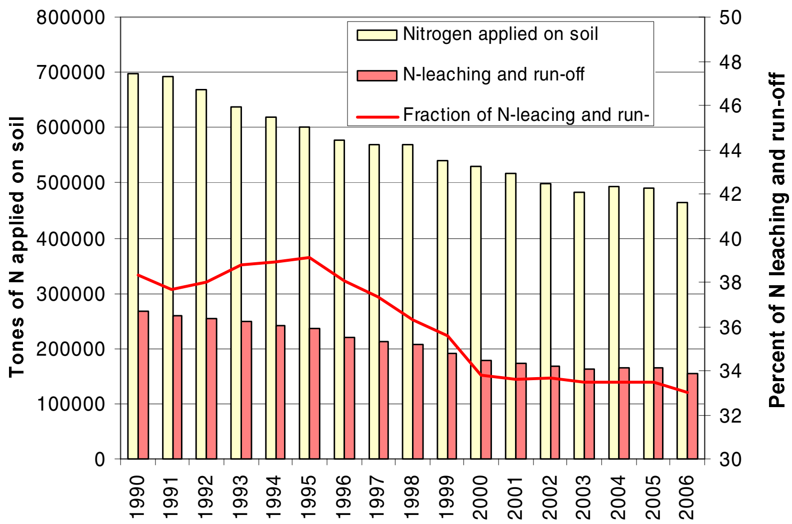

Figure 6.4 Nitrogen applied to agricultural soils and N-leaching from 1990 to 2006

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 6.28 Emission from sludge applied on agricultural soils 1990 - 2006

	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**			
Nitrogen in sewage sludge (t N)	3 625	3 518	3 600	3 572	3 087	3 087	2 867			
Nitrogen in industrial waste (t N)	5 147	7 274	8 000	8 000	10 000	10 000	11 000			
NH_3-N emission (t NH_3-N)	68	66	67	67	58	58	54			
N applied as fertiliser to the soil (t N)	8 705	10 726	11 532	11 505	13 029	13 029	13 813			
N_2O emission (Gg N_2O)	0.17	0.21	0.23	0.23	0.26	0.26	0.27			

6.3.6 Activity data

Table 6.26 provides an overview on activity data from 1990 to 2006 used in relation to the estimation of N_2O emission from agricultural soils. The amount of nitrogen applied to agricultural soil has decreased from 1087 Gg N to 718 Gg N, corresponding to a 34% reduction, which results in a lower N_2O emission.

Table 6.29 Activity data - agricultural soils 1990 – 2006 [Gg N]

CRF – table 4.D	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total amount of nitrogen applied on soil	1 087	1 068	1 024	998	970	946	904	897	896	842
1. Direct Emissions										
Synthetic Fertiliser	392	386	362	325	318	308	284	281	277	257
Animal Waste Applied	179	179	181	185	179	174	176	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	109	106	104	103	99	93	89	88	89	85
N-leaching and Runoff	267	261	254	248	241	235	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	4	4	4	4
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
Total amount of nitrogen applied on soil	817	797	767	741	754	752	718			
1. Direct Emissions										
Synthetic Fertiliser	246	229	206	197	202	202	187			
Animal Waste Applied	173	176	181	180	182	182	175			
N-fixing Crops	38	36	36	31	30	34	35			
Crop Residue	56	57	53	53	53	54	54			
2. Animal Production	31	32	31	30	30	29	29			
3. Indirect Emissions										
Atmospheric Deposition	84	83	81	77	78	74	72			
N-leaching and Runoff	179	174	168	162	166	164	153			
4. Other										
Industrial Waste	5	7	8	8	10	10	11			
Sewage Sludge	4	3	4	4	3	3	3			

6.3.7 Time-series consistency

The N_2O emissions from agricultural soils have reduced by 35% from 1990 to 2006. 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 6.30 Emissions of N_2O from Agricultural Soils 1990 – 2006 [Gg N_2O]

CRF – table 4.D	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total N_2O emission	26.93	26.44	25.46	24.83	24.18	23.58	22.48	22.20	22.06	20.71
1. Direct Emissions	13.62	13.39	12.67	12.24	11.94	11.67	11.23	11.27	11.35	10.68
Synthetic Fertiliser	7.69	7.59	7.10	6.39	6.25	6.06	5.58	5.53	5.44	5.05
Animal Waste Applied	3.51	3.52	3.56	3.63	3.51	3.42	3.45	3.42	3.49	3.44
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	12.22	11.91	11.63	11.36	11.04	10.69	10.02	9.74	9.53	8.89
Atmospheric Deposition	1.72	1.67	1.64	1.62	1.55	1.46	1.40	1.39	1.40	1.34
N-leaching and Runoff	10.50	10.24	9.99	9.74	9.49	9.23	8.62	8.35	8.13	7.56
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**			
Total N_2O emission	19.97	19.48	18.76	18.15	18.46	18.42	17.55			
1. Direct Emissions	10.44	10.12	9.71	9.41	9.54	9.63	9.23			
Synthetic Fertiliser	4.83	4.49	4.05	3.87	3.97	3.96	3.68			
Animal Waste Applied	3.40	3.45	3.55	3.54	3.58	3.57	3.43			
N-fixing Crops	0.75	0.70	0.72	0.62	0.59	0.67	0.68			
Crop Residue	1.09	1.12	1.05	1.03	1.05	1.07	1.06			
Cultivation of Histosols	0.36	0.36	0.35	0.35	0.35	0.37	0.37			
2. Animal Production	0.99	1.01	0.97	0.95	0.93	0.91	0.90			
3. Indirect Emissions	8.37	8.14	7.86	7.57	7.74	7.62	7.15			
Atmospheric Deposition	1.33	1.31	1.27	1.21	1.23	1.17	1.12			
N-leaching and Runoff	7.05	6.84	6.59	6.36	6.51	6.45	6.03			
4. Other	0.17	0.21	0.23	0.23	0.26	0.26	0.27			
Industrial Waste	0.10	0.14	0.16	0.16	0.20	0.20	0.22			
Sewage Sludge	0.07	0.07	0.07	0.07	0.06	0.06	0.06			

6.4 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/ha and for grassland, 2120 g NMVOC/ha (Fenhann and Kilde 1994), (Priemé and Christensen 1991).

Table 6.31 NMVOC emission from agricultural soils 1990 - 2006

	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**			
Arable crops (1000 ha)	2 043	2 060	2 065	2 062	2 079	2 086	2 083			
Grassland (1000 ha)	413	414	396	390	369	446	460			
NMVOC emission (Gg)	1.68	1.69	1.65	1.64	1.60	1.77	1.79			

6.5 Uncertainties

Table 6.32 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 6.32 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	9 605				19	1 790
4.A Enteric Fermentation	CH_4	2 602	10	8	13	13	333
4.B Manure Management	CH_4 and N_2O	1 561	7	75	75	75	1 170
	CH_4 – table 4.B(a)	1 042	10	100	100		
	N_2O – table 4.B(b)	519	10	100	100		
4.D Agricultural Soils	N_2O	5 442	7	23	24	24	1 313
4.D1 Direct soil emissions	N_2O	2 860	5	28	29	29	818
Synthetic Fertiliser	N_2O	1 140	3	50	50		
Animal Waste Applied to Soils	N_2O	1 064	10	50	51		
N-fixing Crops	N_2O	211	20	50	54		
Crop Residue	N_2O	329	20	50	54		
Cultivation of Histosols	N_2O	115	20	50	54		
4.D2 Animal Production	N_2O	279	20	25	32	32	89
4.D3 Indirect soil emissions	N_2O	2 302	16	41	44	44	1 023
Atmospheric Deposition	N_2O	349	10	50	51		
N-Leaching and Runoff	N_2O	1 869	20	50	54		
4.D4 Other							
4.D4 Sewage N	N_2O	17	20	50	54		
4.D4 Industrial Waste Used as Fertiliser	N_2O	67	20	50	54		

6.6 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 2006.

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

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 per 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 Olsen (olo@dst.dk) and Karsten K. Larsen (kkl@dst.dk)

Faculty of Agricultural Sciences (University of Aarhus):

Mrs. Hanne Damgaard Poulsen (HanneD.Poulsen@agrsci.dk)

Mr. Nick Hutchings (Nick.Hutchings@agrsci.dk)

The Danish Agricultural Advisory Centre:

Mr. Niels Henrik Lundgaard (NHL@landscentret.dk)

Mr. Jan Brøgger Rasmussen (JBR@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. Karin Dahlgren (kdl@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. 2004, 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 per 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 per 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 total 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.

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.

Changes compared with the last emissions report are described in the NIR and the total 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. A log-book is kept in the spreadsheet mentioning all changes.

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.

6.7 Recalculation

Compared with the previous reported emission inventory 1990 - 2005, some changes are made. These changes influence the total GHG emission from the agricultural sector by less than 1% (Table 6.33).

Table 6.33 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.)	13 046	12 935	12 642	12 547	12 187	11 945	11 622	11 438	11 440	10 864
Recalculated (Gg CO_2 eqv.)	13 044	12 931	12 637	12 540	12 180	11 938	11 615	11 430	11 433	10 856
Change in Gg CO_2 eqv.	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Change in pct.	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Continued	2000	2001	2002	2003	2004	2005				
Previous inventory (Gg CO_2 eqv.)	10 616	10 558	10 239	10 089	10 039	9 880				
Recalculated (Gg CO_2 eqv.)	10 607	10 549	10 248	9 997	10 027	9 952				
Change in Gg CO_2 eqv.	0.01	0.01	-0.01	0.09	0.01	-0.07				
Change in pct.	-0.1	-0.1	0.1	-0.9	-0.1	0.7				

There have been no changes in the methodology.

The most significant inventory changes are mentioned below:

- Updating of data from the Faculty of Agricultural Science concerning the N_2O emission from N-fixing crops.

- The data received from statistics Denmark concerning the livestock production and the cultivated area 2005 is updated and the changes are implemented in the inventory.

- Updating of data from the Danish Energy Authority concerning the biogas treated slurry from 2002 – 2005.

On basis of the in country review team in April 2007 some improvements is done to meet the recommendations and proposal. The review teams recommendations focused on improvements of the NIR. They pointed out the needs for more transparency and better explanations, especially related to the use of national data and national methodologies. The main recommendations were; to provide table information for key parameters for cattle and swine subcategories (gross energy intake, feed digestibility, nitrogen excretion and volatile solids), table showing the annual changes in country specific value for the methane conversion factor (Ym), more information to explain the decrease in fraction of the nitrogen leaching (FracLEACH) from 1990 to 2005 and information on key source identification for 1990, to compare changes to last reported year

All recommendations have now been performed to improve the transparency in NIR.

Very few recommendations were given directly to the emission calculation and the data registered in CRF. Recommendations included to check notation keys and correctness of unit for volatile solids in CRF table 4B(a).

6.8 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.
- The present inventory operates with 3 subcategories for horses and has to be extending to 4 subcategories to match the latest listed categories for the Danish norm data system.
- To improve the data foundation for biogas treated slurry.
- In 2005 for the first time we have received data from the Danish Plant Directorate concerning the contribution of stable type. Unfortunately, these data was not available for 2006. We are working on a data agreements wit the Danish Plant Directorate to receive data annually.

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.

Other issues which are needed to be improved are the storage of data set. The DIEMA model complex is build up as a number of spreadsheets, where data is linked between the sheets. The systems Achilles heel is the multitude of linked data and every year enlargement. To improve the systems sustainability, it is planned to storage all data set in a data base. At the same time all activity data and emission factors will be updated as the latest knowledge and some changes might be necessary to take into account.

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7 The Specific methodologies regarding Land Use, Land Use Change and Forestry (CRF Sector 5)

7.1 Overview

The methodology for LULUCF is described in Gyldenkærne et al. (2005). 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 2006 emissions from LULUCF were estimated to be a sink of approximately 1.8 Gg CO_2 or 2.6% of the total reported Danish emission.

Approximately 2/3 of the total Danish land area is cultivated. 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 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 thorough GIS analysis of Land Use and Land Use Change has been made for the agricultural sector. The method is described in more detail in Chapter 7.3 Cropland. A full land-use matrix still remains to be carried out for 1990 to 2006. This is expected to take place in 2008 by analysis of 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 y^{-1} except for years with storm damage. Cropland is estimated to have a net emission of 300-2 400 Gg CO_2 y^{-1}. 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, 1990-2004 (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
5. Land Use, Land-Use Change and Forestry, CO_2	1 630.64	-769.20	-1 978.74	-2 290.28	-824.36	-633.17	-1 801.90
A. Forest Land	-664.25	-3 551.13	-3 827.01	-3 547.21	-3 465.22	-1 829.67	-2 757.66
B. Cropland	2 227.07	2 712.61	1 779.33	1 190.96	2 579.57	1 126.98	888.16
C. Grassland	71.10	74.29	75.93	75.97	73.79	82.52	80.99
D. Wetlands	-3.28	-4.97	-6.99	-10.00	-12.50	-13.01	-13.39
E. Settlements	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
5. Land Use, Land-Use Change and Forestry, N_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A. Forest Land	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NA	NA	NA	NA	NA	NA	NA
C. Grassland	NA	NA	NA	NA	NA	NA	NA
D. Wetlands	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
F. Other Land	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
G. Other	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	-633.59	-1 802.32

7.2 Forest Land

7.2.1 Source category description

Danish forests cover only a small part of the country (11%) since the dominant land-use in Denmark is agriculture. Danish forests are managed as closed canopy forests. The main objective is to ensure sustainable and multiple-use management. The main management system used to be the clear-cut system. Today, 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.

The Danish Forest Act protects the main part of the forest area (about 80%) against conversion to other land uses. In principle, the main part of the Danish forests will always remain forest. It is the ambition to enlarge the forested area to 20-25% of the country size by the end of the 21st century. Afforestation of arable land is therefore encouraged by use of subsidies to private landowners. Subsidized afforestation areas are automatically protected as forest reserves. Denmark is the only part of the Kingdom with a forestry sector. Greenland and the Faroe Islands have almost no forest.

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 is 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 is 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 1990, the forested area with trees was about 411 000 ha (= 4 110 km^2) or approximately 10% of the land area (Forestry Census, 1990). Broadleaved tree species made up 35% and coniferous species made up 65% of the forest area. See Table 7.2 for the distribution to specific tree species and species categories.

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. From Statistics Denmark (http://www.statistikbanken.dk/).

Area in ha	1990	2000
Total wooded area	417089	473320
Area temporarily without trees[1]	5702	4985
Broadleaves, total area	143253	174385
Beech	71764	79552
Oak	30247	43011
Ash	10158	12681
Sycamore maple	7979	9444
Other broadleaves	23105	29698
Conifers, total area	268134	293950
Norway spruce	135010	132237
Sitka spruce	35464	34223
Silver fir and other fir	7001	11919
Nordmann's fir	11841	28173
Noble fir	15115	15498
Other conifers	63703	71901

[1]Area not yet replanted with trees following clear-cutting

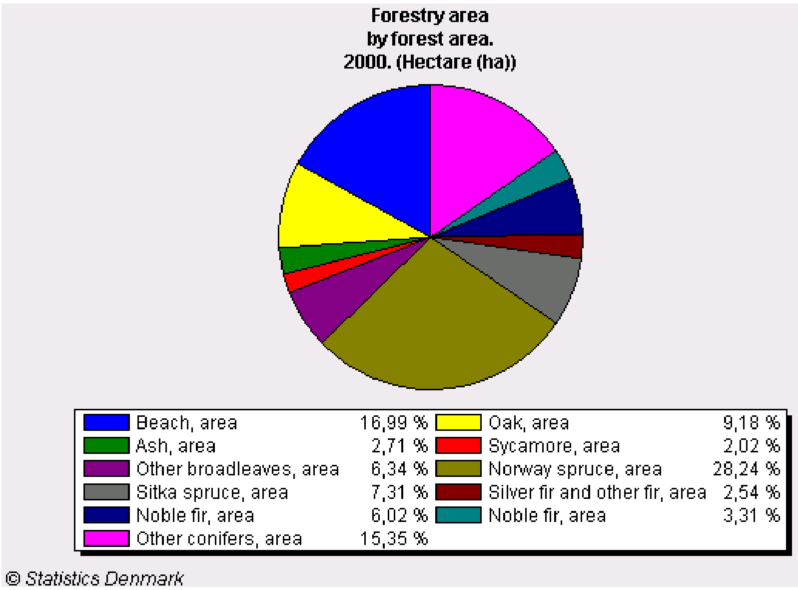

Figure 7.1 Tree species distribution to the total forested area in 2000. From Statistics Denmark (http://www.statistikbanken.dk/).

In 2000, the forested area with trees was 468 000 ha or approximately 11% of the land area. 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 cause 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 (in 2006 about 35 000 ha). Broadleaved tree species made up 37% and coniferous species made up 63% of the forest area. See Figure 7.1 and Table 7.2 or the distribution to specific tree species and species categories.

Compared with other sectors, forestry has very low energy consumption. Green accounting and environmental management are being developed in the sector, partly with the intention to determine whether the use of fossil fuels can be reduced.

Danish forests are managed with special reference to multiple-use and sustainability, and carbon sequestration is 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. There are several measures aiming at achieving this objective. Firstly, a government subsidy scheme has been established that supports private afforestation on agricultural land. Secondly, also governmental and municipal afforestation is taking place, and thirdly some private afforestation is taking place without subsidies. The Danish Forest and Nature Agency is responsible for policies on afforestation on private agricultural land and on state-owned land.

7.2.2 Methodological issues

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).

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 Danish Centre for Forest, Landscape and Planning[5]. 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.

In 1990, the standing stock of wood was 64.8 million m^3, equivalent to 158 m^3 per ha, distributed with 40% broadleaved species and 60% coniferous species. This stock of wood was equivalent to 22425 Gg C or 82225 Gg CO_2. In 2000, the standing stock of wood was 77.9 million m^3, equivalent to 166 m^3 per ha, distributed with 37% broadleaved species and 63% coniferous species. This stock of wood was equivalent to 26803 Gg C or 98278 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 32300, considerably higher than the number of 22300 in the 1990 survey.

From 2002, a new sample-based National Forest Inventory (NFI) has been launched. The new NFI will replace the Forestry Census and measures 1/5 of the plots every year. The first rotation of the NFI was complete by 2006 (after 5 years of field measurements), and the first background data for use in the NIR is expected during 2008. This type of forest inventory is very similar to inventories used in other countries, e.g. Sweden. (see also Section 7.2.6).

[5] Contact: Dr. V.K. Johannsen, Danish Centre for Forest, Landscape and Planning, Hoersholm Kongevej 11, DK-2970 Hoersholm, Denmark. E-mail: vkj@kvl.dk

Expansion factors are needed to convert stem volumes for conifers and total aboveground biomass for the broadleaves to total biomass. There is currently no information on applicable expansion factors for Danish conditions. However, a couple of studies will supply valuable national information within a few years. At present, 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 biomass data for the species categories. The total biomass in m^3 is converted to dry mass by use of tree species-specific basic wood densities (Moltesen, 1988, see Table 7.3), and carbon content is finally calculated by using a carbon concentration of 0.5 g C g^{-1} dry mass.

Table 7.3 Basic wood densities for Danish tree species (Moltesen, 1988).

	Wood density (t dry matter/ 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 for use in the reporting.

Annual CO_2-sequestration in forests planted before 1990

Net C sequestration in the periods 1990–1999 and 2000-2006 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 most recent questionnaire-based 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 2000-2009 are both provided in the Forestry Census of 2000. The gross annual increment for 1990-99 was estimated at 4.6 M m^3 y^{-1} and around 5.2 M m^3 y^{-1} for 2000-09. For the period 1990-99 a new increment estimate was calculated based on information from the 1990 Forestry Census, since missing information on site productivity now could be replaced by reference values on site productivity from the State Forests. Further details on the calculation of the estimates can be found in Johannsen (2002).

Data on the annually harvested amount of wood (Figure 7.2) are obtained from Statistics Denmark (http://www.statistikbanken.dk/). Commercial harvesting was used in the calculations for broadleaved species as wood from thinning operations in young stands is sold as fuel wood and therefore appears in the statistics. For conifers, non-commercial thinning operations are more common. In order to account for this, 20% were added to the figures for commercial harvests of coniferous wood.

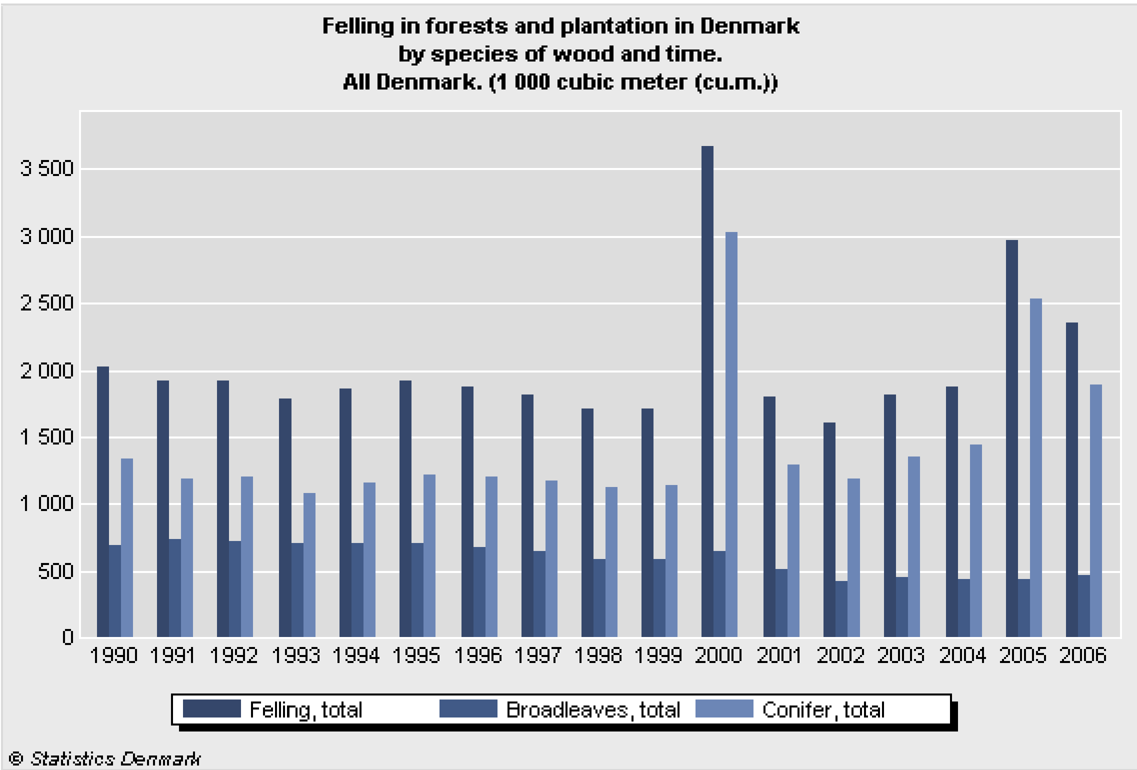

Figure 7.2 The annual harvest of commercial wood (total, broadleaves and conifers) in forests planted before 1990. The peak in 2000 is caused by windthrow of conifers during the storm on Dec. 3, 1999, and the peak in 2005 is caused by windthrow of conifers in the storm Jan. 8, 2005. From Statistics Denmark (http://www.statistikbanken.dk/).

The net annual increment (gross wood increment minus harvested wood) was estimated to approximately 2.3 M m^3 y^{-1} for 1990–1999 and is estimated to approximately 2.7 M m^3 y^{-1} for 2000-2006 (Larsen and Johannsen, 2002). Rates of wood increment are converted to CO_2 uptake by using the expansion factors, basic wood densities and carbon concentration mentioned above.

Table 7.4 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 ha^{-1}	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, t dm	2 080 298	2 080 298	2 080 298
Annual total biomass growth, t dm	3 318 133	3 318 133	3 318 133
C uptake, t	1 659 066	1 659 066	1 659 066
CO_2 uptake, t	6 083 242	6 083 242	6 083 242
Annually harvested, m^3	2 126 607	2 205 006	3 523 824
Annually harvested merchantable biomass, t dm	890 982	916 526	1 417 814
Annually harvested total biomass, t dm	1 449 985	1 503 806	2 405 925
Annual loss of C with harvested wood, t	724 993	751 903	1 202 962
Annual loss of CO_2 with harvested wood, t	2 658 306	2 756 977	4 410 862
Net annual uptake of CO_2, t	3 424 936	3 326 265	1 672 380

An example of calculations for three individual years is given in Table 7.4. The table shows the different steps of calculation from annual gross increment in order to estimate the net sink for CO_2. A summary of gross uptake of CO_2 since 1990 is given in Table 7.5. Figure 7.3 shows the dynamics in the C balance for broadleaves and conifers, respectively. The resulting net sink for CO_2 in existing forests in 1990 was around 3 000 Gg CO_2 yr^{-1} for the period 1990-1999 and somewhat higher (around 3 500 Gg CO_2 yr^{-1}) for the period 2000-2006. 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 M m^3 distributed over about 20 000 ha (Larsen and Johannsen, 2002). In Jan. 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, i.e. the included forest area was larger (440 000 ha in 2000 vs. 411 000 ha in 1990). Annual gross increment per ha was similar for the two periods (11 m^3 ha^{-1} y^{-1}). 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 yr^{-1} for the period 2000-2009.

Table 7.5 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 (Gg).

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gross uptake of CO_2 (Gg yr^{-1})	-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 yr^{-1})	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 yr^{-1})	-2 831	-3 007	-2 996	-3 205	-3 091	-2 977	-3 047	-31	-3 278	-3 267
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
Gross uptake of CO_2 (Gg yr^{-1})	-6 083	-6 083	-6 083	-6 083	-6 083	-6 083	-6 083			
Loss of CO_2 in harvested wood (Gg yr^{-1})	5 489	2 618	2 358	2 658	2 757	4 411	3 509			
Net annual sink for CO_2 (Gg yr^{-1})	-594	-3 465	-3 725	-3 424	-3 326	-1 672	-2 574			

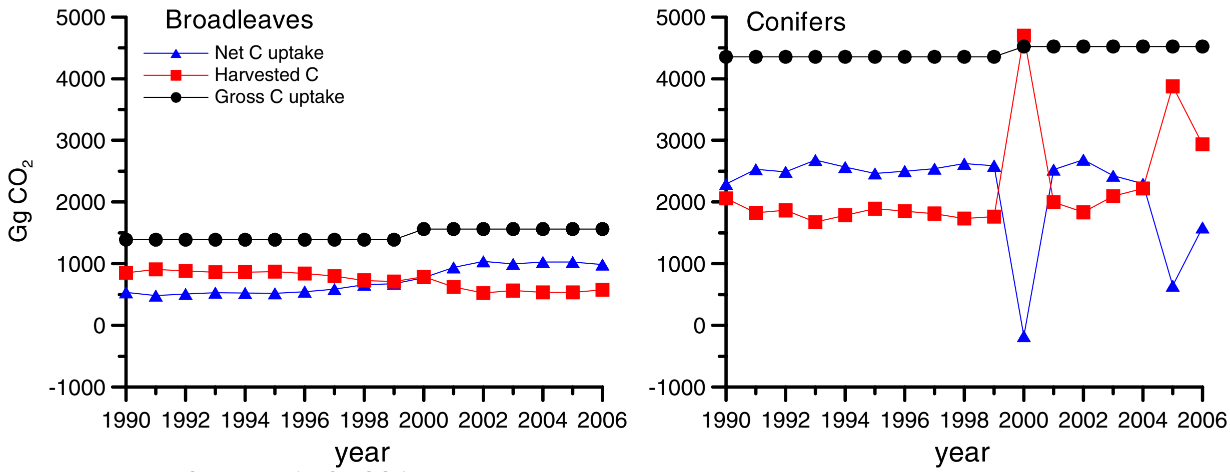

Figure 7.3 The C balance (in Gg CO_2) for broadleaves and conifers in forests planted before 1990. The windthrow incidents for conifers during the storms on Dec. 3, 1999 and Jan. 8, 2005 are clearly visible in data for 2000 and 2005, respectively.

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 yr^{-1} was needed, but in reality the afforestation rate has been much lower with an average afforestation rate of 2 047 ha yr^{-1} for the period 1990-2006. Afforestation is carried out on soils formerly used for agriculture (Cropland). The annually afforested area is specified in Table 7.6. 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 1999-2006 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 per year 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. The reason for this is firstly that Nordmann's fir plantations seldom become closed forest as the trees are harvested within a ten year rotation, and secondly that changes in the market for Christmas trees may force land owners to revert the land use to agriculture after a few years.

Table 7.6 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 (ha).

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
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
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
State forests	196	175	200	300	200	200	100			
Other publicly owned forests	182	59	35	83	51	76	64			
Private forests with subsidies	1 764	1 288	1 497	1 534	463	2 454	3 061			
Private without subsidies	611	611	611	611	611	611	611			
Total area	2 753	2 133	2 343	2 528	1 325	3 341	3 836			
Broadleaved	2 115	1 577	1 828	1 972	857	2 841	3 353			
Coniferous	638	556	515	556	468	500	483			

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 Annex 3D).

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 is 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. This is obviously an area in need of improvement.

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 2006 is the second year with thinning operations in coniferous stands afforested since 1990, but there are no reported emissions of carbon so far 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). 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 have for the first time been included in the NIR for 2008. 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 7.7.

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.

Tree species category	Tree species	Study type	Age (yr)	Forest floor C sequestration ($t\ ha^{-1}\ yr^{-1}$)	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 7.8 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 7.8, 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 7.8 Annual CO_2 uptake in biomass and forest floor (soil), cumulated CO_2 uptake and cumulated afforested area (ha) due to afforestation activities 1990 – 2006 (Gg).

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Biomass CO_2 sink (Gg yr^{-1})	0	-1	-3	-5	-8	-10	-16	-24	-34	-43
Forest floor CO_2 sink (Gg yr^{-1})	0	-1.3	-2.1	-3.0	-3.9	-4.8	-5.7	-7.0	-7.8	-9.9
Total cumulative CO_2 uptake (Gg yr^{-1})	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

Greenhouse gas source and sink categories	2000	2001	2002	2003	2004	2005	2006
Continued				(Gg)			
Biomass CO_2 sink (Gg yr^{-1})	-59	-74	-88	-108	-124	-140	-165
Forest floor CO_2 sink (Gg yr^{-1})	-11.4	-12.5	-13.7	-15.0	-15.8	-17.3	-19.0
Total cumulative CO_2 uptake (Gg yr^{-1})	-215	-290	-379	-488	-613	-755	-921
Cumulated afforestation area (ha)	19 292	21 425	23 768	26 296	27 621	30 962	34 798

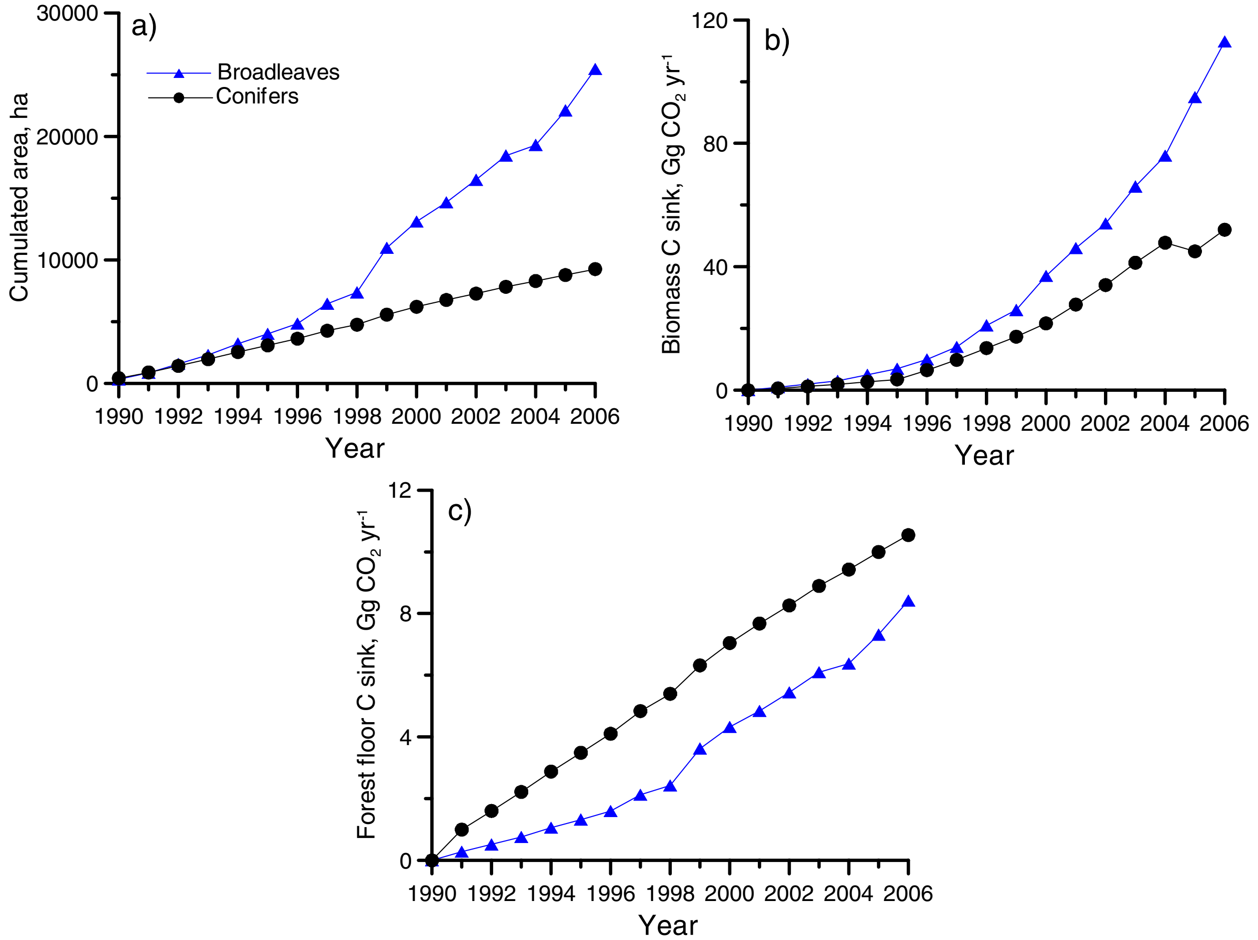

Figure 7.4 a) The cumulated afforested area of broadleaves and conifers and the annual contributions of broadleaves and conifers to the afforestation C sink in b) biomass (in Gg CO_2 yr^{-1}) and c) forest floors (soil, in Gg CO_2 yr^{-1}).

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 7.9 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 7.9 Annual CO_2 uptake in total forest area, forests planted before 1990 and in afforestation of former arable land during 1990-2006.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total forest area (Gg CO_2 yr^{-1})	-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 yr^{-1})	-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 yr^{-1})	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
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
Total forest area (Gg CO_2 yr^{-1})	-664	-3 551	-3 827	-3 547	-3 466	-1 830	-2 758			
Forests remaining forests (Gg CO_2 yr^{-1})	-594	-3 465	-3 725	-3 424	-3 326	-1 672	-2 574			
Afforestation since 1990 (Gg CO_2 yr^{-1})	-70	-86	-102	-123	-140	-158	-184			
(% of total)	10.7	2.4	2.7	3.5	4.1	8.7	6.7			

7.2.3 Uncertainties and time-series consistency

Uncertainty of the reported sinks

In response to previous reviews the probably high but currently unknown uncertainty for CO_2 uptake in forestry is discussed. Uncertainty will be addressed for the inventory data in detail when the first results from the new sample-based National Forest Inventory are available during 2008.

So far, the design of the currently used Danish Forestry Census has not made it possible to quantitatively address uncertainty of inventory data used to estimate the reported sink for CO_2 in Danish forests. The uncertainty of the volume and increment estimates in the Forestry Census 1990 and 2000 are related to a number of issues: The values of site productivity refer to fully stocked stands with no border effects and with a given thinning regime. However, a number of these issues are uncertain. The stands are not fully stocked as 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 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. However, the assessment of uncertainty will improve significantly from 2008 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.

Time-series consistency

The forest areas in 1990 and 2000 were not the same for forests existing before 1990 (411 000 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. 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 per ha was similar for the two periods. However, as mentioned below (Section 7.2.6), we prefer to avoid recalculations of the present data based on the Forestry Census due to the coming large data revision based on the new National Forest Inventory.

In addition to this coming revision, we are currently initiating work on construction of the land-use matrix including changes based on satellite images, aerial photos and databases. A national 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 is carried out by Statistics Denmark, 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.

7.2.5 Source-specific recalculations

Since the submission to UNFCCC in April 2007 we have only corrected an error in the reported figures for C uptake in afforested cropland for 2005. By a mistake, C storage in wood products from thinning of coniferous stands was included. We have consequently changed the reported uptake from 151 Gg CO_2 to 140 Gg CO_2 for 2005.

The other change is the above-mentioned inclusion of changes in forest floor C pools in the accounting of C sequestration following afforestation (see Table 7.7).

7.2.6 Source-specific planned improvements

The new National Forest Inventory

The most important improvement for the reporting of the source category Forest Land was the initiation of the new sample-based National Forest Inventory (NFI) in 2002. The NFI will replace the Forestry Census as source of activity data and removal data. Statistics Denmark is still expected to supply background data for emission (harvesting) but those data can be combined with harvesting data from the NFI.

The mission of the NFI is, as stated in the Forest Act of Denmark, to improve the understanding and management of the Danish Forests by maintaining a comprehensive inventory of their status and trends. The objectives of the inventory are to require 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 in the inventory. The National Forest Inventory uses a continuous sample based inventory with partial replacement of plots. The NFI system gives good estimates of both growth (permanent clusters) and current status (all clusters - including the temporary). The sampling of variables must be economically feasible. The selected variables must cover the indicators concerning sustainable forest management and meet the data needs for national and international forest statistics.

The NFI was initiated in 2002 and has collected data on approximately 60% of the total number of sample plots. One fifth of the sample plots are visited every year. The fifth and last year of data collection in the first rotation of the inventory (2006) has been completed and the second year of the second full inventory is currently planned for 2008. Over the five years more than 7000 plots have been visited and inventoried by the 3 two-man teams travelling from May through September. Data will be prepared and analysed for a report during 2008.

Improvements planned based on NFI and other sources

The background data to come from the sample-based NFI will provide much better estimates of the status of the forest area since 1990 and the development in forest area in the future. Furthermore, growth and harvesting estimates will be based on real sample plots, enabling quantification of error for background data used in calculation of carbon stock changes.

As a first step, after the first full rotation, the NFI is able to supply new activity data, whereas repeated measurements are necessary to assess carbon stock changes. Due to the continuous monitoring every year of one fifth of the sample plots, the first estimates of carbon stock changes may possibly be obtained following just one or two years of measurements in the second rotation of the NFI.

The NFI also supports reporting of more carbon pools than previously. Coarse woody debris and understorey vegetation is monitored and carbon stock changes will be estimated. Unfortunately soil sampling has not been included as part of the NFI so far. However, simple measurements of forest floor thickness in each plot enable estimation of carbon stock changes in the litter pool according to IPCC GPG. Existing national data on forest floor depth/mass relationships can be used for this purpose. Better information on C stock changes of Danish forest soils is foreseen for the commitment period. A national project has just been initiated to resample forest soils in a 7x7 km grid (106 forest plots and ca. 5 afforested cropland plots). The main aim is to document that Danish forest soils are not a source for CO_2 emissions, as Denmark foresees to apply the non-source principle for litter and mineral soil pools under the Kyoto Protocol.

For afforested cropland, the NFI will provide activity data for comparison with the other data sources currently used (subsidized afforestation area). The NFI may have limitations in gauging the relatively small afforestation area. However, the NFI will provide a better estimate of the residual area of land afforested by private landowners without subsidies than the current estimate based on the Forestry Census.

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 will be available within a couple of years due to a just initiated project. Data on belowground carbon is even scarcer. So far it has only been possible to conduct a pilot study in Norway spruce in a thinning trial at one site. However, root-top relationships from these stands will provide a better basis for selecting root-top relationships for Norway spruce from the literature. In addition work has just been initiated on reconstruction of the land use matrix by 1990, 2005 and 2008 by use of databases, satellite photos and aerial photos.

7.3 Cropland

The total Danish agricultural area of approximately 2.7 million hectares has been related to approximately 700 000 individual fields, which again is located at 220 000 land parcels. As mentioned in the overview a detailed GIS analysis has been performed on the agricultural area with data on land use in 1998 with data from EUs IACS (Integrated Administration and Control System), the EUs LPIS (Land Parcel Information System) and detailed soil maps (1:25 000). This gives an average field size of less than four hectares. The actual crop grown in each field is known from 1998 and onwards. However, for simplicity the distribution between mineral soils and organic soils is kept constant for all years from 1990 to 2006.

7.3.1 Source category description

The main sources/sinks on Cropland are land use, establishing of hedgerows and liming. Table 7.10 shows the development in the agricultural area from 1990 to 2006 (Statistics Denmark). In Denmark a continuous decrease of 10-12 000 hectares per year 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.

Table 7.10 Agricultural areas in Denmark 1990-2006, hectare.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(hectare)									
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
	(hectare)						
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
Grass in rotation (CM)	330 834	326 553	292 566	302 896	284 064	342 417	361 351
Permanent grass (GM)	166 261	173 702	177 546	177 635	172 536	192 968	189 384
Horticulture – vegetables (CM)	10 803	9 616	8 903	9 933	9 763	9 557	10 071
Horticulture – permanent (CM)	8 010	8 447	7 976	8 330	7 816	8 237	8 083
Set-a-side (CM)	192 441	202 757	206 555	208 893	199 510	200 751	190 020
Total	2 646 982	2 675 566	2 665 507	2 657 706	2 645 304	2 707 236	2 710 507

[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 7.11 and 7.12 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 7.11 The distribution of crops between organic and mineral soils in 1998 according to the GIS-analysis. The figures are given in hectares. The figures are slightly different from Table 7.9 due to different data sources.

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 7.12 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 7.13 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.

C-TOOL is run on a county based level (average 250 000 hectares), 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 (1999-2006), there have been very warm winters in Denmark and hence the modelled CO_2-emission from the mineral soils is 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 in 1999-2006.

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.

The year 2006 was very warm with a warm winter. As a consequence there has been a very high loss of 2 Gg C or 0.5% of the estimated C stock from the agricultural soils (Figure 7.5 and Table 7.14).

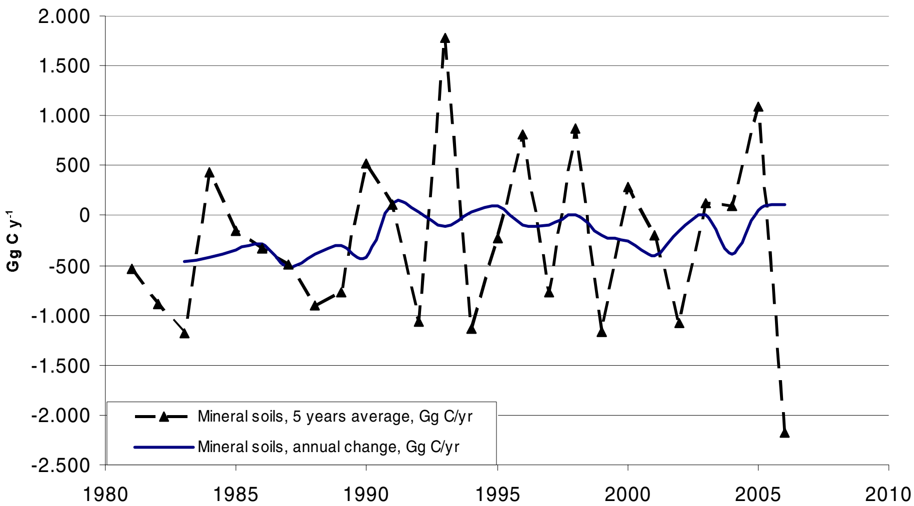

Figure 7.5 Modelled total annually emission and five-year average from all mineral soils in Denmark, Gg C/yr from 1980 to 2006.

Table 7.14 Modelled carbon stock (0-100 cm) in mineral soils from 1980 to 2006.

Year	Carbon stock, Gg C	Emission, Gg C/yr	Emission, Five-year average, Gg C/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	-0.228184
2005	426.52656	1.085113	0.0451142 a
2006	424.354412	-2.172148	0.1097284 [a]

[a]based on projected C input climatic conditions for 2007 and 2008.

Table 7.14 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 380 agricultural fields scattered throughout Denmark on all soil types. Resampling was made in 1998. New resamplings will take place 2009 and 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/ha from 110 tonnes/ha to 112 tonnes/ha (0-50 cm) 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 7.15. 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 7.15 Emission factors for organic soils. Negative values indicates a built up.

	% organic soils[1]	% with deep organic soils	% wet soils	Emission factor, t C $ha^{-1}y^{-1}$ 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.

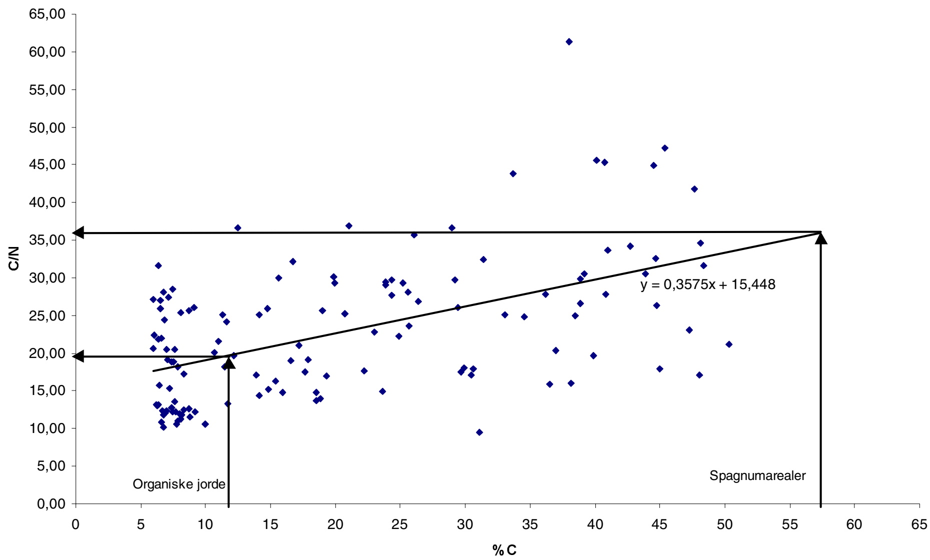

Figure 7.6 C:N-ratio in organic soils in relation to soil carbon content (Olesen 2004)

The estimated emissions from organic soils are given in Table 7.16. The approximately area distribution are shown in Table. 7.11 and the emission factors are given in Table 7.15. For 1990 to 2006 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.

Table 7.16 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 y^{-1}	288	287	288	289	294	278	282	279	285	278
Grassland, Gg C y^{-1}	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**			
				(Gg)						
Cropland, Gg C y^{-1}	279	279	272	273	269	283	288			
Grassland, Gg C y^{-1}	19	20	21	21	20	23	22			
Total organic soils	298	300	293	294	290	304	310			

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 7.17. 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 7.17 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 7.18. Expansion factors and densities are the same as used in forestry (Section 7.2).

Table 7.17 Areas with perennial fruit trees and – bushes, C stock and stock changes from 1990-2006.

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 y^{-1}	-0.406	2.316	-8.329	10.557	-2.334	3.152	-3.871	5.277	0.540	-0.842
CO_2-emission, Gg y^{-1}	-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**			
Apples, ha	1 679	1 783	1 574	1 624	1 673	1 751	1 645			
Pears, ha	441	469	420	457	439	416	413			
Cherries and Plumes, ha	3 002	2 903	2 871	2 967	2 513	2 132	2 128			
Black currant, ha	1 492	1 850	1 939	2 028	1 976	2 000	1 846			
Other, ha	412	376	384	448	756	848	774			
Total, ha	7 026	7 381	7 188	7 524	7 816	8 237	8 083			
C_t, stock, Gg	60.135	61.368	58.121	60.316	56.759	54.025	52.047			
Stock change, Gg y^{-1}	-1.754	-1.233	3.247	-2.195	3.556	-2.734	-1.979			
CO_2-emission, Gg y^{-1}	-6.430	-4.519	11.905	-8.048	13.040	-10.025	-7.255			

Table 7.18 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 per 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 7.19. 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 7.20. 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 7.19 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**			
Replaced, %	27	25	23	22	20	20	26			
Replaced, km	292	298	63	187	110	101	104			
Replaced, ha	73	74	16	47	28	25	26			
New hedges, ha	626	682	207	474	320	287	230			
Removed hedge incl. thinning, Gg C y-1	12	12	3	8	5	19	21			
Sink in new hedge, Gg C y-1	-39	-41	-42	-43	-44	-45	-46			
Stock in new hedges, Gg C	466	507	549	592	640	674	707			

Table 7.20 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 ha^{-1}	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 ha^{-1}	182	130
Expansion factor	1.80	1.20
Biomass, m^3 ha^{-1}	328	156
t C t $biomass^{-1}$	0.50	0.50
t C ha $hedgerow^{-1}$	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 7.10). In 2006 189 384 hectares is reported as permanent grassland. Based on the GIS analysis it is concluded that 17 671 hectares 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 7.15).

Table 7.16 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 22.1 Gg in 2006 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 hectares decreasing to 885 hectares 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^{-1} y^{-1}. 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 per 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 factor of 20 kg CH_4 ha^{-1} y^{-1}.

Table 7.21 Annual emissions from the surface area where peat extraction takes place, Gg C y^{-1} and N_2O y^{-1}.

Greenhouse gas source and sink categories	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Emission, Gg C y^{-1}	0.533	0.535	0.535	0.531	0.528	0.527	0.524	0.524	0.522	0.442
Emission, Mg N_2O y^{-1}	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Emission, Gg CH_4 y^{-1}	-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**			
Emission, Gg C y^{-1}	0.442	0.442	0.442	0.442	0.442	0.442	0.442			
Emission, Mg N_2O y^{-1}	0.24	0.24	0.24	0.24	0.24	0.24	0.24			
Emission, Gg CH_4 y^{-1}	-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 hectare up to 2 180 hectares has been reported to NERI. The total area converted to wetlands up to the year 2003 is 4 792 hectares and 3 767 hectares with raised water table. In 2004 1 622 hectares re-established wetlands and 318 hectares with raised water tables were reported. In 2005 only 413 hectares was re-established and no areas with raised water table. It has been difficult to obtain data for 2006 and therefore an estimate of 300 hectares has been used. This data will be validated further in future.

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.

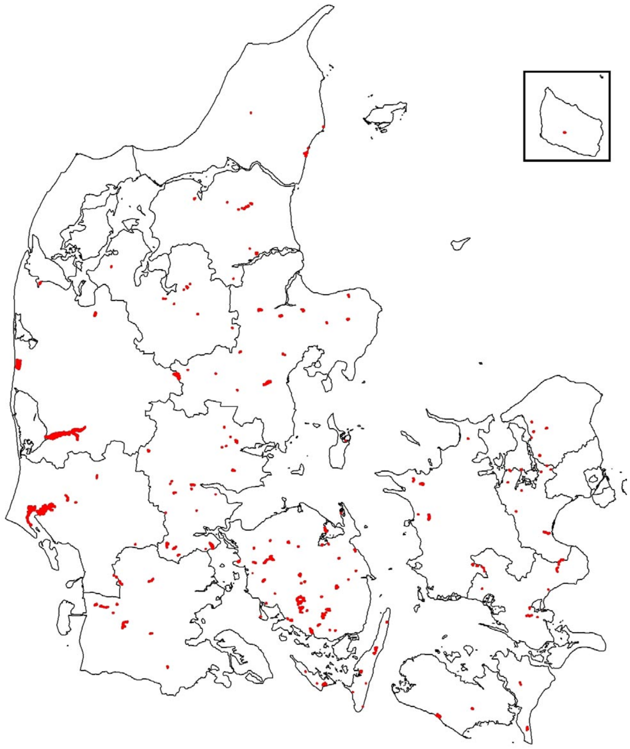

Figure 7.7 Areas with established wetlands and increased water tables from 1997 to 2003.

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 7.22 and 7.23). 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 7.15.

Table 7.22 Area classification of the established wetlands in hectares.

	Area, total	Agricultural area					
		Annual crops	Set-a-side	Permanent grassland	Grass in rotation	Total	Pct.
Dry mineral soil	2441	1155	325	367	225	2072	85%
Dry organic	2223	1072	432	296	106	1906	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	6414	2342	849	814	383	4389	68%

Table 7.23 Area classification where the water table has been raised in hectares.

	Area, total	Agricultural area					
		Annual crops	Set-a-side	Permanent grassland	Grass in rotation	Total	Pct.
Dry mineral soil	1646	475	286	507	160	1427	87%
Dry organic	931	225	132	356	80	793	85%
Wet mineral	1003	37	17	627	89	770	77%
Wet organic	399	21	29	190	49	289	72%
Other	96	9	4	14	3	30	32%
Total	4075	767	468	1695	380	3310	81%

The net-accumulation of C, with a standard sink factor of 0.5 t C ha y^{-1} for the former agricultural area is included in the CRF-Table 5.D. The total annual net - build up from anthropogenic wetlands in 2005 - is estimated to 3.99 Gg C (only former cropland and grassland are included) (Table 7.24). 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 7.24 Increase in carbon sink in anthropogenic established wetlands, 1990-2006, Gg C y^{-1}.

Greenhouse gas source and sink categories	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Net sink. Gg G y^{-1}	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**			
Net sink. Gg G y^{-1}	-1.34	-1.80	-2.35	-3.17	-3.84	-3.99	-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 2008 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 7.24). 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 $CaCO_3$ y^{-1} 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 2005 to 2006 the consumption in agriculture has decreased slightly from 499 000 t $CaCO_3$ to 407 000 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 7.25 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 y^{-1}	-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**			
Agriculture, 1000 t $CaCO_3$	590	454	528	512	356	497	405			
Private gardens, 1000 t $CaCO_3$	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	407			
Total, Gg C y^{-1}	-71.1	-54.7	-63.6	-61.7	-43.0	-59.9	48.9			

7.9 Uncertainties

A Tier 1 uncertainty analysis has been made for part of the LULUCF sector cf. Table 7.25. 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 2008 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 2006

		Emission/sink, Gg CO_2-eqv.	Activity data, %	Emission factor, %	Combined uncertainty	Total uncertainty, %	Uncertainty 95%, Gg CO_2-eqv.
5. LULUCF		-1 802.3				15.7	282.6
5.A Forests		-2 757.7				19.2	530.1
Broadleaves, Forest remaining forest	CO_2	-986.3	20	20	28.3	28.3	279.0
Conifers, Forest remaining forest	CO_2	-1 587.7	20	20	28.3	28.3	449.1
Broadleaves, Land converted to forest	CO_2	-121.4	20	20	28.3	28.3	34.3
Conifers, Land converted to forest	CO_2	-62.2	20	20	28.3	28.3	17.6
5.B Cropland		708.9				32.5	230.3
Mineral soils	CO_2	-402.3	10	20	22.4	22.4	90.0
Organic soils	CO_2	1 055.0	10	50	51.0	51.0	537.9
Hedgerows	CO_2	-90.1	5	20	20.6	20.6	18.6
Perennial horticultural	CO_2	7.3	10	10	14.1	14.1	1.0
Peat for horticultural use	CO_2	139.1	10	50	51.0	51.0	70.9
5.C.Grassland		81.0				51.0	41.3
Organic soils	CO_2	81.0	10	50	51.0	51.0	41.3
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
5(IV) Liming	CO_2	179.2	5	50	50.2	50.2	90.1

7.10 Recalculation

Recalculations have been made for mineral soils in 2003, 2004 and 2005 due to errors in the export of data from the the spreadsheets to the CRF-Reporter. Furthermore a recalculation is made due to the chosen methodology where a five-year average is used. The recalculation has the largest impact on the emission estimate for 2004, which has turned from a net sink of 836 Gg CO_2 to a large emitter of 1422 Gg CO_2.

7.11 Planned improvements

Lime in animal fodder will be incorporated in future. C-TOOL which estimates the emission from mineral soils in cropland and grassland will be validated further. A remapping of all organic soils, both agricultural and forest soils, will take place from 2008 to 2010 to obtain a better estimate of the actual area. Danish emission factors for CO_2 and N_2O from organic soils will be established in 2008-2010. A full land-use matrix for 1990 and 2005 will be available next year.

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 will be carried out in 2007 by analysing satellite data from the European Space Agency (ESA). Natural areas such as heath land, natural wetlands etc. are thus not included in the 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/2006/5_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 2008.

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. Application for financial funding has been made to cover this area. It is assumed that data from forest soils are available in 2008 or 2009.

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 under construction in the 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.

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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 have been some smaller methodological revisions in the submission in 2006 (Illerup et al., 2006), and in the 2007 submission no revisions were introduced. For this submission minor revisions have been introduced that are related to the calculation of the Gross methane emissions.

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 occuring in 2006. Further, previously reported (1994-2005) CO_2 emissions from this activity has been removed 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 (Gg CO_2 equivalents) for the waste sector

		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**			
6 A. Solid Waste Disposal on Land	CH_4	1 215	1 209	1 155	1 178	1 084	1 043	1 028			
6 B. Wastewater Handling	CH_4	217	231	310	300	275	262	248			
6 B. Wastewater Handling	N_2O	65	57	58	50	53	51	50			
6 D Other	CH_4+N_2O	0.029	0.019	0.022	0.025	0.020	0.016	NO			
6. Waste	total	1 498	1 498	1 523	1 528	1 412	1 355	1 326			

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 total Gg CO_2 equivalents. In 2006, the contribution is 77.5%. 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 2006 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 1990-2006 resulting from the increase in industrial influent load of total organic 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 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, i.e. a decrease in activity data, 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. Compared with 1990, the 2006 emission is 14.3% lower, Table 8.1.

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 2006 a key source category. In 2005 it was a key source category to level only. Before 2005 it was a key source with regard to level and trend. In the key-source level analysis for 2006, it is number 13 of 23 key sources and contributes with 1.4% of the national total. As regards the key-source trend analysis for 2006, the category is number 21 on the list, where 29 sources are keys (Cf. Annex 1). The emission estimates for the CH_4 emission is decreasing with 23.0% from 1990 to 2006.

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 1990-2006. 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) and in 2006 it decreased further to 6.5%.

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 1990-2006.

Year	Waste	Annual gross emission	Biogas Collected	Gas oxidized	Annual Net Emission	
	kt	kt CH4	kt CH4	kt CH4	kt CH4	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	11.5	5.5	49.7	1 043
2006	976	65.2	10.8	5.4	49.0	1 028

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 (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 1997, 1998, 2000, 2001a, 2001b, 2002, 2004a, 2004b, 2005, 2006a and 2006b). 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 (GPG page 5.9, Table 5.1). Furthermore, 0.50 is used as the fraction of DOC dissimilated, which is considered good practice (GPG page 5.9). Finally, the fraction of CH_4 in landfill gas is taken as 0.45 (GPG 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 CH_4 emission factors according to waste types

Waste type	DOC-fraction of waste (1)	Fraction of waste emitted as CH4 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 (fraction) of waste types.

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 (kg CH_4/kg waste) for ISAG waste types.

	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 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 GPG page 5.7)

which is in line with values mentioned in the GPG and close to the GPG default value of 0.05.

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 per 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	Com-mercial & office Waste	Industrial Waste	Building & cons-truction 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	Kt CH_4	Kt CH_4	Kt CH_4	Kt CH_4	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	12.0	165.0	5.0	152.0	352.0	208.0	35.0	28.0	957.0	43.8	66.7	11.5	55.2	49.7
2006	13.0	156.0	6.0	152.0	375.0	204.0	39.0	31.0	976.0	43.7	65.2	10.8	54.4	49.0

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 GPG, 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 per capita in the Table 6A,C of the CRF and that these per 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 2006, 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.

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 submission 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 GPG page 5.10). The consequence for the resulting emission has been systematically, slightly increasing emissions, ranging from 0.08% (1990) to 2.38% (1998).

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 kt					
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

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. 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 the 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 is for waste composition in 1985, Table 8.6. It was agreed upon with the reviewers that the composition should be further studied and analysed. In this NIR a first attempt to show the sensitivity of the FOD-model to the waste composition is presented. Based on a estimate on how composition may have changed from 1985 to 2006 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 2006.

In Table 8.10 is shown estimates of the percentage changes of the composition from 1985 to 2006 and in Table 8.11 is shown the composition in 2006 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 2006

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 2006.

Material fractions in	Waste-food	Card-Board	Paper	Wet Card-board and paper	Plastics	Other combustible	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 2006 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 (Half lifetime 10 years). In the table this result is compared with the model with fixed composition and still 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 wit fixed composition.

Year		Annual Gross emissions kt CH4		Per cent
	Fixed 1985 composition	Changing composition 1985-2006	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	74.5	-0.6	-0.8
1993	74.9	75.6	-0.7	-1.0
1994	75.8	76.6	-0.8	-1.1
1995	76.3	77.2	-0.9	-1.2
1996	76.5	77.5	-1.0	-1.3
1997	76.3	77.4	-1.1	-1.5
1998	76.1	77.4	-1.3	-1.7
1999	75.7	77.1	-1.4	-1.8
2000	75.3	76.8	-1.5	-2.0
2001	74.0	75.5	-1.6	-2.1
2002	72.3	73.9	-1.6	-2.2
2003	70.2	71.9	-1.7	-2.4
2004	68.3	70.1	-1.7	-2.5
2005	66.7	68.5	-1.8	-2.7
2006	65.2	67.0	-1.8	-2.8

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 GPG, 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 GPG 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 GPG.

As regards the uncertainty given in the GPG for the methane generation constant, k, (-40%, +300%), this uncertainty cannot be included in simple equations for total uncertainties, such as GPG 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 CH4 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 GPG 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 the IPCC GL and GPG. The half-life time parameter used is within the intervals recommended by the IPCC GPG.

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 GPG 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 SWDS. The main effort has, however, centred on improving the description in the NIR and this section is to be regarded as a further improvement.

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*	*Contact(s)*	*Data agreement/ Comment*
	Report on 2006 amounts according to the waste fractions, Annex 1	Activity data	Danish Environmental Protection Agency, Waste Statistics (Affaldsstatistik)	Lene Graversen	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 GL GPG	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 the IPCC GL and GPG. 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 the IPCC GL and GPG.

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 the IPCC GL and GPG 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 the IPCC GL and GPG.

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 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 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 the IPCC GL and GPG, described in these IPCC reports.

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 of the IPCC GL and GPG, 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 the IPCC GL and GPG 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 GPG and the IPCC GL, as appropriate. The parameters (on the pages of the IPCC GL and IPCC GPG) 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 GPG, 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 1990-2006

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/cap/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/year	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/year	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/year	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**			
	Population	1000 cap	5 330	5 349	5 368	5 384	5 398	5 410	5 427			
MSW	Waste generation rate GL Table 6-1	kg/cap/day	1.26	1.26	1.26	1.26	1.26	1.26	1.26			
MSWT	Waste generation GL Table 6-1	Gg/year	2 451	2 460	2 469	2 476	2 482	2 488	2 496			
MSWF	Fract. of waste to SWDS GL Table 6-1		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			
DOC	Degr Organic C GPG p 5.9		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			
F	Fraction CH_4 in gas GPG p5.10		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			
R	Danish Energy statistics	Gg CH_4/year	11.0	10.0	11.2	7.9	11.0	10.7	10.7			
OX	Oxid. Factor GPG p5.10		0.1	0.1	0.1	0.1	0.1	0.1	0.1			
CH_4 emissions		Gg CH_4/year	21.4	22.4	21.4	24.4	21.8	22.1	22.2			

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.

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/cap/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/year	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 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	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 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/year	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/year	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**			
	Population	1000 cap	5 330	5 349	5 368	5 384	5 398	5 410	5 427			
MSW	Waste generation rate ISAG	kg/cap/day	6.7	6.5	6.7	6.4	6.8	7.2	7.8			
MSWT	Waste generation	Gg/year	13 031	12 768	13 105	12 614	13 359	14 210	15 459			
MSWF	Fract. of waste to SWDS ISAG		0.11	0.10	0.09	0.08	0.08	0.08	0.06			
MCF	Methan Corr Factor GPG p 5.8		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			
DOCF	Fract DOC diss GPG p 5.9		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			
Lo	Methan gener. pot GPG p5.8		0.07	0.07	0.07	0.07	0.07	0.07	0.07			
R	Danish Energy statistics	Gg CH_4/year	11.0	10.0	11.2	7.9	11.0	10.7	10.7			
OX	Oxid. Factor GPG p5.10		0.1	0.1	0.1	0.1	0.1	0.1	0.1			
CH_4 emissions		Gg CH_4/year	81.5	72.4	65.2	57.2	55.4	53.1	54.3			

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.

8.2.5 Recalculations

For the submissions in 2008, recalculations have been carried out in relation to the final submission in 2007 of inventories for the year 2005. The recalculation represents updates in the energy statistics on the uptake of CH_4 by installations at SWDSs for energy production for years. The recalculation implies a decrease in emissions of 1.5%.

8.2.6 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 the 2006 IPCC 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 loads at Danish WWTPs; such as organic degradable carbon. 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. New published data in a report on point sources in 2007 includes activity data on nitrogen in effluents for 2005 and 2006 (Agency for Spatial and Environmental Planning, 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 (cf. Table 8.25).

The CH_4 emission from wastewater handling constitutes in 2006 a key source category to trend (cf. Annex 1). Before 2006 this source category did not include any key sources. In the key-source trend analysis for 2006, it of minor importance being number 28 of 29 key sources 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 49.4% from 1990 to 2006 mainly caused by the industrial influent load which have increase from zero to 40.5%.

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. 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 2006 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

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 61% throughout the period, 1990-2006. 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 35% 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 mariculture 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	0	0	0	0	265	265	17	283
1991	0	14	0	0	237	252	17	269
1992	0	14	0	0	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

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 (cf. Annex 3E, Table 3E.4).

Regarding the time trend in indirect N_2O emission from 1990 to 2006 has decreased 59% 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 43% from 1990 to 2006.

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 (cf. Annex 3.E, Table 3E.5 and 3E.5 and Figure 3E.1). 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
Contribution from industrial inlet BOD	2.5	2.5	2.5	5.0	13.6	22.2	30.8	39.4
Population (1000)	5 140	5 153	5 170	5 188	5 208	5 228	5 248	5 268
TOW [Gg] -; corrected IPPC method*	96.62	96.39	96.71	99.42	107.97	116.59	125.28	134.02
TOW [Gg] - country-specific data	-	-	-	-	-	-	-	-
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Contribution from industrial inlet BOD	48	41	42	38	38	37	40.5	40.5
Population (1000)	5 287	5 305	5 322	5 338	5 351	5 384	5 398	5 411
TOW [Gg] - corrected IPPC method*	142.80	-	-	-	-	-	-	-
TOW [Gg] - country-specific data	-	140.25	141.49	144.36	156.18	160.21	153.06	149.83
	2006							
Contribution from industrial inlet BOD	40.5							
Population (1000)	5 427							
TOW [Gg] - country-specific data	146.59							

*TOW = (1+I/100) x (P x D_{dom}), where P is the Population number and D_{dom}= 18250 kg BOD/1000 persons/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 2004, 2005 and 2006 will be updated when data from all the counties of Denmark have been reported (Agency for Spatial and Environmental Planning, 2007).

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/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 / kg BOD]*
1987	Sludge amount in Tons 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 Tons 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 CH4/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 / kg BOD based on the dry weight fraction of sludge treated anaerobic and an emission factor of 0.15 kg CH4 / 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/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/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. Details regarding the results are addressed in Annex 3, Table 3E.7.

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.

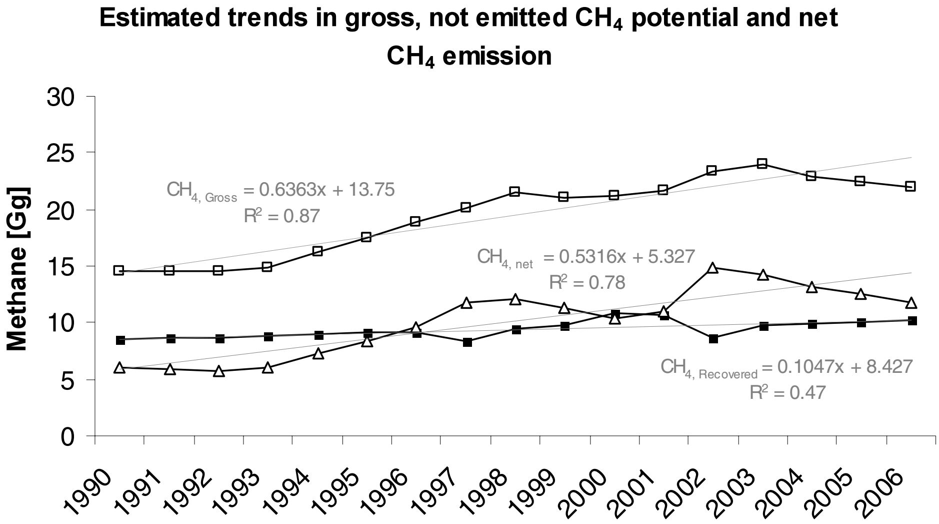

Figure 8.1 Estimated time trends for the gross emission of methane (open squares), methane potential not emitted; i.e. sum of columns 2 to 5, or column 6, in Table 8.13 (black squares) and net emission of methane (open triangles).

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 2005. Figure 8.1 shows that the net emission of methane on average increases 0.53 Gg per year, as a result of the increase in the gross emission of, on average, 0.64 Gg per year, and a minor increase in the amount of methane potential not emitted by 0.11 Gg per 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). So, even though the TOW data indicates a decreasing trend in the last years, the overall influent TOW is considered constant.

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. Annex 3E).

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/capita per year (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 (cf. Annex 3.E, Table 3.E.8). 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. Annex 3.E, and Thomsen and 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/capita per year 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	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
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/person per year	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			
N-population (1000)	5 330	5 349	5 368	5 384	5 398	5 411	5 427			
F-connected fraction	0.9	0.9	0.9	0.9	0.9	0.9	0.9			
Industrial load, %	42.0	38.0	38.0	37.0	40.5	40.5	40.5			
Danish EF gN_2O/person per year	11.5	10.0	10.4	11.3	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 (Table 3.E.3, Annex 3.E). 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 given in Table 3.E.8 in Annex 3.E. 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 per 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 per capita consumption per person per 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/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
Separate industrial discharges	897	812	752	509	469	441	441
Rainwater conditioned effluent	762	758	1 005	685	827	622	856
Scattered houses	979	1 005	968	957	931	919	907
Mariculture and fish farming	2 714	1 757	1 487	1 162	1 335	1 225	1 078
Municipal and private WWTPs	4 653	4 221	4 528	3 614	4 027	3 825	3 623

Data for 2004, 2005 and 2006 will be updated when data from all the counties of Denmark have been reported (Agency for Spatial and Environmental Planning, 2007)

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.

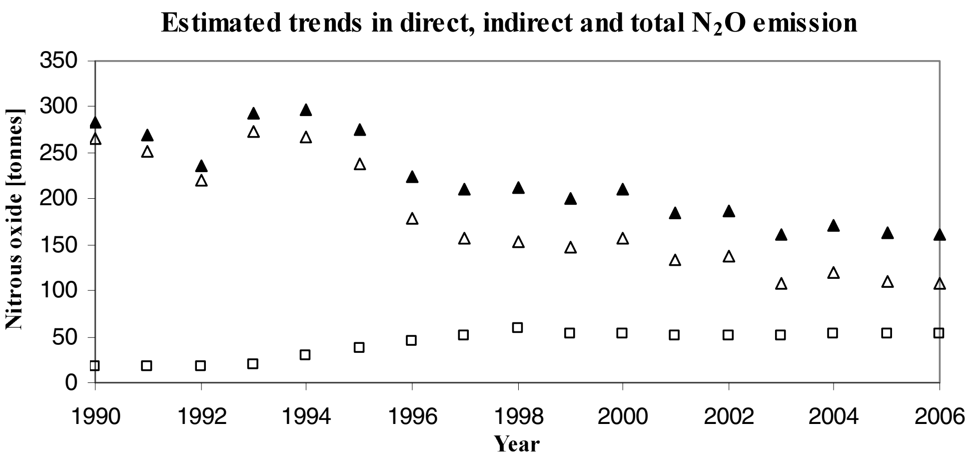

Figure 8.2 Time trends for direct emission of N_2O (open squares), indirect emission, i.e. from wastewater effluents (open triangles) and total N_2O emission (black triangles).

As explained in relation to the summary Table 8.18, the decrease in the 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 given in Annex 3.E , Table 3E.7	
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. Annex 3.E, eq.1), 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 per capita consumption per person per 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/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. Annex 3E, Table 3E.11 and 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 are 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 Agency for Spatial and Environmental Planning and the DEPA. Existing data collection extracted from different reports is part of an ongoing process to increase consistency and completeness in the emissions estimates.

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 2004-2006 as presented in the preceding sections and Annex 3E. 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 published with reference to the already published methodology report published in 2005 (Thomsen & Lyck, 2005).

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 a:t www.mst.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	none
http://faostat.fao.org	Annual protein consumption	Activity data	FAOSTAT	Marianne Thomsen	none
http://www.statistikbanken.dk/FU5	Population	Activity data	Statistics Denmark	Marianne Thomsen	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	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 and Annex 3.E.

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 Agency for Spatial and Environmental Planning. Contact persons related to the delivery of data related to wastewater and sewage sludge are, respectively, Karin Dahlgren and Kristoffer Colding, Agency for Spatial and Environmental Planning.

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 l, has been performed and is presented in Annex 3E and 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 Annex 3E and 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 fouth time in this submission. Smaller revisions as compared to the 2007 submission have been performed. For the years 2003-2005 an error in the model formulation has been corrected resulting in a minor increase in CH_4 emissions.

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.

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. 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.

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).

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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 2007. 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 2007 submission for the Kingdom of Denmark (i.e. Denmark as well as Greenland and the Faroe Islands), which has been submitted in 2007 due under the Climate Change Convention and submitted in parallel to the inventories for Denmark. However, only one recalculation database can be included per 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 2006 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 analyses 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, 2007 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 2007 submission are:

Energy

Stationary Combustion

Update of fuel rates according to the latest energy statistics. The update included the years 1980-2005.

For natural gas fired gas engines emission factors for CH_4, NMVOC, CO and NO_x were updated in connection with a research project including the higher emission factor during start-up/shut-down in the total emission factor.

Mobile sources

Road transport

An error in the distribution of the total mileage between passenger cars and vans has been corrected, and this change in input data has given slight emission changes. The mileage for passenger cars has been reduced in the new situation, and due to the fuel balance in the calculation model for diesel, more fuel has been allocated to vans and heavy duty vehicles.

Also changes have been made to the gasoline fuel consumption input data for the NERI model, throughout the 1990-2005 periods. The gasoline fuel consumption generally increases, due to a reduced gasoline consumption calculated for non road working machinery in the same years. This latter fuel amount is being subtracted from the road transport sales of gasoline reported by the DEA, prior to NERI road transport model input.

Moreover, the emission factors of CH_4 and N_2O have been updated due to new emission data provided by the COPERT IV model developers.

The changes in fuel consumption figures and emission factors cause the emissions from road transport to change in the 1990-2005 time series.

National sea transport

Based on new research findings, the fuel consumption of heavy oil and gas oil for national sea transport is now calculated directly by NERI. Fuel adjustments are made in the fishery sector (gas oil) and stationary industry sources (heavy fuel oil) in order to maintain the grand national energy balance. The fuel consumption changes for national sea transport cause the CO_2, CH_4 and N_2O emissions to change from 1990 to 2005.

Fisheries

Fuel adjustments are made for gas oil, which affects the emissions of CO_2, CH_4 and N_2O for this category. The emission changes for fisheries are followed by the opposite emission changes in national sea transport of approximately the same absolute values.

Military

Emission factors derived from the new road transport simulations have caused minor emission changes for emissions of CH_4 and N_2O from 1990 to 2005.

Residential

The emissions somewhat decrease due to a smaller amount of fuel used by gasoline fuelled working machinery.

Agriculture

Updated stock information for ATV's 2002-2005, has given a smaller fuel use and emissions increase for these years.

Fugitive emissions

Recalculation has been carried out according to the energy statistics published in 2006.

Industry

In the CRF-tables a new split has been made so that calcination of limestone, production of yellow bricks and expanded clay products appears separately. In the data treatment calcination of limestone has been split up in production of lime and hydrated lime with specific emission factors instead of a weighted emission factor. The changes made have caused small recalculations for CO_2 for the years 1990-2005 as compared to 2007 submissions.

Solvent

The main improvements in this reporting resulting in recalculations include revisions of the following:

- Propane and butane is used as aerosol in spraying cans primarily in households. The mean volume of a can is set to 200 ml according to information from e.g. trade associations. This reduces the propane and butane emissions compared to previous inventories.
- Propylalcohol used as windscreen washing agent is reallocated from autopaint and repair to household use.
- Emission factor for propylalcohol used as windscreen washing agent, corresponding to approximately 80% of the annually used amount, is changed to 1.0 for use. Approximately 20% of the annual propylalcohol use is used in closed industrial processes. This amount is assigned a low emission factor of 0.01.
- N_2O emission is introduced in the solvents emission inventory from year 2005. N_2O is used mainly in anaesthesia.

Agriculture

No changes in methodology occurred since 2007 submission, only minor changes resulted in recalculations:

- Updating of data from the Faculty of Agricultural Science concerning the N_2O emission from N-fixing crops.

- The data received from statistics Denmark concerning the livestock production and the cultivated area 2005 is updated and the changes are implemented in the inventory.

- Updating of data from the Danish Energy Authority concerning the biogas treated slurry for the years 2002 – 2005.

Waste

For solid waste disposal sites recalculations have been carried out for the inventory for the year 2005. The recalculation represents updates in the energy statistics on the uptake of CH_4 by installations at SWDSs for energy production.

For waste water handling and for the years 2003-2005 an error in the model formulation has been corrected resulting in recalculations with a minor increase in CH_4 emissions.

LULUCF

For Forest land a correction has been made of an error in the reported figures for C uptake in afforested cropland for 2005. By a mistake, C storage in wood products from thinning of coniferous stands was included. We have consequently changed the reported uptake from 151 Gg CO_2 to 140 Gg CO_2 for 2005. Another change is the inclusion of changes in forest floor C pools in the accounting of C sequestration following afforestation.

Recalculations have been made for Cropland and mineral soils in 2003, 2004 and 2005 due to errors in the export of data from the the spreadsheets to the CRF-Reporter. Furthermore a recalculation is made due to the chosen methodology where a five-year average is used. The recalculation has the largest impact on the emission estimate for 2004, which has turned from a net sink of 836 Gg CO_2 to a large emitter of 1422 Gg CO_2.

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 -0.61 % (2005) and +0.26 % (1994). Therefore, the implications of the recalculations on the level and on the trend, 1990-2005, 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 rather small, although the impact is larger than without LULUCF due to recalculations in the LULUCF sector especially for 2004. The differences vary between –0.44 % (2001) and +2.90 % (2004), refer Table 10.1.

Table 10.1 Recalculation performed year 2008 for 1990-2005. Differences in pct of CO_2-eqv between this submission and the April 2007 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	-0.03	-0.06	0.09	0.11	0.26	-0.10	-0.18	-0.25	-0.31	-0.36
Total CO_2 Equiv. Emissions without Land-Use Change and Forestry	-0.04	-0.06	0.09	0.11	0.26	-0.09	-0.18	-0.24	-0.30	-0.34
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**				
Total CO_2 Equiv. Emissions with Land-Use Change and Forestry	-0.38	-0.44	-0.41	-0.37	2.90	0.68				
Total CO_2 Equiv. Emissions without Land-Use Change and Forestry	-0.38	-0.42	-0.38	-0.53	-0.52	-0.61				

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 submission 2007 has not been finalized and no country specific report is available. So the most recent review was the in-country review which took place in April 2007 on 2006 submissions for the 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. 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 2008 for 1990-2005. Differences in CO_2-eqv between this and the April 2007 submission for DK (Excluding Greenland and Faroe Islands)

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total National Emissions and Removals		**7,08**	**3,51**	**1,34**	**161,77**	**308,38**	**57,35**	**-7,14**	**-13,43**	**-17,68**	**-22,14**	**-18,32**	**-41,74**	**-15,52**	**114,25**	**2209,27**	**699,40**
1. Energy		**0,00**	**0,00**	**0,00**	**163,09**	**311,79**	**59,91**	**-1,68**	**-1,96**	**-1,65**	**-1,82**	**7,39**	**-11,79**	**11,86**	**3,04**	**-18,17**	**-105,34**
1.A.	Fuel Combustion Activities	0,00	0,00	0,00	163,09	311,79	62,36	0,00	0,00	0,00	0,00	9,07	-9,76	14,37	4,91	-16,23	-105,34
1.A.1.	Energy Industries	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-0,61	-0,04	0,00	0,00	7,75	6,14
1.A.2.	Manufacturing Industries and Construction	0,21	96,14	91,54	25,34	-36,86	-82,73	-56,04	-8,83	39,44	55,31	72,44	56,63	125,16	103,80	18,57	35,09
1.A.3.	Transport	184,35	98,36	157,64	266,26	470,59	224,22	193,97	240,59	205,17	132,64	52,68	61,20	-15,53	3,46	63,43	-8,95
1.A.4.	Other Sectors	-184,56	-194,49	-249,18	-128,52	-121,94	-79,13	-137,94	-231,76	-244,61	-187,94	-115,44	-127,55	-95,26	-102,35	-105,98	-137,63
1.B.	Fugitive Emissions from Fuels	0,00	0,00	0,00	0,00	0,00	-2,45	-1,68	-1,97	-1,65	-1,82	-1,68	-2,04	-2,51	-1,87	-1,94	0,00
1.B.2.	Oil and Natural Gas	0,000	0,000	0,000	0,000	0,000	-2,449	-1,679	-1,966	-1,647	-1,822	-1,678	-2,035	-2,509	-1,865	-1,944	0,000
2. Industrial Processes		**1,00**	**0,00**	**0,00**	**-0,50**	**-0,30**	**-0,34**	**-1,55**	**0,00**	**0,47**	**0,03**	**0,21**	**0,00**	**-0,35**	**0,00**	**0,00**	**0,00**
2.A.	Mineral Products	0,998	-0,004	-0,002	-0,501	-0,298	-0,337	-1,546	-0,002	0,469	0,030	0,213	-0,001	-0,353	-0,001	-0,001	-0,001
3. Solvent and Other Product Use		**6,04**	**4,76**	**3,48**	**2,20**	**0,91**	**3,02**	**2,12**	**-4,24**	**-5,84**	**-6,82**	**-11,12**	**-15,34**	**-10,88**	**-16,53**	**-12,70**	**-13,00**
5. Land-Use Change and Forestry (net)		**0,04**	**-1,25**	**-2,14**	**-3,01**	**-3,96**	**-4,85**	**-5,66**	**-6,84**	**-7,70**	**-9,88**	**-11,37**	**-12,34**	**-13,59**	**130,71**	**2242,55**	**819,59**
6. Waste		0,000	0,000	0,000	0,000	-0,072	-0,394	-0,376	-0,372	-2,961	-3,652	-3,427	-2,280	-2,555	-2,971	-2,403	-1,842

Table 10.3 Recalculation for CH_4 performed year 2008 for 1990-2005. Differences in CO_2-eqv between this and the April 2007 submission for DK (Excluding Greenland and Faroe Islands)

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total National Emissions and Removals		**-3,05**	**-6,43**	**-7,67**	**-9,03**	**-8,59**	**-10,73**	**-13,49**	**-12,97**	**-13,19**	**-11,53**	**-11,75**	**-11,96**	**-10,44**	**-7,41**	**-18,38**	**-5,53**
1. Energy		**-3,05**	**-6,43**	**-7,67**	**-9,03**	**-8,59**	**-10,73**	**-13,49**	**-12,97**	**-13,19**	**-11,52**	**-11,74**	**-11,96**	**-10,07**	**-10,42**	**-25,00**	**-37,57**
1.A.	Fuel Combustion Activities	-3,045	-6,425	-7,666	-9,032	-8,585	-10,726	-13,485	-12,968	-13,184	-11,519	-11,742	-11,959	-10,067	-10,412	-25,001	-37,567
1.A.1.	Energy Industries	0,128	0,272	0,555	1,489	3,389	7,040	9,470	8,691	9,622	9,665	9,231	10,034	9,968	9,709	-3,953	-15,224
1.A.2.	Manufacturing Industries and Construction	0,000	0,078	0,074	0,021	-0,025	0,006	0,322	0,336	0,445	0,459	0,609	0,673	0,645	0,626	-0,442	-4,679
1.A.3.	Transport	-2,459	-5,991	-7,671	-10,177	-11,830	-18,044	-24,063	-22,841	-24,402	-22,824	-22,520	-23,232	-21,023	-20,965	-17,934	-19,041
1.A.4.	Other Sectors	-0,711	-0,737	-0,597	-0,338	-0,097	0,319	0,806	0,878	1,188	1,213	0,948	0,590	0,354	0,234	-2,636	1,414
1.A.5.	Other	-0,004	-0,047	-0,027	-0,027	-0,021	-0,046	-0,019	-0,031	-0,037	-0,032	-0,009	-0,024	-0,011	-0,017	-0,037	-0,037
1.B.	Fugitive Emissions from Fuels	0,000	0,000	0,000	0,000	0,000	-0,005	-0,003	-0,004	-0,003	-0,003	-0,003	-0,004	-0,005	-0,003	-0,004	0,000
1.B.2.	Oil and Natural Gas	0,000	0,000	0,000	0,000	0,000	-0,005	-0,003	-0,004	-0,003	-0,003	-0,003	-0,004	-0,005	-0,003	-0,004	0,000
4. Agriculture		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**-0,01**	**-0,01**	**0,00**	**-0,37**	**2,04**	**-3,43**	**39,69**
4.A.	Enteric Fermentation	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	-6,020	30,771
4.B.	Manure Management	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	-0,005	-0,005	-0,002	-0,369	2,038	2,595	8,918
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**	**0,96**	**10,05**	**-7,65**
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	-15,975
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	0,963	10,048	8,327

Table 10.4 Recalculation for N_2O performed year 2008 for 1990-2005. Differences in CO_2-eqv between this and the April 2007 submission for DK (Excluding Greenland and Faroe Islands)

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total National Emissions and Removals		**-28,34**	**-46,15**	**-61,24**	**-73,99**	**-97,00**	**-121,79**	**-142,93**	**-174,40**	**-201,55**	**-222,24**	**-238,72**	**-250,12**	**-251,14**	**-371,32**	**-304,69**	**-267,61**
1. Energy		**-25,71**	**-42,65**	**-56,62**	**-67,73**	**-89,83**	**-114,70**	**-135,78**	**-167,06**	**-194,01**	**-214,71**	**-229,77**	**-240,97**	**-260,38**	**-276,56**	**-296,55**	**-303,44**
1.A.	Fuel Combustion Activities	-25,712	-42,646	-56,620	-67,728	-89,830	-114,690	-135,771	-167,052	-194,005	-214,695	-229,757	-240,957	-260,365	-276,545	-296,537	-303,437
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	-0,005	0,000	0,000	0,000	-0,014	0,189
1.A.2.	Manufacturing Industries and Construction	0,002	0,764	0,728	0,201	-0,293	-0,658	-0,445	-0,070	0,314	0,440	0,593	0,503	1,019	0,879	0,068	0,688
1.A.3.	Transport	-22,326	-38,643	-52,049	-65,087	-86,949	-111,475	-132,531	-161,899	-188,840	-211,124	-226,726	-237,515	-257,952	-275,411	-292,349	-304,731
1.A.4.	Other Sectors	-3,269	-3,430	-4,474	-2,079	-1,929	-1,069	-2,205	-4,029	-4,266	-3,139	-3,298	-3,164	-3,029	-1,451	-2,816	1,764
1.A.5.	Other	-0,119	-1,337	-0,825	-0,763	-0,659	-1,487	-0,590	-1,054	-1,213	-0,872	-0,320	-0,780	-0,403	-0,561	-1,425	-1,347
1.B.	Fugitive Emissions from Fuels	0,000	0,000	0,000	0,000	0,000	-0,013	-0,009	-0,011	-0,009	-0,010	-0,009	-0,011	-0,014	-0,010	-0,011	0,000
1.B.2.	Oil and Natural Gas	0,000	0,000	0,000	0,000	0,000	-0,013	-0,009	-0,011	-0,009	-0,010	-0,009	-0,011	-0,014	-0,010	-0,011	0,000
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**	**14,04**
4. Agriculture		**-2,53**	**-3,41**	**-4,53**	**-6,17**	**-7,08**	**-7,00**	**-7,06**	**-7,25**	**-7,44**	**-7,46**	**-8,88**	**-9,07**	**9,31**	**-94,69**	**-8,06**	**32,32**
4.B.	Manure Management	0,000	-1,370	-2,908	-4,653	-5,632	-7,008	-7,082	-7,159	-6,978	-6,974	-7,187	-7,539	-7,261	-6,030	-6,934	0,348
4.D.	Agricultural Soils (2)	-2,533	-2,041	-1,622	-1,520	-1,449	0,012	0,018	-0,090	-0,467	-0,491	-1,692	-1,534	16,575	-88,657	-1,131	31,969
5. Land-Use Change and Forestry (net)		**-0,09**	**-0,09**	**-0,09**	**-0,09**	**-0,09**	**-0,09**	**-0,09**	**-0,09**	**-0,09**	**-0,07**	**-0,07**	**-0,07**	**-0,07**	**-0,07**	**-0,07**	**-0,07**
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**	**-10,46**
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	-10,456

Annexes to Denmarks NIR 2008, Inventories 1990 - 2006

Annex 1 Key Category Analyses

Description of the methodology used for identifying key Categories

The Key Category Analysis (KCA) is carried out according to the IPCC Good Practice Guidance (GPG). 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 base year is not adjusted for electricity import/export. The analysis was made for the inventory for the year 2006.

The present KCA differs from the approach for the years 2000-2005 as presented in NIRs from 2002 to 2007. In this KCA the LULUCF sector has been included as suggested by the in-country review team. Further some categorisations have changed, which will appear during the description below. Those changes have been made in order to follow changes made in the categorisation used for the CRF Tables. As before 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

CO_2 emission factors, fossil	kg/GJ
COAL [1)]	95
COKE OVEN COKE	108
PETROLEUM COKE	92
PLASTIC WASTE	17.6
RESIDUAL OIL [1)]	78
GAS OIL	74
KEROSENE	72
ORIMULSION	80
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 2006 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. The split made in the analyses for year 2003 between brown coal and coke-oven coke is, in this analysis, not of importance since brown coal, according to the Energy Statistics, is not used in 2005-2006.

For energy and mobile combustion, the basis for the source categories is unchanged since previous KCA and are the following activities:

	Category for KS anal		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.

For the sectors Industry, Agriculture, LULUCF and Waste, the source categories in the KCA are activities found in the CRF source categorisation. For industry a new split of categories for CRF tables are also reflected in the KCA. The activities "production of Yellow Bricks" and "Expanded Clay" has been split from the "Lime Production" activity 2.A.2 and put under activity "Other" 2.A.7. Further, F-gas activities has also been split into CRF activities "Refrigeration and Air Conditioning Equipment" 2(II)F(a)1 and "Foam blowing".

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 2000-2005. The choice of categories for the analysis identifies 91 source categories, which appear in the table section of this Annex in Table 3. The key source categories are listed according to the inventory section in which they appear. As compared to the analysis made for year 2005 (refer NIR 2007) with 72 categories, most of the increase in number comes from adding the LULUCF sector to the analyses. The LULUCF sector includes 17 categories for the analysis. The changes for the Industry sector give 3 extra categories, while CH_4 from gasification of biogas is no longer a category since emissions are zero in 1990 and in 2006. This sums to 19 extra categories as compared to the analysis for 2005.

The result of the Key Category Analysis for Denmark for the year 2006

The entries in the results of KCA in Table 1 and Table 2 for the years 1990 and 2006 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, but are only included in Table 1 to make it more uniform with Table 2.

The result of the key category level assessment for Denmark for 2006 is shown in Table 1. 23 key categories were identified and marked as shaded in the table. 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 2. A number of 29 key categories (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 3. 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 91 source categories chosen for this analysis, 30 are identified as key source categories either in the level or in the trend analysis or in both. 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 2006 22 key categories were keys in both level and trend. This number was 16 in 2005 and 18 in 2004 and 2003. In 2002 this number was 15, and 14 in both 2001 and 2000. 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 2006 seven categories were key categories for trend only. In 2005, four categories were key in trend only as in 2004 and 2003 (three in 2002, three in 2001 and two in 2000).

The **Energy Sector and CO_2 emission from Stationary Combustion** contributes in 2006 with 7 key categories with respect to level and trend. 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 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 2006, 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 28.9% of the national total (Table 1). Also in 2004, 2003, 2002 and 2001, Coal was the most contributing category, in 2005 contributing 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 2006 as in 2005, 2004, 2003, 2002 and 2001, the third largest contributor with 14,6% (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 seven largest contributor with 2.7%. Gas Oil is, in 2006 the eight largest contributor with 2.7% (in 2005 the seventh largest contributor with 3.8%, in 2004 4.0%, in 2003 3.9%, in 2002 4.3%, in 2001 4.4% and in 2000 4.2%). The rest of the categories mentioned in this paragraph as level and trend key categories each contribute below 1.2% of the national total in 2006.

The **Energy Sector and CO_2 emission from Mobile Combustion** contributes with 3 key categories to level and trend. The category Road Transportation is the largest of these with increasing emission estimates from year 1990 to 2006. 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 16.9 % in 2006 as compared to 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 2006, as in 2005, 2004 and 2003, a key category with respect to both level and trend. For this category the trend in emission estimates from 1990 to 2006 is falling and the contribution to the national total in 2006 is 1.5%. The category CO_2 from Mobil Combustion Other Machinery in Industry is as in 2005 a key category for both level and trend, contributing in 2006 with 1.4%; the emission estimates are slightly increasing. The category CO_2 from Mobile Combustion National Fishing is in 2006 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 0.6% in 2006. The category CO_2 from Mobile Combustion Navigation is in 2006 no longer a key category with decreasing emission estimates from 1990 to 2006, contributing 0.6 % in 2006.

The source category **CO_2 from Fugitive Emissions Oil and Natural Gas** is in the 2006 analysis a 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 2006 is 0.6% and the emission estimates from 1990 to 2006 are increasing.

The source category **CH_4 as Non-CO_2 Emission from Stationary Combustion** is in the 2006 analysis, a key category for level and trend, as in 2005 and 2004. The contribution in 2006 is 0.6% and the emission estimates from 1990 to 2006 increase markedly.

In the **Industry Sector**, two categories are keys with respect to both level and trend in 2006, as in 2005, in 2003 and 2002 this number was three. The two keys in 2006 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 2005, 2004, 2003 and 2002. The F-gas emission before the split made as explained above was in former years a key for both level and trend. N_2O emission from Nitric Acid Production is in 2005 not a category since production stopped in the middle of 2004. The trends from year 1990 to 2006 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 10 on the list to the national total and contributes with 1.9% (2.3% in 2005 and 2004, 1.9% in 2003 and 2.1% in 2002), and F-gases is number 18 with a contribution of 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 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. All of those are in 2006 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 five key categories mentioned in order of falling contribution are direct N_2O emissions from agriculture soils (3.8%), CH_4 from enteric fermentation (3.5%), indirect N_2O emissions from nitrogen used in agriculture (3.5%), CH_4 from manure management (1.4%) and N_2O from manure management (0.7%). The emission estimates for the three most contributing categories represent a reduced emission from 1990 to 2006, while the fourth and fifth represents increasing emissions. According to the level assessment, the four largest categories are among the 12 most contributing categories. Direct N_2O emissions from agriculture soils contributes 3.8% (in 2005 4.7%, in 2004 4.3%, in 2003 3.9%, in 2002 4.3% and in 2001 6.5%), indirect N_2O emissions from nitrogen used in agriculture contributes 3.5% (4.2% in 2005, in 2004 4.1%, in 2003 3.7%, in 2002 4.1% and in 2001 4.3%), CH_4 from enteric fermentation 3.5% (4.1% in 2005, in 2004 4.0%, in 2003 3.7%, in 2002 4.1% and in 2001 4.0%) and CH_4 from manure management 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 0.7%, (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. Three categories with CO_2 emissions/removals became key categories for both level and trend. These are in decreasing order of contribution for there absolute 2006 contribution. Forest Land remaining Forest Land, Conifers (2.1%, CO_2 removal decreasing from 1990 to 2006). Forest Land remaining Forest Land, Broadleaves (1.3%, CO_2 removal increasing from 1990 to 2006) and Cropland remaining Cropland, Agriculture Soils (0.9%, CO_2 emission decreasing from 1990 to 2006. CO_2 from limestone application on Cropland is a key category with respect to trend, the emission is falling markedly from 1990 to 2006.

In the **Waste Sector**, one category – CH_4 emissions from solid disposal of waste – is a key category with respect to level and trend. 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 2006, the contribution to national total being 1.4% in 2006 as compared to 1.6% in 2005, 2004 and 2003. N_2O has become a key category with respect to trend only, the trend is decreasing emissions 1990-2006.

Tables 7.A1 – 7.A3 of the Good Practice Guidance

Table 1 Key Category Analysis 1990-2006, level assessment.

Table 7.A1 of Good Practice Guidance Tier 1 Analysis - Level Assessment DK - inventory							
	A IPCC Source Categories (LULUCF included)		B Direct GHG	C Base Year Estimate (1) Mt CO_2-eq	D Year 2006 Estimate (1) Mt CO_2-eq	E Year 2006 Level Assess ment	F Year 2006 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		N_2O	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	0.2483	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

Continued							
	A **IPCC Source Categories (LULUCF included)**		B	C	D	E	F
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
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		SF6	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		SF6	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				**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 2 Key Category Analysis 1990-2006, trend assessment.

Table 7.A2 of Good Practice Guidance Tier 1 Analysis - Trend Assessment DK Inventory									
A IPCC Source Categories (LULUCF included)			B Direct GHG	C Base Year Estimate (1) Mt CO_2-eq	D Year 2006 Estimate (1) Mt CO_2-eq	E Trend Assess-ment	F Contribution to Trend %	G Cumul. total of col. F %
Energy	Stationary Combustion	Natural Gas	CO_2	4.3297	10.8458	0.0871	22.65	22.65
Energy	Mobile combustion	Road Transportation	CO_2	9.2752	12.5945	0.0458	11.89	34.54
Energy	Stationary Combustion	Gas Oil	CO_2	4.5472	1.9828	0.0331	8.60	43.13
Energy	Stationary Combustion	Coal	CO_2	24.0771	21.5580	0.0287	7.45	50.58
LULUCF	Cropl. remain. Cropl.	Agriculture soils	CO_2	2.5946	0.6527	0.0252	6.55	57.14
Agriculture	Nitrogen use, indirect emissions		N_2O	4.1271	2.5813	0.0197	5.11	62.25
Agriculture	Agriculture soils, direct emissions		N_2O	4.2220	2.8603	0.0172	4.47	66.72
Industrial Proc.	Nitric Acid Production		N_2O	1.0429	0.0000	0.0136	3.54	70.26
LULUCF	Forest L. remain. Forest L.	Conifers	CO_2	-2.2917	-1.5877	0.0098	2.54	72.79
Industrial Proc.	Refrigeration and AC Equipment		HfcPfc	0.0357	0.7034	0.0088	2.30	75.09
Agriculture	Enteric Fermentation		CH_4	3.2590	2.6025	0.0081	2.09	77.19
Industrial Proc.	Cement Production		CO_2	0.8824	1.3955	0.0070	1.81	79.00
Energy	Stationary Combustion	Petroleum Coke	CO_2	0.4103	0.8942	0.0065	1.69	80.69
LULUCF	Forest L. remain. Forest L.	Broadleaves	CO_2	-0.5390	-0.9863	0.0058	1.51	82.20
Energy	Stationary Combustion	Residual Oil	CO_2	2.5052	2.0344	0.0057	1.49	83.69
LULUCF	Agricultural limestone CACO3	Appl. Cropl.	CO_2	0.5655	0.1792	0.0050	1.30	84.99
Energy	Stationary Combustion	Plastic Waste	CO_2	0.3487	0.7021	0.0047	1.23	86.23
Energy	Stationary Combustion	Kerosene	CO_2	0.3662	0.0159	0.0046	1.19	87.41
Energy	Non-CO_2 Stationary Combustion		CH_4	0.1214	0.4609	0.0045	1.17	88.59
Agriculture	Manure Management		CH_4	0.7512	1.0423	0.0040	1.04	89.63
Waste	Solid Waste Disposal Sites		CH_4	1.3352	1.0280	0.0038	0.99	90.62
Energy	Mobile combustion	Navigation	CO_2	0.7134	0.4548	0.0033	0.85	91.47
Energy	Mobile combustion, Other	Machinery/Industry	CO_2	0.8415	1.0210	0.0025	0.66	92.13
Agriculture	Manure management		N_2O	0.6844	0.5187	0.0021	0.54	92.67
Energy	Fugitive emissions	Oil and Natural Gas	CO_2	0.2634	0.4147	0.0021	0.53	93.20
Energy	Mobile combustion	Agriculture	CO_2	1.2725	1.1092	0.0019	0.50	93.70
Energy	Stationary Combustion	Refinery Gas	CO_2	0.8062	0.9325	0.0018	0.48	94.17
Waste	Waste Water Handling		CH_4	0.1256	0.2483	0.0016	0.42	94.59
Energy	Mobile combustion	Househ., Gardening	CO_2	0.1128	0.2326	0.0016	0.42	95.01
LULUCF	Cropl. converted to Forest L.	Broadleaves	CO_2	NA NE NO	-0.1214	0.0016	0.42	95.43
LULUCF	Cropl. remain. Cropl.	Hedgerows	CO_2	0.0243	-0.0901	0.0015	0.39	95.82
Energy	Mobile combustion	National Fishing	CO_2	0.5907	0.4728	0.0014	0.38	96.20
Energy	Mobile combustion	Civil Aviation	CO_2	0.2427	0.1412	0.0013	0.34	96.54
Energy	Mobile combustion	Railways	CO_2	0.2967	0.2268	0.0009	0.23	96.76
LULUCF	Cropl. converted to Forest L.	Conifers	CO_2	NA NE NO	-0.0622	0.0008	0.21	96.98
Energy	Fugitive emissions	Oil and Natural Gas	CH_4	0.0396	0.0976	0.0008	0.20	97.18
Industrial Proc.	Limestone and Dolomite use		CO_2	0.0181	0.0738	0.0007	0.19	97.37
Energy	Stationary Combustion	LPG	CO_2	0.1687	0.1118	0.0007	0.19	97.56
Energy	Non-CO_2 Stationary Combustion		N_2O	0.2404	0.2913	0.0007	0.19	97.74
Industrial Proc.	Foam Blowing		HFC	0.1826	0.1267	0.0007	0.18	97.93
Industrial Proc.	Lime Production		CO_2	0.1155	0.0692	0.0006	0.15	98.08
Solvent Oth Pro.			CO_2	0.1481	0.1020	0.0006	0.15	98.23
Industrial Proc.	Other sources of SF_6		SF_6	0.0676	0.0230	0.0006	0.15	98.38
Waste	Waste Water Handling		N_2O	0.0876	0.0500	0.0005	0.13	98.51
LULUCF	Cropl. remain. Cropl.	Peat for horticulture	CO_2	0.1046	0.1391	0.0005	0.12	98.63

Continued								
	A IPCC Source Categories (LULUCF included)		**B**	**C**	**D**	**E**	**F**	**G**
Industrial Proc.	Magnesium Production		SF_6	0.0359	0.0000	0.0005	0.12	98.75
Energy	Mobile combustion	Road Transportation	N_2O	0.0966	0.1247	0.0004	0.10	98.85
Industrial Proc.	Iron and Steel Production		CO_2	0.0284	0.0000	0.0004	0.10	98.95
Energy	Mobile combustion	Road Transportation	CH_4	0.0550	0.0271	0.0004	0.09	99.04
Energy	Stationary Combustion	Coke Oven Coke	CO_2	0.1378	0.1091	0.0004	0.09	99.14
Energy	Mobile combustion	Forestry	CO_2	0.0357	0.0173	0.0002	0.06	99.20
Industrial Proc.	Aerosols		HFC	NA	0.0161	0.0002	0.06	99.25
Solvent, Oth Pro.			N_2O	0.0000	0.0373	0.0014	0.38	99.63
Industrial Proc.	Yellow Bricks Production		CO_2	0.0230	0.0368	0.0002	0.05	99.68
Energy	Stationary Combustion	Brown Coal Bri	CO_2	0.0110	0.0000	0.0001	0.04	99.71
LULUCF	Grassl. remain. Grassl.	Agriculture soils	CO_2	0.0929	0.0810	0.0001	0.04	99.75
Energy	Mobile combustion	Military	CO_2	0.1190	0.1265	0.0001	0.03	99.78
Industrial Proc.	Electrical equipment		SF_6	0.0039	0.0129	0.0001	0.03	99.81
LULUCF	Cropl. remain. Cropl.	Horticulture	CO_2	-0.0015	0.0073	0.0001	0.03	99.84
LULUCF	Cropland conv. to Wetlands.	Mineral soils	CO_2	NA	-0.0057	0.0001	0.02	99.86
Energy	Mobile combustion	Navigation	N_2O	0.0134	0.0080	0.0001	0.02	99.88
LULUCF	Cropland conv. to Wetlands.	Organic soils	CO_2	NA	-0.0046	0.0001	0.02	99.90
Industrial Proc.	Other i.e Fibre Optics		HfcPfc	NO	0.0043	0.0001	0.01	99.91
Industrial Proc.	Expanded Clay		CO_2	0.0149	0.0185	0.0001	0.01	99.92
Industrial Proc.	Glass/GlassWoll Production		CO_2	0.0174	0.0135	<0.0001	0.01	99.94
LULUCF	Grassland conv. to Wetlands.	Mineral soils	CO_2	NA	-0.0030	<0.0001	0.01	99.95
Energy	Mobile combustion, Other	Machinery/Industry	N_2O	0.0106	0.0134	<0.0001	0.01	99.96
Energy	Mobile combustion	National Fishing	N_2O	0.0115	0.0093	<0.0001	0.01	99.96
LULUCF	Grassland conv. to Wetlands.	Organic soils	CO_2	NA	-0.0018	<0.0001	0.01	99.97
Energy	Mobile combustion	Househ., Gardening	CH_4	0.0031	0.0049	<0.0001	0.01	99.98
Industrial Proc.	Catalysts/Fertilizers/Pesticides		CO_2	0.0008	0.0022	<0.0001	0.00	99.98
Energy	Fugitive emissions	Oil and Natural Gas	N_2O	0.0014	0.0023	<0.0001	0.00	99.98
Energy	Mobile combustion	Civil Aviation	N_2O	0.0032	0.0025	<0.0001	0.00	99.99
Energy	Mobile combustion	Agriculture	N_2O	0.0153	0.0144	<0.0001	0.00	99.99
Energy	Mobile combustion	Househ., Gardening	N_2O	0.0005	0.0011	<0.0001	0.00	99.99
Energy	Mobile combustion	Railways	N_2O	0.0025	0.0019	<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	Forestry	CH_4	0.0004	0.0001	<0.0001	0.00	100.00
LULUCF	Wetlands remain. Wetlands.	Peat extraction	CO_2	0.0020	0.0016	<0.0001	0.00	100.00
Energy	Mobile combustion, Other	Machinery/Industry	CH_4	0.0013	0.0009	<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	Military	N_2O	0.0012	0.0012	<0.0001	0.00	100.00
Industrial Proc.	Road paving with Asphalt		CO_2	0.0018	0.0018	<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	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	Military	CH_4	0.0001	0.0001	<0.0001	0.00	100.00
Energy	Mobile combustion	Civil Aviation	CH_4	0.0002	0.0001	<0.0001	0.00	100.00
LULUCF	Land conv. to Wetlands		N_2O	0.0001	0.0001	<0.0001	0.00	100.00
Industrial Proc.	Asphalt Roofing		CO_2	0.0000	0.0000	<0.0001	0.00	100.00
Energy	Mobile combustion	Forestry	N_2O	0.0002	0.0002	<0.0001	0.00	100.00
Total				**69.9**	**68.8**		**100.0**	

(1) The Estimates include signs, where + : emission - : removals

Table 3 Key Category Analysis 1990-2006, summary.

Table 7.A3 of Good Practice Guidance Source Category Analysis Summary (DK-inventory) Quantitative method used: Tier 1						
A IPCC Source Categories (LULUCF included)			B Direct GHG	C Key Category 2006	D If C is yes criteria for identi-fikation	E 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		
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	Trend	*See text*
Energy	Mobile combustion	Military	CO_2	No		
Energy	Mobile combustion	National Fishing	CO_2	Yes	Level	*See text*
Energy	Mobile combustion	Agriculture	CO_2	Yes	Level, Trend	*See text*
Energy	Mobile combustion	Forestry	CO_2	No		
Energy	Mobile combustion, Other	Machinery/Industry	CO_2	Yes	Level, Trend	*See text*
Energy	Mobile combustion	Househ., Gardening	CO_2	Yes	Trend	*See text*
Energy	Fugitive emissions	Oil and Natural Gas	CO_2	Yes	Trend	*See text*
Energy	Non-CO_2 Stationary Combustion		CH_4	Yes	Level, Trend	*See text*
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	Machinery/Industry	CH_4	No		
Energy	Mobile combustion	Househ., Gardening	CH_4	No		
Energy	Fugitive emissions	Oil and Natural Gas	CH_4	No		
Energy	Non-CO_2 Stationary Combustion		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		
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	Machinery/Industry	N_2O	No		
Energy	Mobile combustion	Househ., Gardening	N_2O	No		

A IPCC Source Categories (LULUCF included)			B Direct GHG	C Key Category 2006	D If C is yes criteria for identi-fikation	E Comments
Energy	Fugitive emissions	Oil and Natural Gas	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/Pesticides		CO_2	No		
Industrial Proc.	Iron and Steel Production		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		HfcPfc	Yes	Level, Trend	*See text*
Industrial Proc.	Foam Blowing		HFC	No		
Industrial Proc.	Aerosols		HFC	No		
Industrial Proc.	Other i.e Fibre Optics		HfcPfc	No		
Solvent			CO_2	No		
Solvent			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, Trend	*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	No		
LULUCF	Cropl. converted to Forest L.	Conifers	CO_2	No		
LULUCF	Cropl. remain. Cropl.	Hedgerows	CO_2	No		
LULUCF	Cropl. remain. Cropl.	Horticulture	CO_2	No		
LULUCF	Cropl. remain. Cropl.	Agriculture soils	CO_2	Yes	Level, Trend	*See text*
LULUCF	Cropl. remain. Cropl.	Peat for horticulture	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		
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 3A Stationary Combustion Plants (Energy)

This annex is a sector report for stationary combustion that includes more background data and a more detailed methodology description than included in the main NIR report.

Contents

1 Introduction

The Danish atmospheric emission inventories are prepared on an annual basis and the results are reported to the *UN Framework Convention on Climate Change* (UNFCCC or Climate Convention) and to the UNECE *Convention on Long-Range Transboundary Air Pollution* (LRTAP Convention). Furthermore, a greenhouse gas emission inventory is reported to the EU, due to the EU – as well as the individual Member States –party to the Climate Convention. The Danish atmospheric emission inventories are calculated by the Danish National Environmental Research Institute (NERI).

This annex provides a summary of the emission inventories for stationary combustion reported to the Climate Convention and background documentation for the estimates. Stationary combustion plants include power plants, district heating plants, non-industrial and industrial combustion plants, industrial process burners, petroleum-refining plants, as well as combustion in oil/gas extraction and in pipeline compressors. Emissions from flaring in oil/gas production and from flaring carried out in refineries are not covered in this annex.

This annex presents detailed emission inventories and time-series for emissions from stationary combustion plants. Furthermore, emissions from stationary combustion plants are compared with total Danish emissions. The methodology and references for the emission inventories for stationary combustion plants are described. Furthermore, uncertainty estimates are provided.

2 Methodology and references

The Danish emission inventory is based on the CORINAIR (CORe INventory on AIR emissions) system, which is a European programme for air emission inventories. CORINAIR includes methodology structure and software for inventories. The methodology is originally described in the EMEP/Corinair Emission Inventory Guidebook 3rd edition, prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections (EMEP/Corinair 2004) since then numerous updates has been made available through the European Environment agency's webpage. Emission data are stored in an Access database, from which data are transferred to the reporting formats.

The emissions 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. Data from the EU ETS are incorporated into the inventory as well.

2.1 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 enclosed in Appendix 3A-2.

The sector codes applied in the reporting activity will be referred to as IPCC sectors. The IPCC sectors define 6 main source categories, listed in Table 3A-1, and a number of subcategories. Stationary combustion is part of the IPCC sector 1, *Energy*. Table 3A-2 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 stationary combustion, detailed documentation for some of the specific industries is discussed in the industry chapters/annexes. Stationary combustion is defined as combustion activities in the SNAP sectors 01-03.

Table 3A-1 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-2 IPCC source categories for the energy sector.

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 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 industry. 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 included in the tables and figures in this annex 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.

2.2 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 2006, 75 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 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 under the Danish law "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 383 PJ (2006). This corresponds to 62% of the overall fuel consumption for stationary combustion.

A list of the large point sources for 2006 and the fuel consumption rates is provided in Appendix 3A-5. The number of large point sources registered in the databases increased from 1990 to 2006.

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-5 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. Emissions of CO and NMVOC are also plant-specific for some plants. CO_2 emissions from some plants are available through the EU emission trading scheme (ETS). 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 Elsam and E2, the two major electricity suppliers
- Emission data reported by industrial plants
- 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.

2.3 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.

2.4 Activity rates, fuel consumption

The fuel consumption rates are based on the official Danish energy statistics prepared by the Danish Energy Authority. The Danish Energy Authority aggregates fuel consumption rates to SNAP sector categories

(DEA 2007a). The link between the official energy statistics and the SNAP nomenclature as well as a description of the national energy statistics is included in appendix 3A-11. Some fuel types in the official Danish energy statistics are added to obtain a less detailed fuel aggregation level, see Appendix 3A-7. The calorific values on which the energy statistics are based are also enclosed in Appendix 3A-7.

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 is discussed in Chapter 3.6.

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.

For the purpose of compiling the emission inventory emissions stemming from the use of town gas is calculated as natural gas. According to information regarding the composition of town gas received from one of the major distributors, this is a fair assumption. (Jeppesen, 2007) Since November of 2007, town gas has been produced solely based on natural gas and air.

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 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 is based on the DEA database (DEA 2007c).

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

Emissions from the non-energy use of fuels have not been included in the Danish inventory for stationary combustion. 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 Denmark.

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 3.

2.5 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 (EMEP/Corinair, 2007) and IPCC Reference Manual (IPCC 1996).

A complete list of emission factors, including time-series and references, is provided in Appendix 3A-4.

2.5.1 CO_2

The CO_2 emission factors applied for 2006 are presented in Table 3A-3. For municipal waste and natural gas, time-series have been estimated. For all other fuels the same emission factor is applied for 1990-2006.

Data reported under the EU ETS were included directly in the inventory for the first time in 2006. The data were mainly from coal powered central power plants, where measurements of carbon content, oxidation factor etc. have been carried out to estimate the CO_2 emission.

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-3.

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 the incineration of municipal waste (94.5 + 17.6 kg/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 in the case of 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 non-CO_2 emissions from municipal waste combustion are also included in full 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-3 CO_2 emission factors 2006.

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

Data from EU ETS incorporated for individual plants

Coal

The emission factor 95 kg/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 1990-2006.

As mentioned above ETS data were utilised for the first time in the emission inventory. The implied emission factors for the power plants using coal ranged from 90.01 to 95.31 kg/GJ. There were detailed data available from 15 coal powered units, which allowed the information to be included in the emission inventory.

Brown coal briquettes

The emission factor 94.6 kg/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/TJ, corresponding to $25.8 \cdot (12+2 \cdot 16)/12 = 94.6$ kg CO_2/GJ assuming full oxidation. The same emission factor is applied for 1990-2006.

Coke oven coke

The emission factor 108 kg/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/TJ, corresponding to $29.5 \cdot (12+2 \cdot 16)/12 = 108$ kg CO_2/GJ assuming full oxidation. The same emission factor is applied for 1990-2006.

Petroleum coke

The emission factor 92 kg/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 1990-2006.

Wood

The emission factor for wood, 102 kg/GJ, refers to Fenhann & Kilde 1994. The factor is based on the interval stated in a former edition of the EMEP/Corinair Guidebook and the actual value is the default value from the Collector database. The same emission factor is applied for 1990-2006.

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-4). 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-4 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/ kg municipal waste	% of plastic	MJ/kg plastic	MJ/kg municipal waste	g/MJ plastic	g/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/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/kg municipal waste (Table 3A-4). The CO_2 emission per GJ of waste is calculated based on the lower heating values for waste listed in Table 3A-5 (DEA 2007b). It has been assumed that the plastic content as a percentage (weight) 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 an increase in the plastic content in the municipal waste. Time-series for the CO_2 emission factor for plastic content in waste are included in Table 3A-5.

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-5 CO_2 emission factor for municipal waste, plastic content and biomass content.

Year	Lower heating value of municipal waste 1) [GJ/Mg]	Plastic content [% of energy]	CO_2 emission factor for plastic 3) [g/kg waste]	CO_2 emission factor for plastic [kg/GJ waste]	CO_2 emission factor for municipal waste, total 2) [kg/GJ waste]	CO_2 emission factor for biomass content of waste [kg/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

1) DEA 2007b
2) Based on data from Jørgensen & Johansen 2003
3) From Table 3A-4

Straw

The emission factor for straw, 102 kg/GJ, is from Fenhann & Kilde, 1994. The factor is based on the interval stated in the EMEP/Corinair Guidebook (EMEP/Corinair, 2004) and the actual value is the default value from the Collecter database. The same emission factor is applied for 1990-2006.

Residual oil

The emission factor 78 kg/GJ comes from Fenhann & Kilde, 1994. The factor is based on the interval stated in the EMEP/Corinair Guidebook (EMEP/Corinair; 2004). The factor is slightly higher than the IPCC default emission factor for residual fuel oil (77.4 kg/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 1990-2006.

As mentioned above ETS data were utilised for the first time in the emission inventory. The implied emission factors for the power plants using coal ranged from 77.34 to 80.34 kg/GJ. There were detailed data available from 14 units using residual oil, which allowed the information to be included in the emission inventory.

Gas oil

The emission factor 74 kg/GJ refers to Fenhann & Kilde 1994. The factor is based on the interval stated in the EMEP/Corinair Guidebook (EMEP/Corinair, 2004). The factor agrees with the IPCC default emission factor for gas oil (74.1 kg/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 1990-2006.

Kerosene

The emission factor 72 kg/GJ refers to Fenhann & Kilde 1994. The factor agrees with the IPCC default emission factor for other kerosene (71.9 kg/GJ assuming full oxidation). The same emission factor is applied for 1990-2006.

Fish & rape oil

The emission factor is assumed to be the same as for gas oil – 74 kg/GJ. The consumption of fish and rape oil is relatively low.

Orimulsion

The emission factor 80 kg/GJ refers to the Danish Energy Authority (DEA 2004). The IPCC default emission factor is almost the same: 80.7 kg/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 1990-2006.

Natural gas

The emission factor for natural gas is estimated by the Danish gas transmission company, Energinet.dk. 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 2000-2006. 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). The time-series for the CO_2 emission factors is provided in Table 3A-6.

Table 3A-6 CO_2 emission factor for natural gas.

Year	CO_2 emission factor kg/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

LPG

The emission factor 65 kg/GJ refers to Fenhann & Kilde 1994. The emission factor is based on the EMEP/Corinair Guidebook (EMEP/Corinair, 2004). The emission factor is somewhat higher than the IPCC default emission factor (63 kg/GJ assuming full oxidation). The same emission factor is applied for 1990-2006.

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 (EMEP/Corinair, 2004). The same emission factor is applied for 1990-2006.

Biogas

The emission factor 83.6 kg/GJ is based on a biogas with 65% (vol.) CH_4 and 35% (vol.) CO_2. The Danish Gas Technology Centre has stated that this is typical manure-based biogas as utilised in stationary combustion plants (Kristensen 2001). The same emission factor is applied for 1990-2006.

2.5.2 CH_4

The CH_4 emission factors applied for 2006 are presented in Table 3A-7. In general, the same emission factors have been applied for 1990-2006. 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). Other emission factors refer to the EMEP/Corinair Guidebook (EMEP/Corinair, 2004).

Gas engines, combusting natural gas or biogas, contribute much more to the total CH_4 emission than other stationary combustion plants. The relatively high emission factor for gas engines is well-documented and further discussed below.

Table 3A-7 CH_4 emission factors 1990-2006.

Fuel	ipcc_id	SNAP_id	Emission factor [g/GJ]	Reference
COAL	1A1a	010101, 010102, 010103	1.5	EMEP/Corinair 2004
COAL	1A1a, 1A2f, 1A4b, 1A4c	010202, 010203, 0301, 0202, 0203	15	EMEP/Corinair 2004
BROWN COAL BRI.	all	all	15	EMEP/Corinair 2004, assuming same emission factor as for coal
COKE OVEN COKE	all	all	15	EMEP/Corinair 2004, assuming same emission factor as for coal
PETROLEUM COKE	all	all	15	EMEP/Corinair 2004
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	2	Nielsen & Illerup 2003
WOOD AND SIMIL.	1A4a, 1A4b, 1A4c	0201, 0202, 0203	200	EMEP/Corinair 2004
WOOD AND SIMIL.	1A1a, 1A2f	010105, 010202, 010203, 0301, 030102, 030103	32	EMEP/Corinair 2004
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	0.59	Nielsen & Illerup 2003
MUNICIP. WASTES	1A1a, 1A2f, 1A4a	all other	6	EMEP/Corinair 2004
STRAW	1A1a	010102, 010103	0.5	Nielsen & Illerup 2003
STRAW	1A1a, 1A2f, 1A4c	010202, 010203, 020302, 030105	32	EMEP/Corinair 2004
STRAW	1A4b, 1A4c	0202, 0203	200	EMEP/Corinair 2004
RESIDUAL OIL	all	all	3	EMEP/Corinair 2004
GAS OIL	all	all	1.5	EMEP/Corinair 2004
KEROSENE	all	all	7	EMEP/Corinair 2004
FISH & RAPE OIL	all	all	1.5	EMEP/Corinair 2004, assuming same emission factor as gas oil
ORIMULSION	1A1a	010101	3	EMEP/Corinair 2004, assuming same emission factor as residual oil
NATURAL GAS	1A1a	0101, 010101, 010102, 010202	6	DGC 2001
NATURAL GAS	1A1a	010103, 010203	15	Gruijthuijsen & Jensen 2000
NATURAL GAS	1A1a, 1Ac, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010504, 030104, 020104, 020303	1.5	Nielsen & Illerup 2003
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	1) 465	Nielsen et al. 2008
NATURAL GAS	1A1c, 1A2f, 1A4a, 1A4b, 1A4c	010502, 0301, 0201, 0202, 0203	6	DGC 2001
NATURAL GAS	1A2f, 1A4a, 1A4b	030103, 030106, 020103, 020202	15	Gruijthuijsen & Jensen 2000
LPG	all	all	1	EMEP/Corinair 2004
REFINERY GAS	1A1b	010304	1.5	EMEP/Corinair 2004
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010505, 030105, 020105, 020304	1) 323	Nielsen & Illerup 2003
BIOGAS	1A1a, 1A2f, 1A4a, 1A4c	all other	4	EMEP/Corinair 2004

1) 2006 emission factor. Time-series is shown below

CHP plants

A considerable portion 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 have been estimated for CHP plants <25MW$_e$. The work was reported in 2003 (Nielsen & Illerup 2003) and the results have been fully implemented.

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 datasets 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.

In addition to the above mentioned project a study conducted in 2006/2007 produced updated emission factors for natural gas powered gas engines including start/stop emissions. (Nielsen et al., 2008)

Gas engines, natural gas
SNAP 010105, 010205, 010505, 030105, 020105, 020204 and 020304

The emission factor for natural gas engines was determined as 520 g/GJ in 2000. 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. The new study (Nielsen et al., 2008) calculated a start/stop correction factor, this factor have been applied to the time-series estimated on the basis of Nielsen & Illerup, 2003. Nielsen et al, 2008 calculated updated full load emission factors for 2004-2006. The time-series can be seen in table 3A-8.

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. A time-series for the emission factor has been estimated and is presented below (Nielsen et al., 2008). The time-series was based on:

- Emission factors for different engine types
- Nielsen & Illerup, 2003
- Data regarding fuel consumption (DEA, 2007c)
- Correction factors for start/stop emissions

Table 3A-8 Time-series for the CH_4 emission factor for natural gas fuelled engines.

Year	Emission factor [g/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

Gas engines, biogas

SNAP 010105, 010505, 020105, 020304 and 030105

The emission factor for biogas engines was estimated to be 323 g/GJ in 2000 and the same emission factor has been applied for 2001 - 2006. 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 prechamber engines. A time-series for the emission factor has been estimated (Nielsen & Illerup 2003).

Table 3A-9 Time-series for the CH_4 emission factor for biogas fuelled engines.

Year	Emission factor [g/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

Gas turbines, natural gas

SNAP 010104, 010504, 020104, 020303 and 030104

The emission factor for gas turbines was estimated to be below 1.5g/GJ and the emission factor of 1.5 g/GJ has been applied for all years. The emission factor was based on emission measurements in 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/GJ and the emission factor of 2 g/GJ has been applied for all years. The emission factor was based on emission measurements in 3 plants.

CHP, straw

SNAP 010102 and 010103

The emission factor for CHP plants combusting straw was estimated to be below 0.5g/GJ and the emission factor of 0.5g/GJ has been applied for all years. The emission factor was based on emission measurements in 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 0.59g/GJ and the emission factor of 0.59g/GJ has been applied for all years. The emission factor was based on emission measurements in 16 plants.

Other stationary combustion plants

Emission factors for other plants refer to the EMEP/Corinair Guidebook (EMEP/Corinair 2004 & 2007), the Danish Gas Technology Centre (DGC

2001) or Gruijthuijsen & Jensen 2000. The same emission factors are applied for 1990-2006.

2.5.3 N_2O

The N_2O emission factors applied for the 2006 inventory are listed in Table 3A-10. The same emission factors have been applied for 1990-2006.

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 DONG Energy (Previously Elsam). Other emission factors refer to the EMEP/Corinair Guidebook (EMEP/Corinair 2007).

Table 3A-10 N_2O emission factors 1990-2006.

Fuel	ipcc_id	SNAP_id	Emission factor [g/GJ]	Reference
COAL	1A1a	0101**	0.8	Elsam 2005
COAL	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	All except 0101**	3	EMEP/Corinair 2004
BROWN COAL BRI.	all	all	3	EMEP/Corinair 2004
COKE OVEN COKE	all	all	3	EMEP/Corinair 2004
PETROLEUM COKE	all	all	3	EMEP/Corinair 2004
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	0.8	Nielsen & Illerup 2003
WOOD AND SIMIL.	1A1a	010105, 010202, 010203	4	EMEP/Corinair 2004
WOOD AND SIMIL.	1A2f, 1A4a, 1A4b, 1A4c	all	4	EMEP/Corinair 2004
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	1.2	Nielsen & Illerup 2003
MUNICIP. WASTES	1A1a	010203	4	EMEP/Corinair 2004
MUNICIP. WASTES	1A2f, 1A4a	030102, 0201, 020103	4	EMEP/Corinair 2004
STRAW	1A1a	010102, 010103	1.4	Nielsen & Illerup 2003
STRAW	1A1a	010202, 010203	4	EMEP/Corinair 2004
STRAW	1A2f, 1A4b, 1A4c	all	4	EMEP/Corinair 2004
RESIDUAL OIL	all	all	2	EMEP/Corinair 2004
GAS OIL	all	all	2	EMEP/Corinair 2004
KEROSENE	all	all	2	EMEP/Corinair 2004
FISH & RAPE OIL	all	all	2	EMEP/Corinair 2004, assuming same emission factor as gas oil
ORIMULSION	1A1a	010101	2	EMEP/Corinair 2004, assuming same emission factor as residual oil
NATURAL GAS	1A1a	0101, 010101, 010102, 010103, 010202, 010203	1	EMEP/Corinair 2004
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010504, 030104, 020104, 020303	2.2	Nielsen & Illerup 2003
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	1.3	Nielsen & Illerup 2003
NATURAL GAS	1A1c, 1A2f, 1A4a, 1A4b, 1A4c	010502, 0301, 030103, 030106, 0201, 020103, 0202, 020202, 0203	1	EMEP/Corinair 2004
LPG	all	all	2	EMEP/Corinair 2004
REFINERY GAS	all	all	2.2	EMEP/Corinair 2004
BIOGAS	1A1a	010102, 010103, 010203	2	EMEP/Corinair 2004
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010505, 030105, 020105, 020304	0.5	Nielsen & Illerup 2003
BIOGAS	1A2f, 1A4a, 1A4c	0301, 030102, 0201, 020103, 0203	2	EMEP/Corinair 2004

2.5.4 SO_2, NO_X, NMVOC and CO

Emission factors for SO_2, NO_X, NMVOC and CO are listed in Appendix 3A-4. The appendix includes references and time-series.

The emission factors refer to:

- The EMEP/Corinair Guidebook (EMEP/Corinair 2007)
- The IPCC Guidelines, Reference Manual (IPCC 1996)
- 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
  - Dyrnum et al., 1990
  - Hansen et al., 1994
  - 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 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-4.

2.6 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 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 respect of 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.

3 Fuel consumption data

In 2006, total fuel consumption for stationary combustion plants was 618 PJ, of which 505 PJ related to fossil fuels. The fuel consumption rates are shown in Appendix 3A-3.

Fuel consumption distributed on the stationary combustion subsectors is shown in Figure 3A-1 and Figure 3A-2. The majority (62%) 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 category 1A1c is mainly natural gas used in gas turbines in the offshore industry.

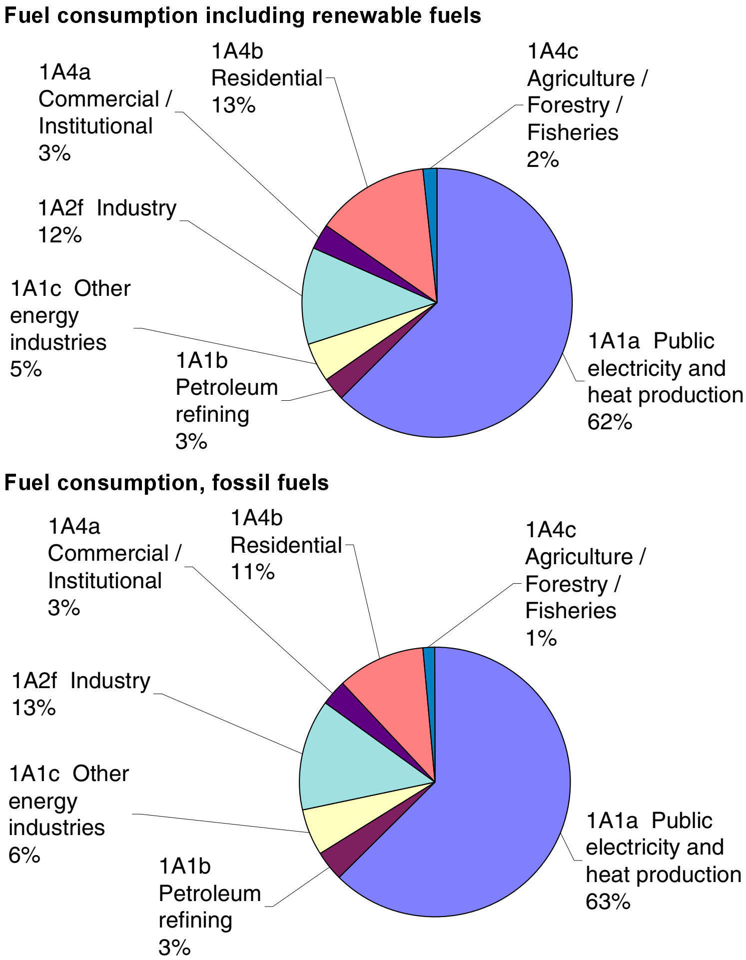

Figure 3A-1 Fuel consumption rate of stationary combustion, 2006 (based on DEA 2007a).

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.

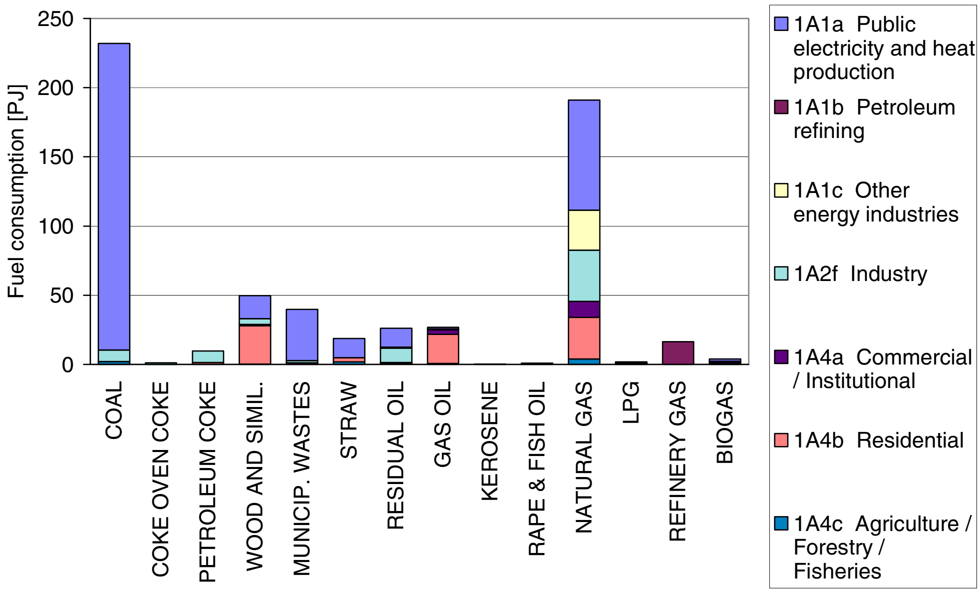

Figure 3A-2 Fuel consumption of stationary combustion plants 2006 (based on DEA 2007a).

Fuel consumption time-series for stationary combustion plants are presented in Figure 3A-3. The total fuel consumption has increased by 24% from 1990 to 2006, while the fossil fuel consumption has increased by 13.1%. The consumption of natural gas and renewable fuels has increased since 1990, whereas coal consumption has decreased.

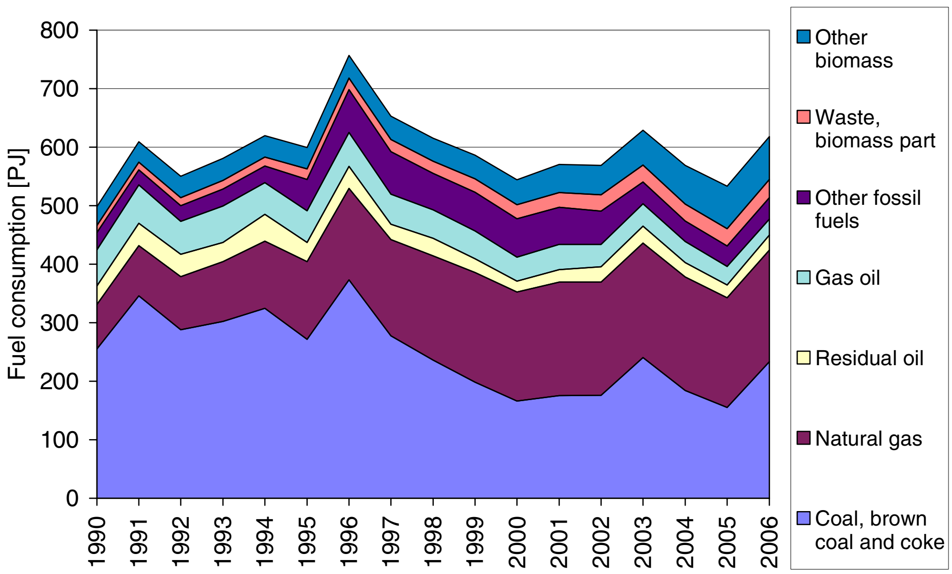

Figure 3A-3 Fuel consumption time-series, stationary combustion (based on DEA 2007a).

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 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 2006 the net electricity export was 24 971 TJ in 2005 there had been a net import. The electricity export in 2006 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 without random variations in electricity imports/exports and 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.

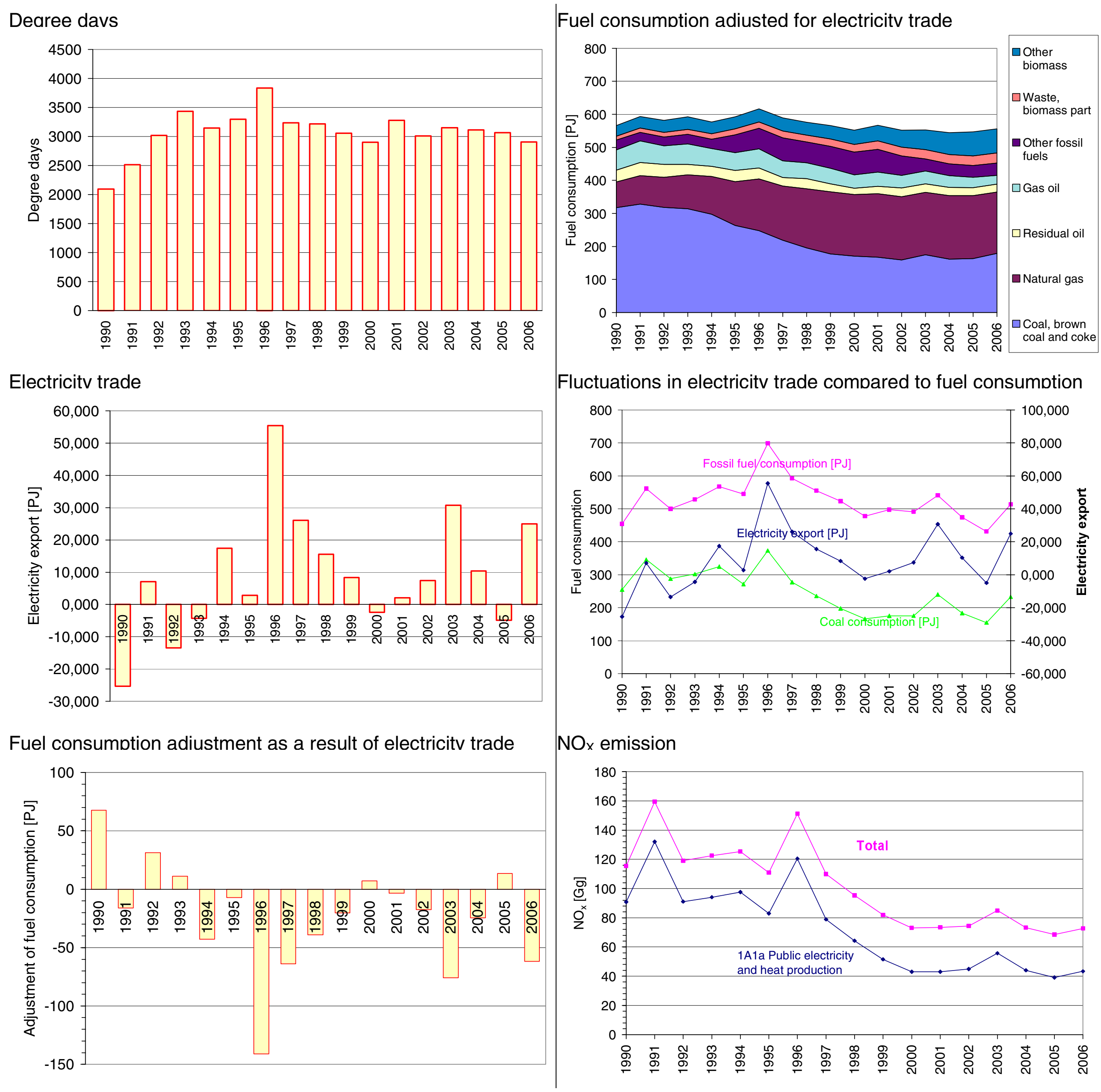

Figure 3A-4 Comparison of time-series fluctuations for electricity trade, fuel consumption and NO_X emission (DEA 2007b).

4 Greenhouse gas emission

The total Danish greenhouse gas (GHG) emission in the year 2006 was 70469 Gg CO_2 equivalents, not including land-use change and forestry, or 68667 Gg CO_2 equivalents including 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-11. The emission from stationary combustion accounts for 58% of the total Danish GHG emission.

The CO_2 emission from stationary combustion plants accounts for 70% of the total Danish CO_2 emission (not including land-use change and forestry). CH_4 accounts for 8% of the total Danish CH_4 emission and N_2O for only 4% of the total Danish N_2O emission.

Table 3A-11 Greenhouse gas emission for the year 2006 [1)].

	CO_2	CH_4	N_2O
	Gg CO_2 equivalent		
1A1 Fuel consumption, Energy industries	29 470	240	168
1A2 Fuel consumption, Manufacturing Industries and Construction[1)]	4 609	23	44
1A4 Fuel consumption, Other sectors [1)]	4 948	198	79
Total emission from stationary combustion plants	39 026	461	291
Total Danish emission (gross)	55 749	5 515	6 518
		%	
Emission share for stationary combustion	70	8	4

1) Only stationary combustion sources of the sector is included

CO_2 is the most important GHG pollutant and accounts for 97.7% of the GHG emission (CO_2 eq.). This is a much higher share than for the total Danish GHG emissions where CO_2 only accounts for 81% of the GHG emission (CO_2 eq.).

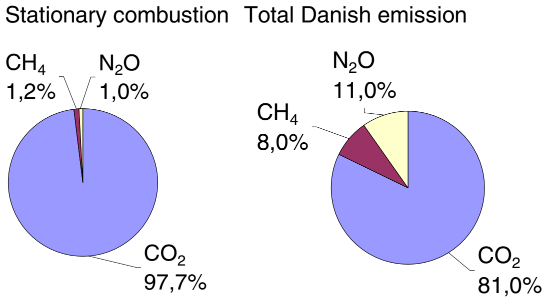

Figure 3A-5 GHG emission (CO_2 equivalent), contribution from each pollutant.

Figure 3A-6 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 higher in 2006 than in 1990, CO_2 by 4% and GHG by 5%. However, fluctuations in the GHG emission level are large.

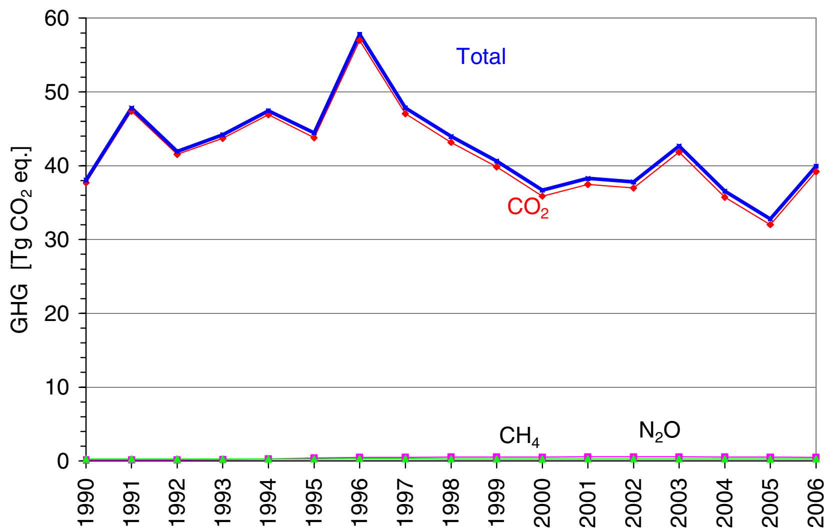

Figure 3A-6 GHG emission time-series for stationary combustion.

The fluctuations in the time-series are mainly 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 3.

As mentioned in Chapter 3, the Danish Energy Authority estimates 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 illustrated in Figure 3A-7. 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 23% since 1990, and the CO_2 emission by 24%.

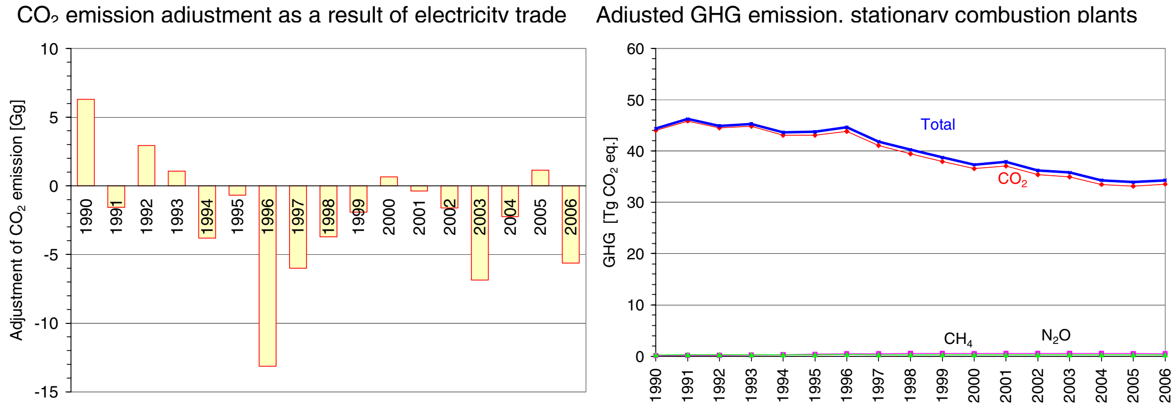

Figure 3A-7 GHG emission time-series for stationary combustion, adjusted for electricity import/export (DEA 2007b).

4.1 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 total Danish CO_2 emission. Table 3A-12 lists the CO_2 emission inventory for stationary combustion plants for 2006. Figure 3A-8 reveals that *Electricity and heat production* accounts for 69% of the CO_2 emission from stationary combustion. This share is somewhat higher than the fossil fuel consumption share for this sector, which is 63% (Figure 3A-1), this is due to a larger share of coal in this sector. 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 3A-12 CO_2 emission from stationary combustion plants 2006 [1)]

CO_2	2006	
1A1a Public electricity and heat production	26858	Gg
1A1b Petroleum refining	982	Gg
1A1c Other energy industries	1631	Gg
1A2 Industry	4609	Gg
1A4a Commercial / Institutional	957	Gg
1A4b Residential	3462	Gg
1A4c Agriculture / Forestry / Fisheries	529	Gg
Total	39026	Gg

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

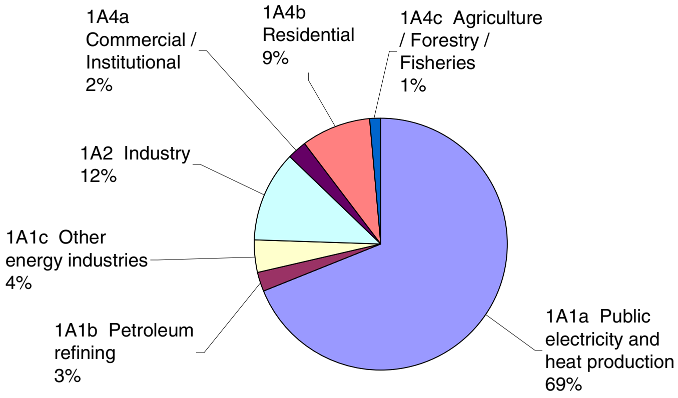

Figure 3A-8 CO_2 emission sources, stationary combustion plants, 2006.

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 2006, the CO_2 emission from biomass combustion was 11 186 Gg.

In Figure 3A-9 the fuel consumption share (fossil fuels) is compared with 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 46% of the fossil fuel consumption and for 57% of the CO_2 emission. Natural gas accounts for 37% of the fossil fuel consumption but only 27% of the CO_2 emission.

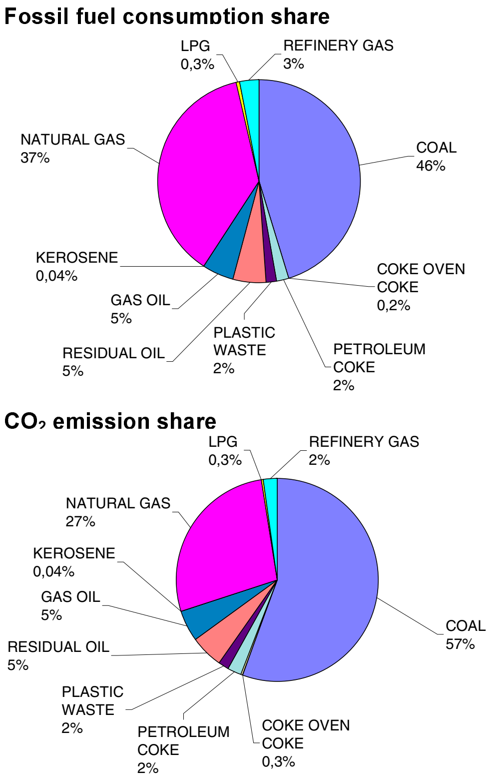

Figure 3A-9 CO_2 emission, fuel origin.

Time-series for the CO_2 emission are provided in Figure 3A-10. Despite an increase in fuel consumption of 24% since 1990, the CO_2 emission from stationary combustion has increased by 4% 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-10) and in coal consumption (Figure 3A-11). The fluctuations are the result of electricity import/export activity as discussed in Chapter 3.

Figure 3A-11 compares the time-series for fossil fuel consumption and the CO_2 emission. As mentioned above, the consumption of coal has decreased whereas the consumption of natural gas, with a lower CO_2 emission factor, has increased. Total fossil fuel use increased by 13.1% between 1990 and 2006.

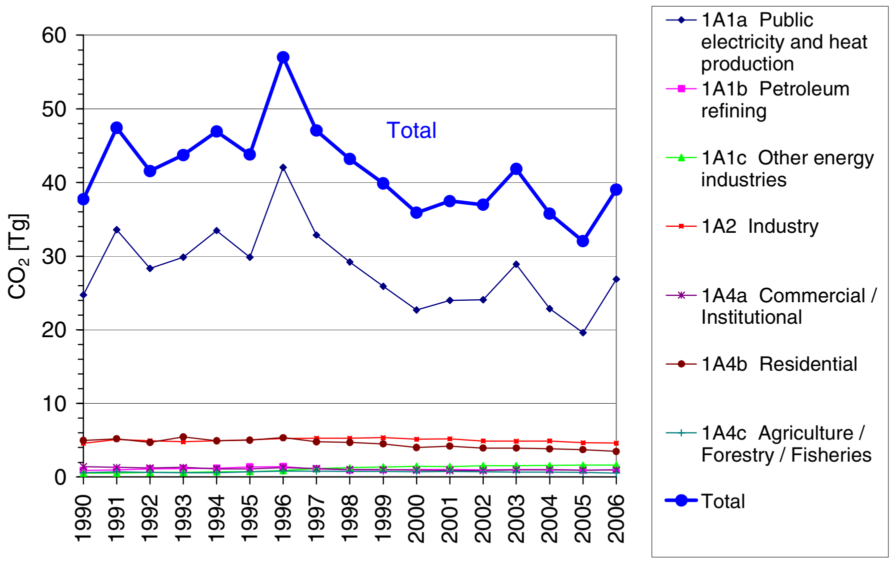

Figure 3A-10 CO_2 emission time-series for stationary combustion plants.

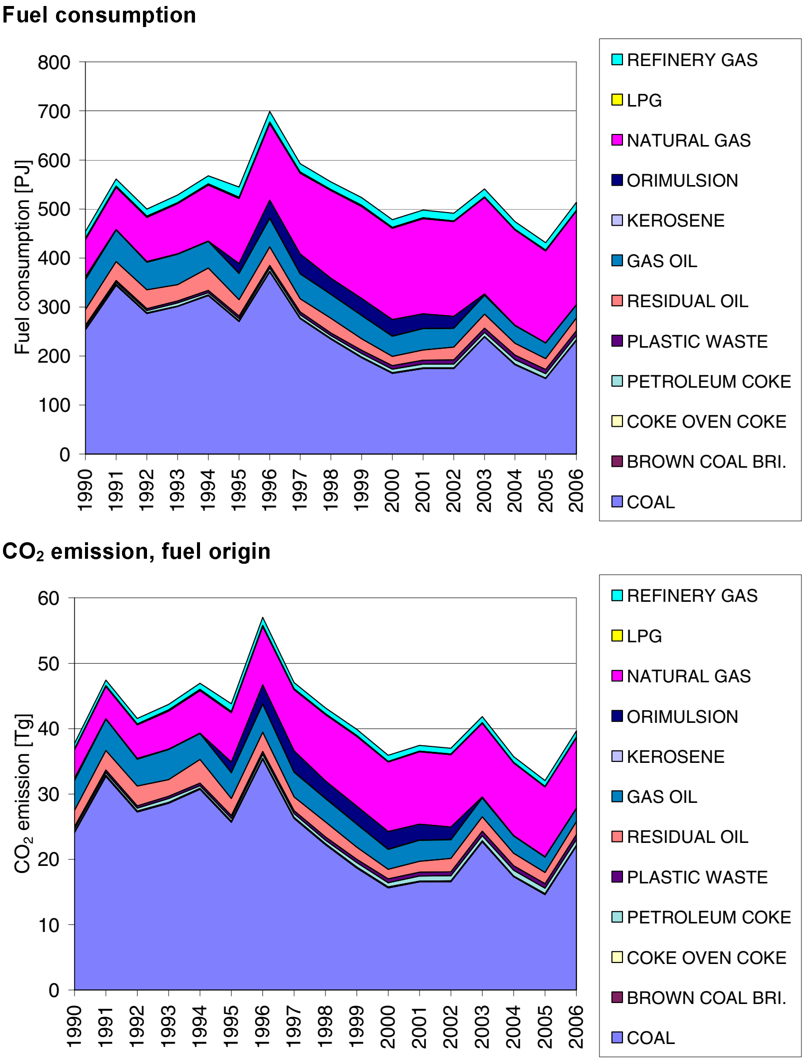

Figure 3A-11 Fossil fuel consumption and CO_2 emission time-series for stationary combustion.

4.2 CH_4

CH_4 emission from stationary combustion plants accounts for 8% of the total Danish CH_4 emission. Table 3A-13 lists the CH_4 emission inventory for stationary combustion plants in 2006. Figure 3A-12 reveals that *Electricity and heat production* accounts for 52% of the CH_4 emission from stationary combustion, which is somewhat less than the fuel consumption share.

Table 3A-13 CH_4 emission from stationary combustion plants 2006 [1).]

CH_4	2006	
1A1a Public electricity and heat production	11337	Mg
1A1b Petroleum refining	0.5	Mg
1A1c Other energy industries	86	Mg
1A2 Industry	1115	Mg
1A4a Commercial / Institutional	872	Mg
1A4b Residential	7088	Mg
1A4c Agriculture / Forestry / Fisheries	1450	Mg
Total	21947	Mg

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

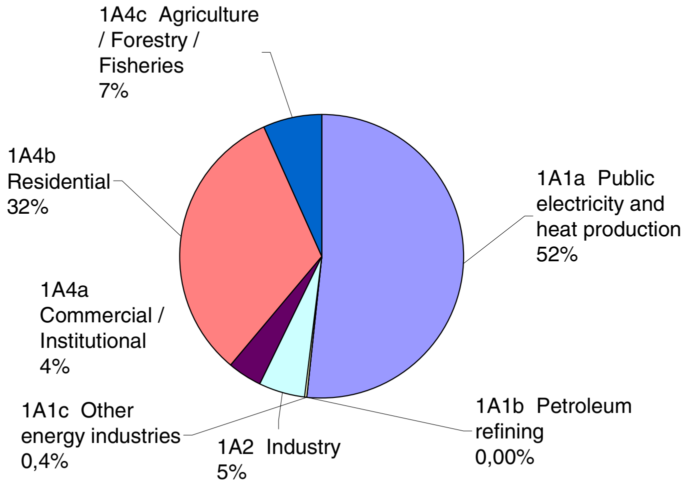

Figure 3A-12 CH_4 emission sources, stationary combustion plants, 2006.

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 2.5.2. A considerable number of lean-burn gas engines are in operation in Denmark and these plants account for 60% of the CH_4 emission from stationary combustion plants (Figure 3A-13). The engines are installed in CHP plants and the fuel used is either natural gas or biogas.

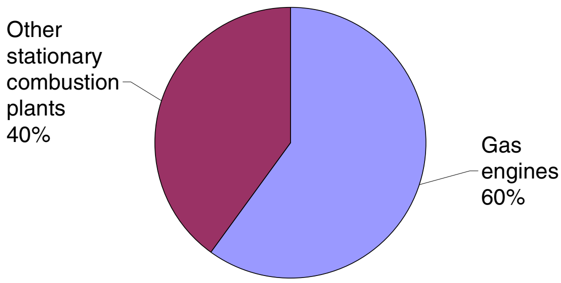

Figure 3A-13 Gas engine CH_4 emission share, 2006.

The CH_4 emission from stationary combustion increased by a factor of 3.8 since 1990 (Figure 3A-14). This results from the considerable number of lean-burn gas engines installed in CHP plants in Denmark in this period. Figure 3A-15 provides time-series for the fuel consumption rate in gas engines and the corresponding increase in the 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.

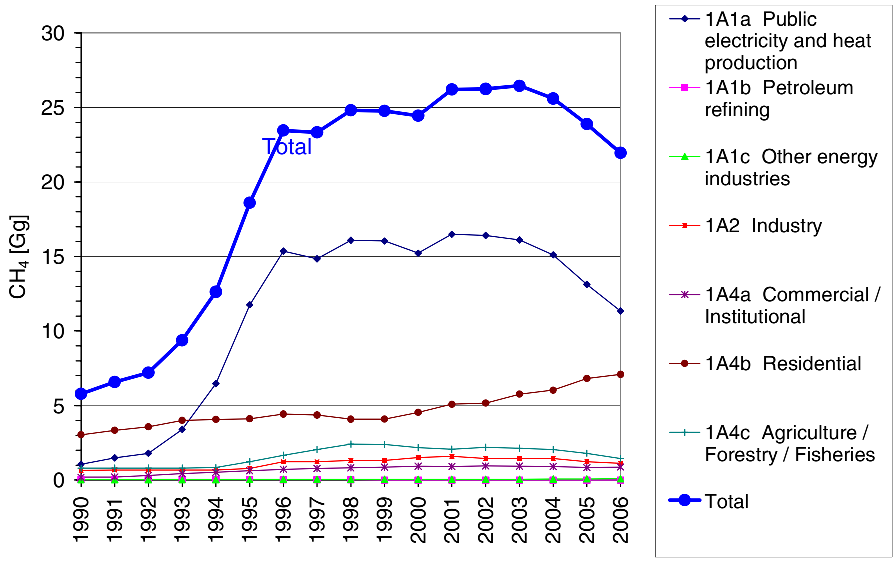

Figure 3A-14 CH_4 emission time-series for stationary combustion plants.

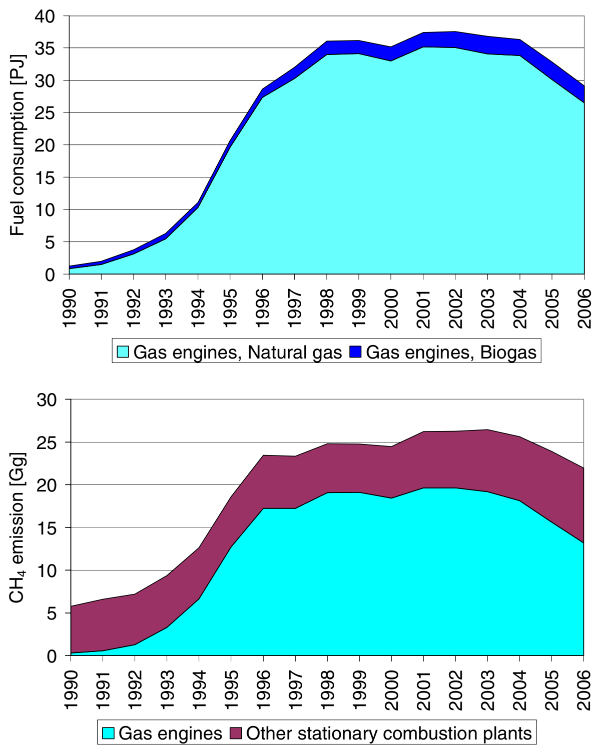

Figure 3A-15 Fuel consumption and CH_4 emission from gas engines, time-series.

4.3 N_2O

The N_2O emission from stationary combustion plants accounts for 4% of the total Danish N_2O emission. Table 3A-14 lists the N_2O emission inventory for stationary combustion plants in the year 2006. Figure 3A-16 reveals that *Electricity and heat production* accounts for 47% of the N_2O emission from stationary combustion.

Table 3A-14 N_2O emission from stationary combustion plants 2006 [1].

N_2O	2006	
1A1a Public electricity and heat production	445	Mg
1A1b Petroleum refining	34	Mg
1A1c Other energy industries	63	Mg
1A2 Industry	143	Mg
1A4a Commercial / Institutional	29	Mg
1A4b Residential	202	Mg
1A4c Agriculture / Forestry / Fisheries	23	Mg
Total	940	Mg

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

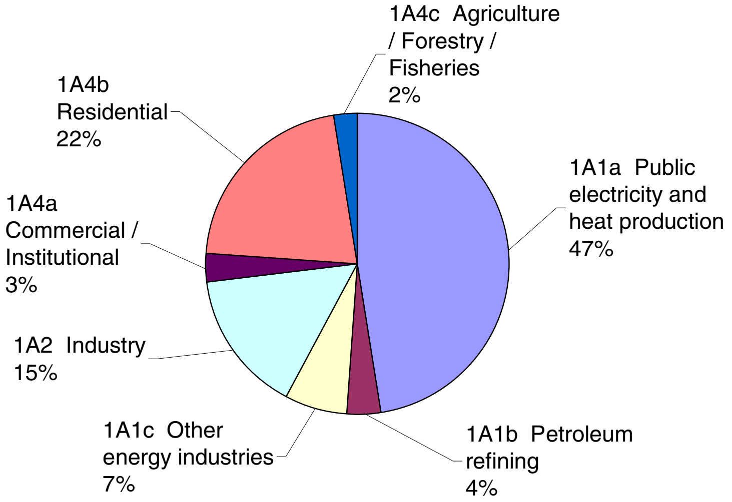

Figure 3A-16 N_2O emission sources, stationary combustion plants, 2006.

Figure 3A-17 shows time-series for N_2O emission. The N_2O emission from stationary combustion increased by 10% from 1990 to 2006, but again fluctuations in emission level due to electricity import/export are considerable.

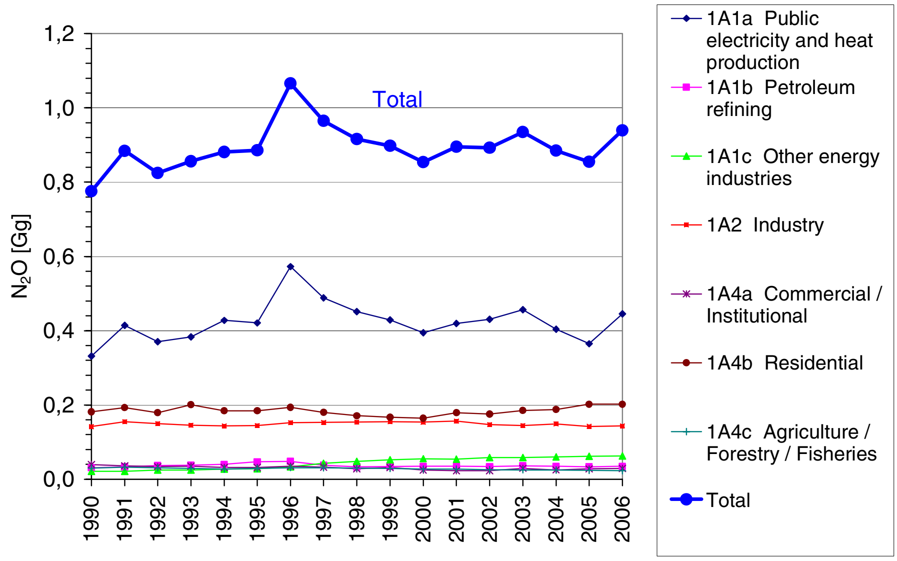

Figure 3A-17 N_2O emission time-series for stationary combustion plants.

4.4 Sectoral trend discussion

On request by the ERT during the in-country review more trend discussion on CRF source category level is included in this chapter. For each CRF subsector relating to stationary combustion the fuel consumption time series will be presented along with emission time series of CO_2, CH_4 and N_2O.

4.4.1 Public 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-18 shows the time series for fuel consumption and CO_2, CH_4 and N_2O emission.

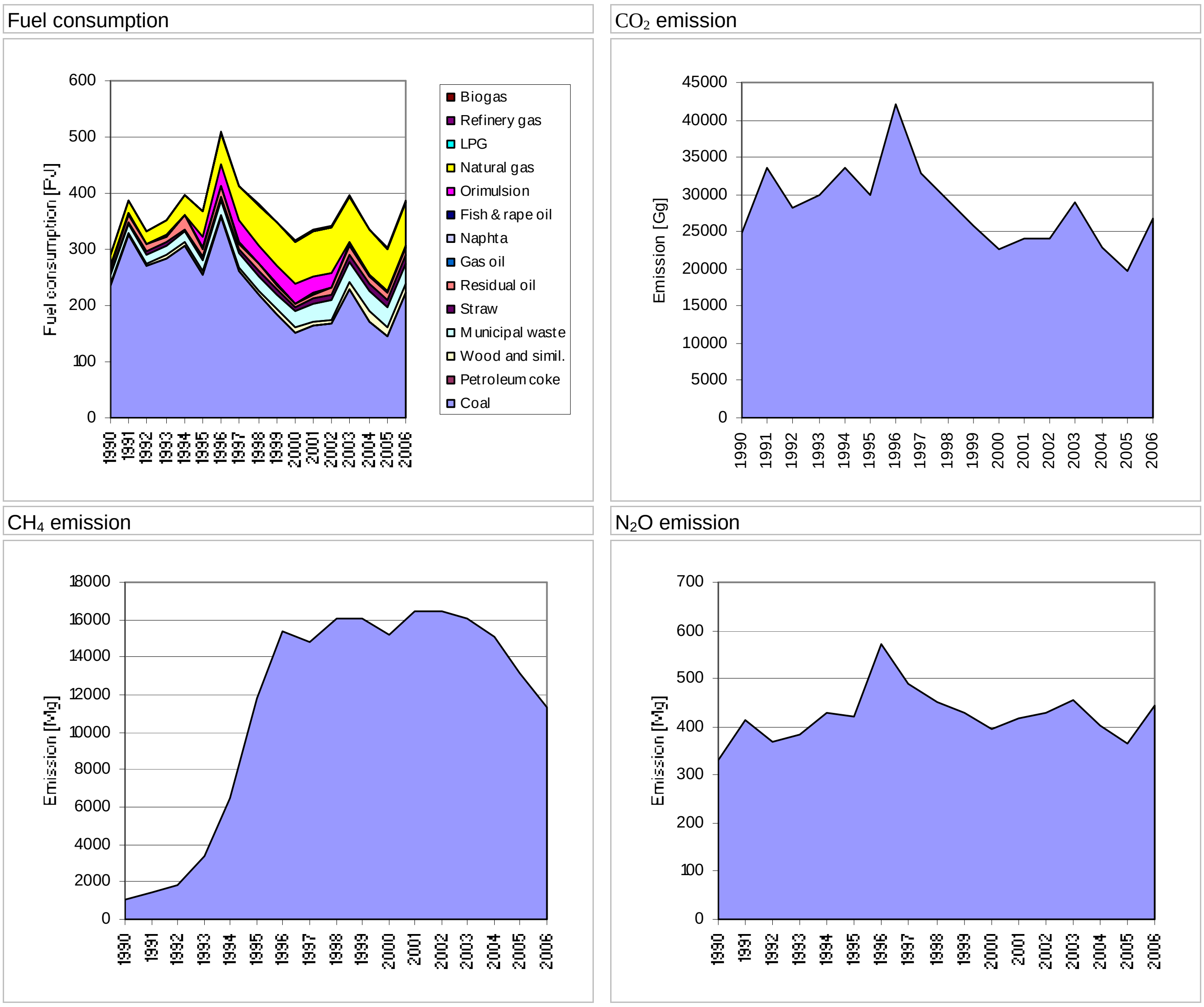

Figure 3A-18 Fuel consumption and CO_2, CH_4 and N_2O emission time-series for CRF category 1A1a Public electricity and heat production.

As discussed in chapter 3 the fuel consumption fluctuates greatly as a consequence of electricity trade. Coal is the fuel that is affected most by the fluctuating electricity trade. Both the CO_2 and N_2O emission fluctuates in a similar pattern as the fuel consumption. For CH_4 the emission increase during the beginning and mitt nineties results from 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.

4.4.2 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-19 shows the time series for fuel consumption and CO_2, CH_4 and N_2O emission.

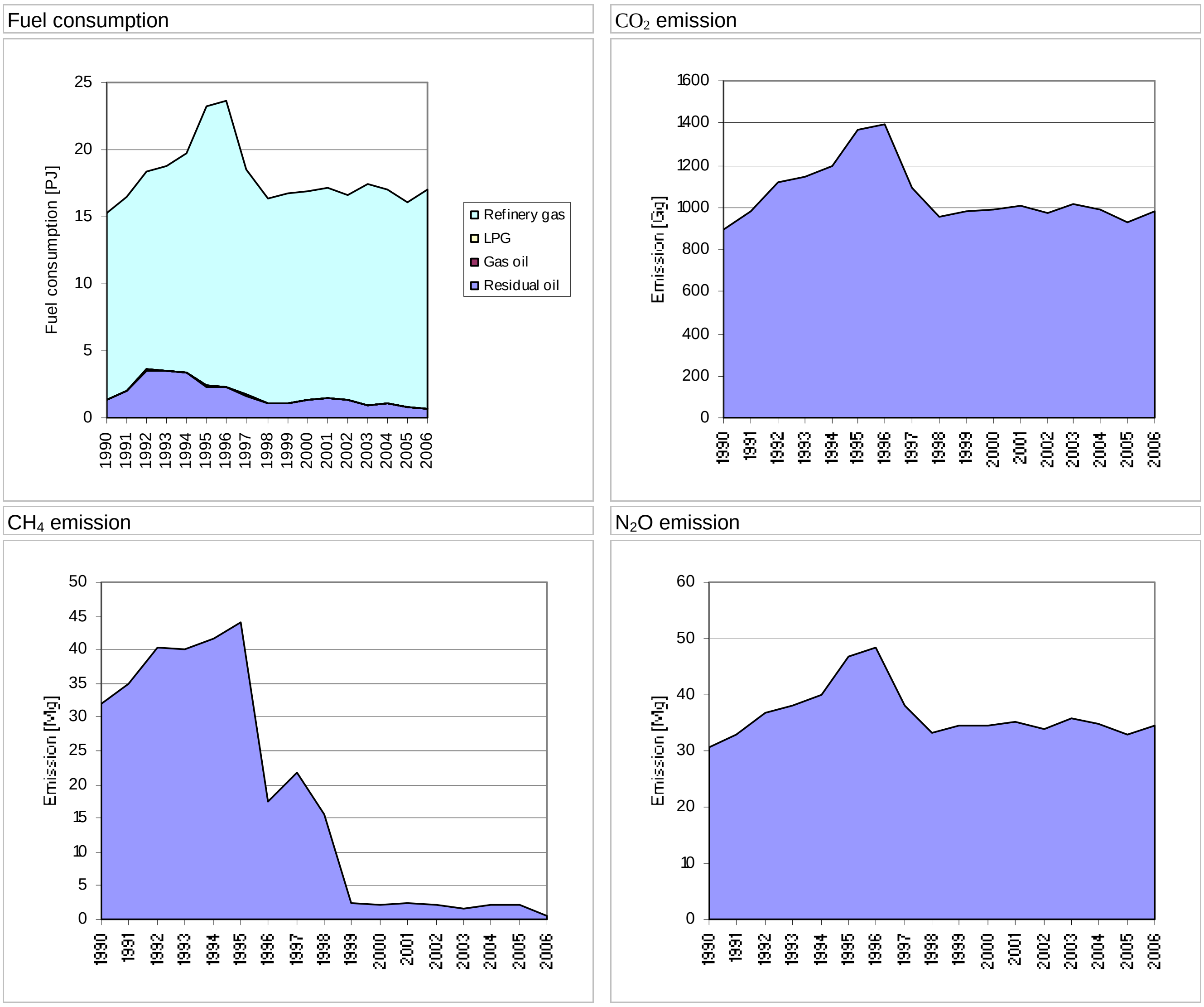

Figure 3A-19 Fuel consumption and CO_2, CH_4 and N_2O emission time-series for CRF category 1A1b Petroleum refining.

The significant decrease in both fuel consumption and emissions from 1996 is due to the closure of a refinery. 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.

4.4.3 Other energy industries

The sector “Other energy industries” is comprised of predominantly natural gas consumption in the off-shore industry. Figure 3A-20 shows the time series for fuel consumption and CO_2, CH_4 and N_2O emission.

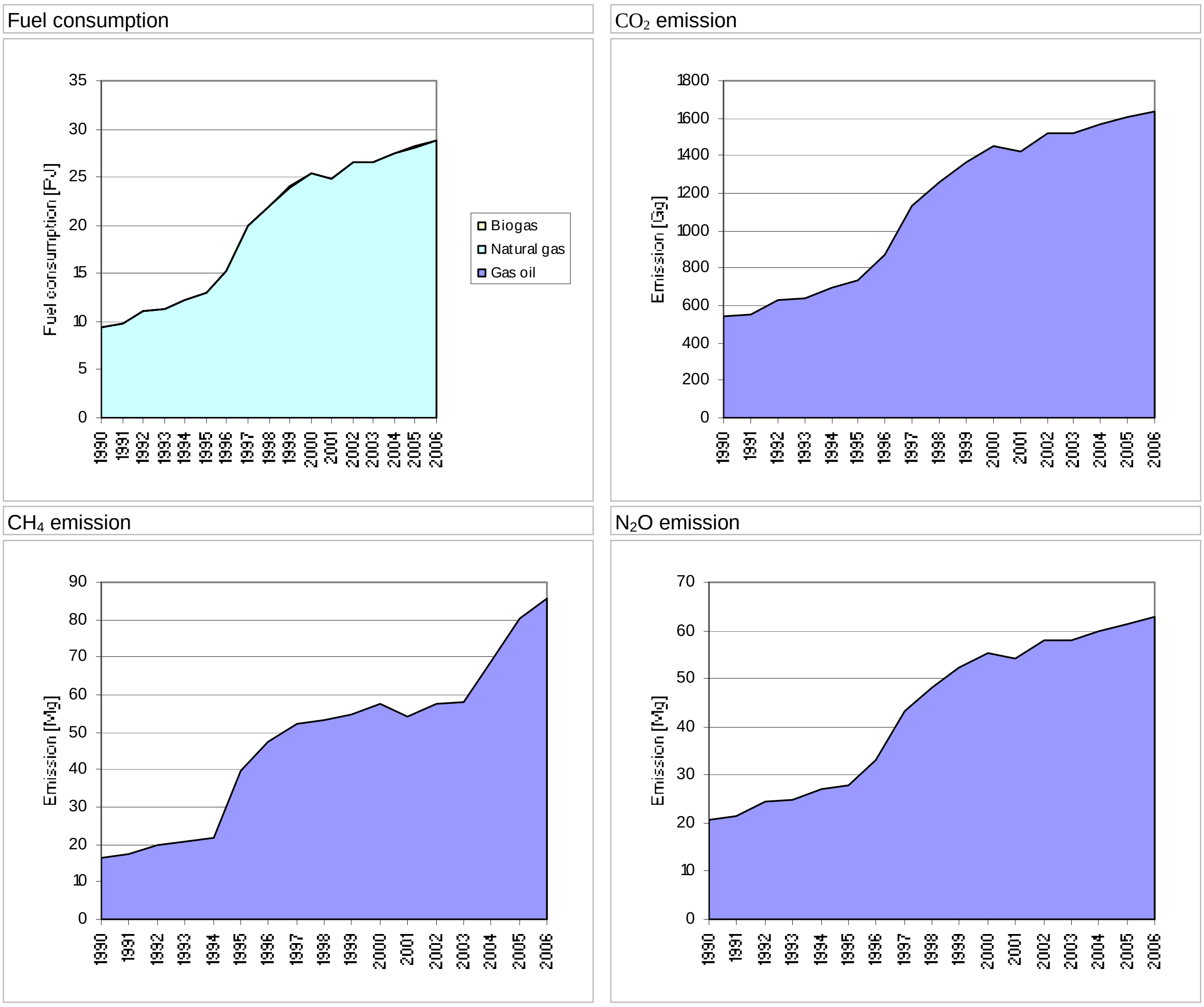

Figure 3A-20 Fuel consumption and CO_2, CH_4 and N_2O emission time-series for CRF category 1A1c Other energy industries.

The emission time series follows closely the fuel consumption time series. 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.

4.4.4 Manufacturing industries and construction

Manufacturing industries and construction, CRF sector 1A2, consists of both stationary and mobile sources. In this chapter only stationary sources are included. Figure 3A-21 shows the time series for fuel consumption and CO_2, CH_4 and N_2O emission.

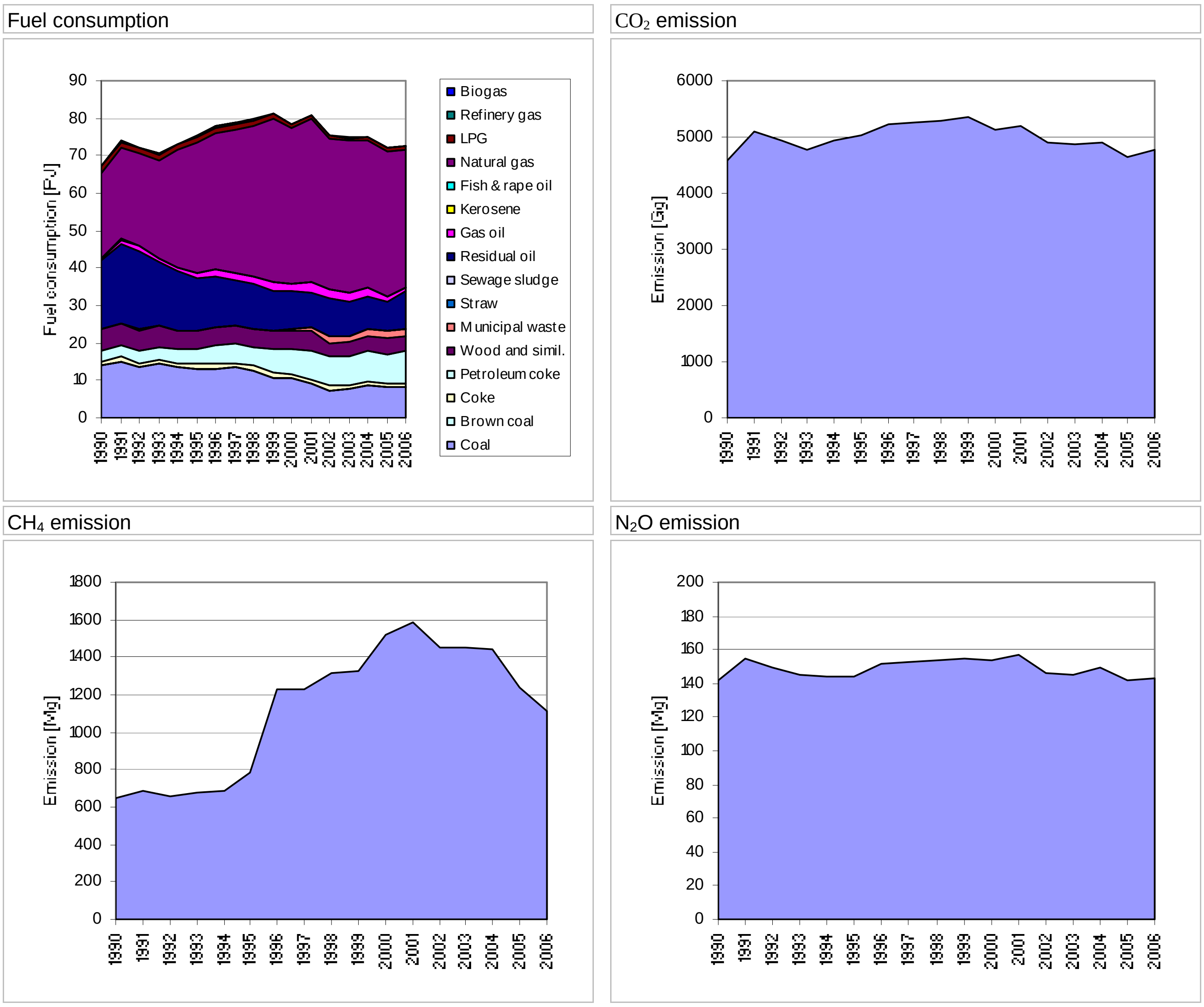

Figure 3A-21 Fuel consumption and CO_2, CH_4 and N_2O emission time-series for CRF category 1A2 Manufacturing industries and construction. Only stationary sources included.

The sector "Manufacturing industries and construction" uses a wide variety of fuels, however the overall fuel consumption is rather stabile. The consumption of coal and residual oil has been decreasing while the consumption of petroleum coke and natural gas has increased.

CO_2 and N_2O emission correlates closely to the fluctuations in fuel consumption. The CH_4 emission increased from 1995 onwards due to the increased use of gas engines, however in later years the fuel consumption in gas engines has decreased leading to a decrease in CH_4 emission. See also chapter 4.2.

4.4.5 Commercial and institutional plants

The CRF sector 1A4a "Commercial and institutional plants" has a low fuel consumption and resulting emissions compared to the other stationary combustion sectors. Figure 3A-22 shows the time series for fuel consumption and CO_2, CH_4 and N_2O emission.

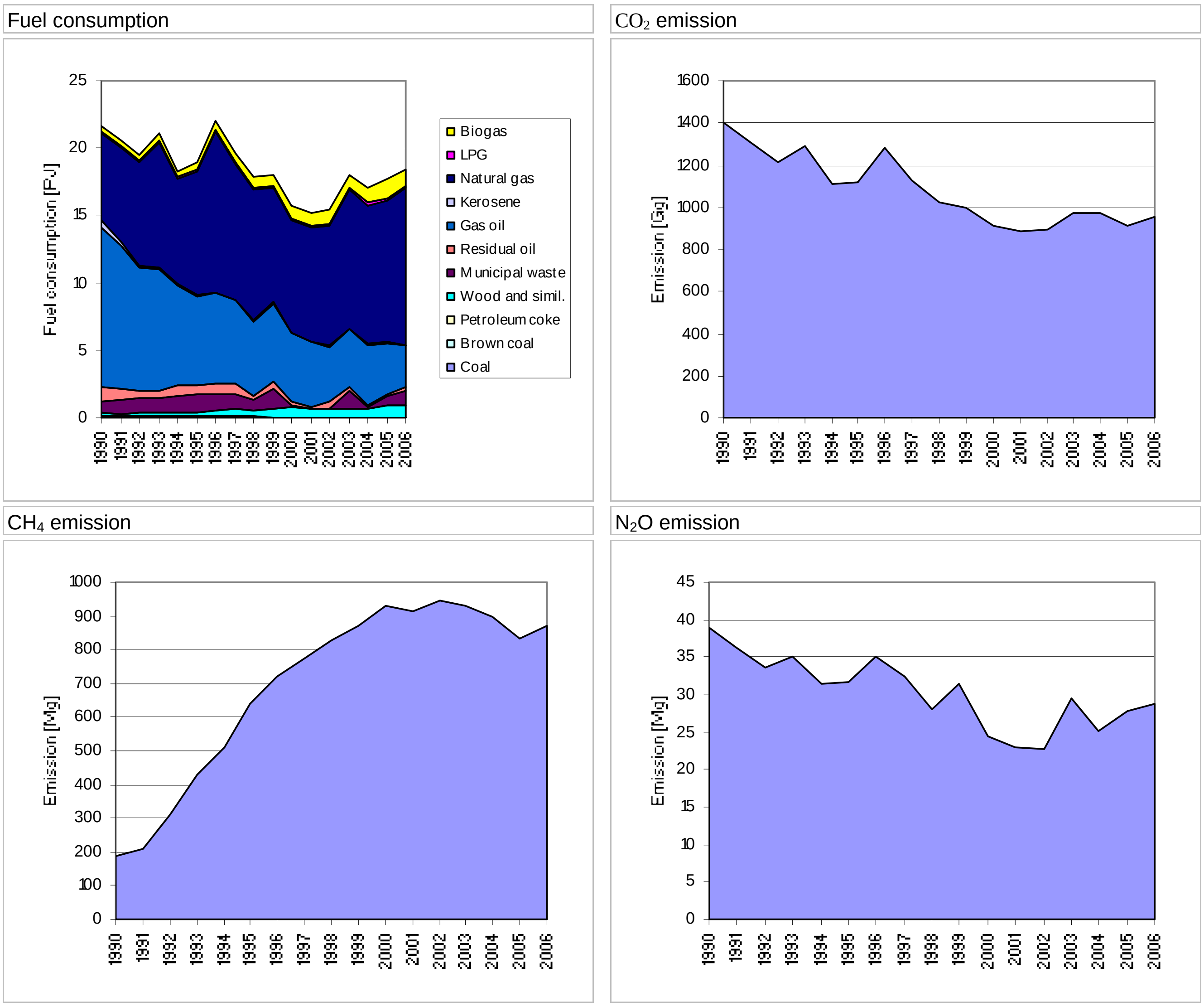

Figure 3A-22 Fuel consumption and CO_2, CH_4 and N_2O emission time-series for CRF category 1A4a Commercial/institutional plants.

The fuel consumption consists mainly of gas oil and natural gas. The consumption of gas oil has been decreasing during the time series while the natural gas consumption has been increasing. The increase in natural gas and biogas consumption has led to an increase in CH_4 emission. The fuel shift from gas oil to natural gas has led to a decrease in CO_2 emission from this sector. The peaks in N_2O emission follow the peaks in fuel consumption, the increased N_2O emission in 2003 is caused by the increase in municipal waste combustion this year.

4.4.6 Residential plants

The CRF sector 1A4b "Residential plants" consists of both stationary and mobile sources. In this chapter only stationary sources are included. Figure 3A-23 shows the time series for fuel consumption and CO_2, CH_4 and N_2O emission.

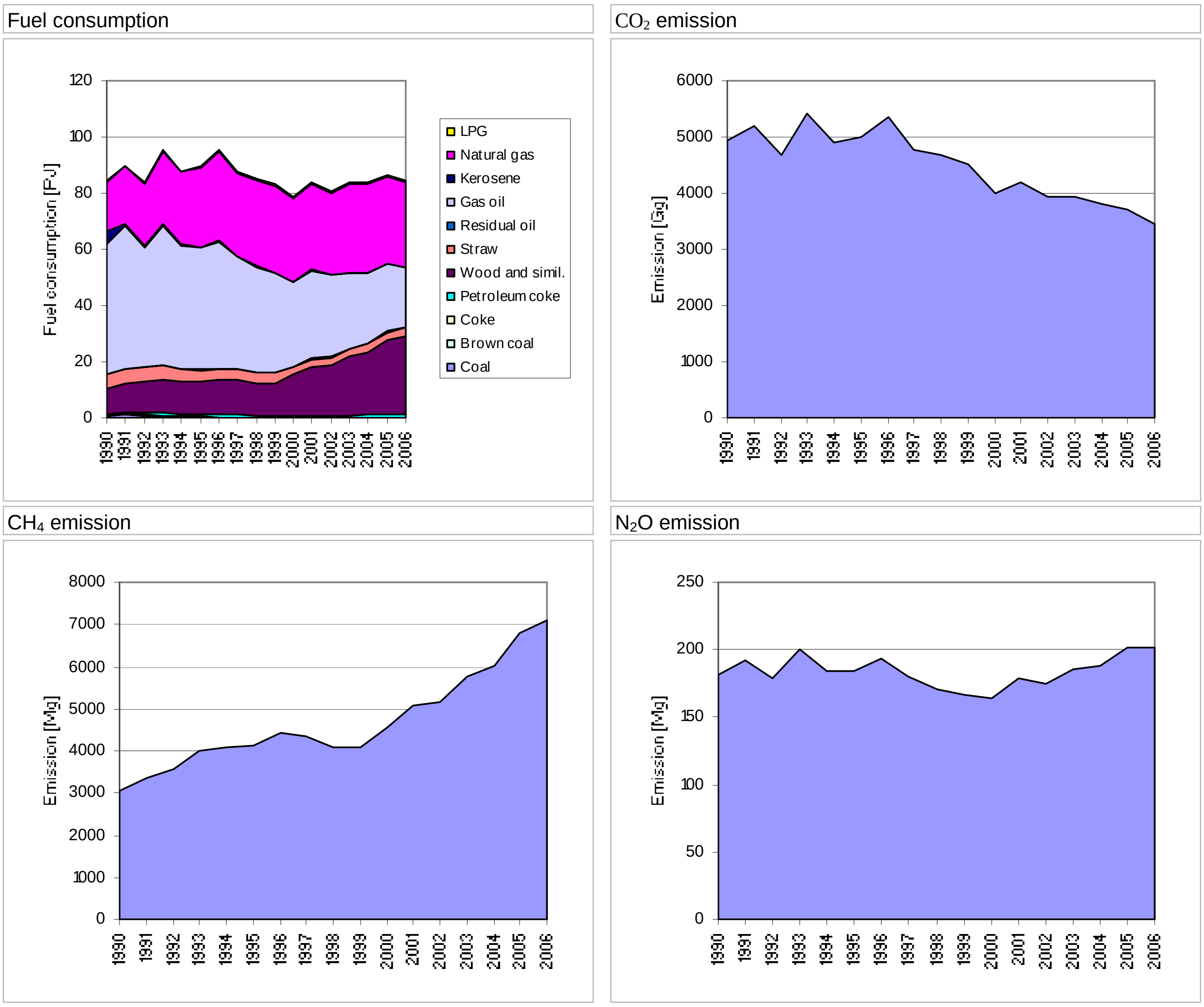

Figure 3A-23 Fuel consumption and CO_2, CH_4 and N_2O emission time-series for CRF category 1A4b Residential plants. Only stationary sources included.

The fuel consumption in the residential sector is relatively constant, however there has been a shift from gas oil to natural gas and to a large extent wood products. The change from gas oil to natural gas and biomass is responsible for the decrease in CO_2 emission. The CH_4 emission has increased partly due to the increased consumption in gas engines but also due to the significant increase in wood consumption in fireplaces and stoves. The N_2O emission follows closely the fuel consumption curve.

4.4.7 Plants in agriculture/forestry

The CRF sector 1A4c “Plants in agriculture/forestry” consists of both stationary and mobile sources. In this chapter only stationary sources are included. Figure 3A-24 shows the time series for fuel consumption and CO_2, CH_4 and N_2O emission.

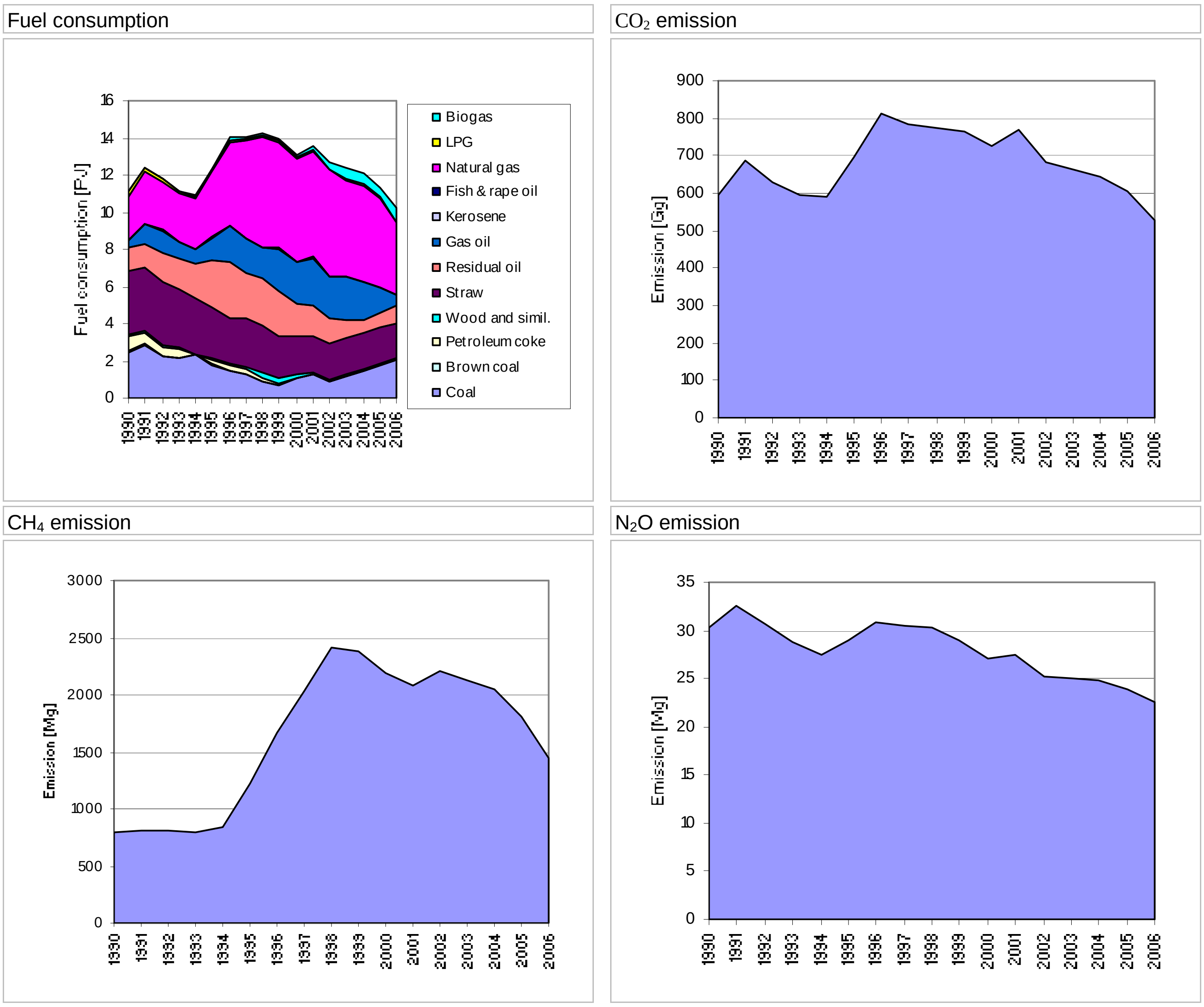

Figure 3A-24 Fuel consumption and CO_2, CH_4 and N_2O emission time-series for CRF category 1A4c Plants in agriculture/forestry. Only stationary sources included.

The increase in fuel consumption from 1994 to 1996 was mainly natural gas used in gas engines. The natural gas consumption increased most from 1994 to 1998, this caused the CH_4 emission to increase in this period. In later years the CH_4 emission has decreased in line with the reduced consumption. 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 N_2O emission has slightly decreased due to a decrease in fuel consumption of straw.

5 SO_2, NO_X, NMVOC and CO

The emissions of SO_2, NO_X, NMVOC and CO from Danish stationary combustion plants 2006 are presented in Table 3A-15. The emission of these pollutants are also included in the report to the Climate Convention.

SO_2 from stationary combustion plants accounts for 90% of the total Danish emission. NO_X, CO and NMVOC account for 39%, 50% and 21% of total Danish emissions, respectively.

Table 3A-15 SO_2, NO_X, NMVOC and CO emission from stationary combustion 2006 [1].

Pollutant	NO_X	CO	NMVOC	SO_2
	Gg	Gg	Gg	Gg
1A1 Fuel consumption, Energy industries	51.9	10.3	3.3	10.2
1A2 Fuel consumption, Manufacturing Industries and Construction (Stationary combustion)	12.5	12.0	0.6	7.9
1A4 Fuel consumption, Other sectors (Stationary combustion)	8.3	275.1	19.3	4.4
Total emission from stationary combustion plants	72.7	297.3	23.2	22.6
Total Danish emission	185.3	590.6	110.0	25.1
		%		
Emission share for stationary combustion	39	50	21	90

1) Only emissions from stationary combustion plants in the sectors are included

5.1 SO_2

Stationary combustion is the most important emission source for SO_2, accounting for 90% of the total Danish emission. Table 3A-16 and Figure 3A-25 present the SO_2 emission inventory for the stationary combustion subsectors.

Electricity and heat production is the largest emission source accounting for 43% of the emission. However, the SO_2 emission share is lower than the fuel consumption share for this sector, which is 62%. This is possibly due to effective flue gas desulphurisation equipment installed in power plants combusting coal.

The fuel origin of the SO_2 emission is shown in Figure 3A-26. Disaggregation of total emissions from point sources using several fuels is based on emission factors. As expected, the emission from natural gas is negligible and the emission from coal combustion is considerable (47%). Most remarkable is the emission share from residual oil combustion, which is 28%. This emission is very high compared with the fuel consumption share of 4%. The emission factor for residual oil combusted in the industrial sector is uncertain because knowledge of the applied flue gas cleaning technology in this sector is insufficient.

The SO_2 emission from *Industry* 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 also represent a considerable emission source. Some years ago, the SO_2 emission from the industrial sector only accounted for a small portion of the total emission, 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-27. The SO_2 emission from stationary combustion plants has decreased by 95% from 1980 and 86% 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 43% of the total emission from stationary combustion, as mentioned above. The emission from other sectors also decreased considerably since 1980.

Table 3A-16 SO_2 emission from stationary combustion plants 2006 [1)].

SO_2	2006	
1A1a Public electricity and heat production	9 832	Mg
1A1b Petroleum refining	407	Mg
1A1c Other energy industries	11	Mg
1A2 Industry	7 903	Mg
1A4a Commercial / Institutional	272	Mg
1A4b Residential	2 407	Mg
1A4c Agriculture / Forestry / Fisheries	1 754	Mg
Total	22 585	Mg

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

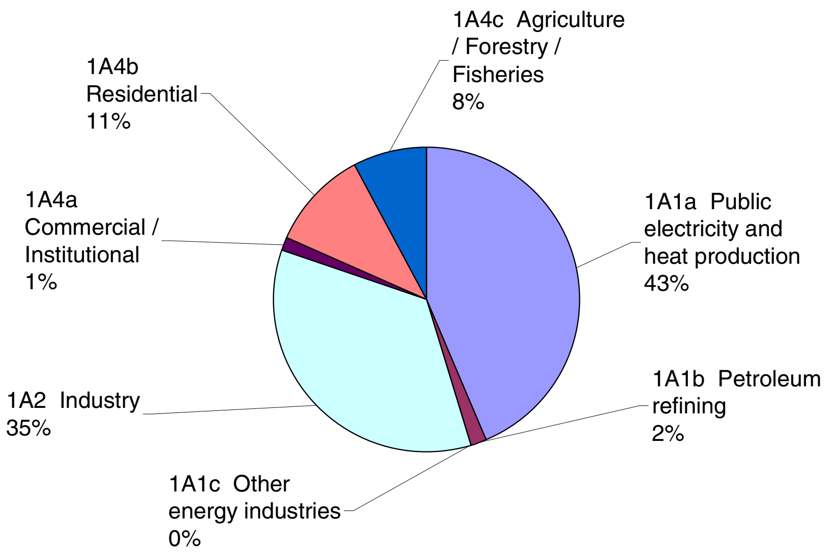

Figure 3A-25 SO_2 emission sources, stationary combustion plants, 2006.

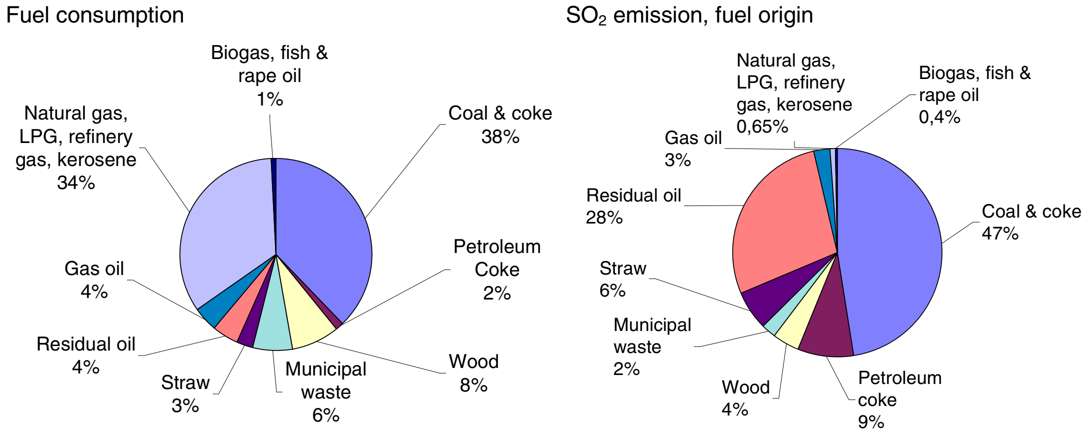

Figure 3A-26 Fuel origin of the SO_2 emission from stationary combustion plants.

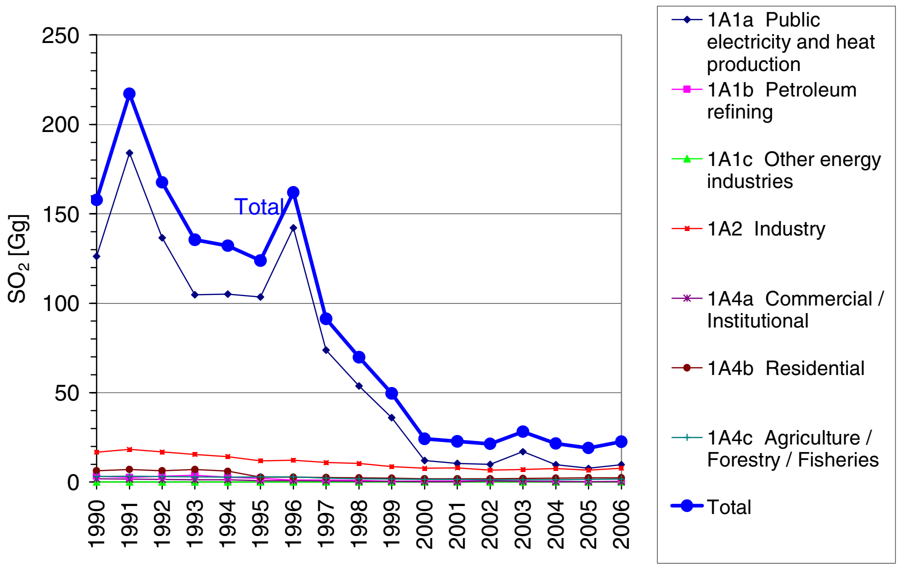

Figure 3A-27 SO_2 emission time-series for stationary combustion.

5.2 NO_X

Stationary combustion accounts for 39% of the total Danish NO_X emission. Table 3A-17 and Figure 3A-28 show the NO_X emission inventory for stationary combustion subsectors.

Electricity and heat production is the largest emission source accounting for 59% of the emission from stationary combustion plants.

Figure 3A-29 shows fuel origin of the NO_X emission from sector 1A1a Electricity and heat production. The fuel origin of the NO_X emission is almost the same as the fuel consumption in this plant category. The emission from coal combustion is; however, somewhat higher than the fuel consumption share.

Industrial combustion plants are also an important emission source, accounting for 17% of the emission. The main industrial emission source is cement production, accounting for 65% of the emission.

Residential plants accounts for 8% of the NO_X emission. The fuel origin of this emission is mainly wood, gas oil and natural gas, accounting for 57%, 19% and 18% of the residential plant emission, respectively.

Time-series for NO_X emission from stationary combustion are shown in Figure 3A-30. The NO_X emission from stationary combustion plants has decreased by 51% from 1985 and 37% from 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-17 NO_X emission from stationary combustion plants 2006 [1].

	2006	
1A1a Public electricity and heat production	43 306	Mg
1A1b Petroleum refining	1 366	Mg
1A1c Other energy industries	7 192	Mg
1A2 Industry	12 498	Mg
1A4a Commercial / Institutional	1 226	Mg
1A4b Residential	5 924	Mg
1A4c Agriculture / Forestry / Fisheries	1 138	Mg
Total	72 650	Mg

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

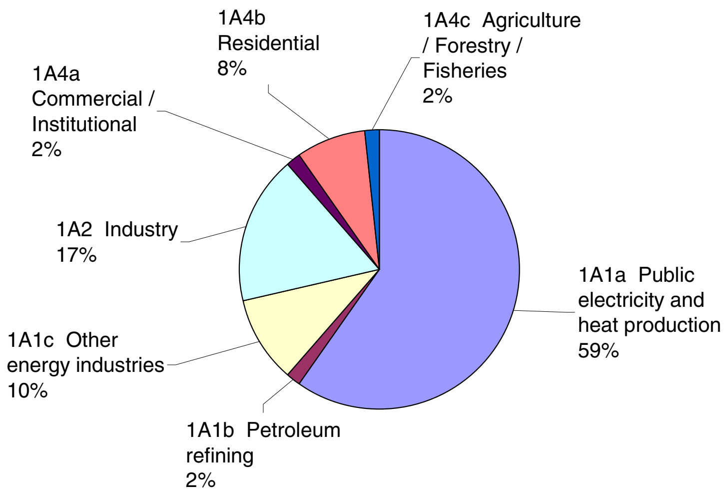

Figure 3A-28 NO_X emission sources, stationary combustion plants, 2006.

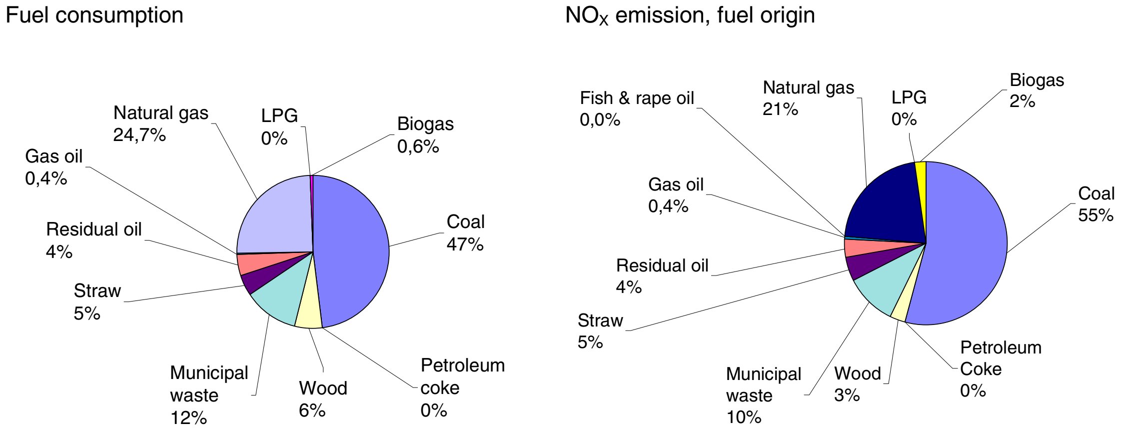

Figure 3A-29 NO_X emissions from 1A1a Electricity and heat production, fuel origin.

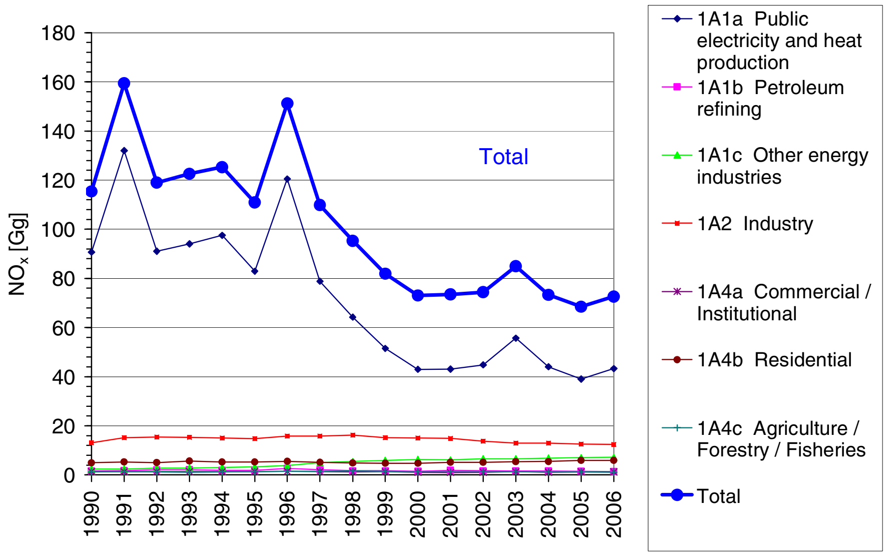

Figure 3A-30 NO_X emission time-series for stationary combustion.

5.3 NMVOC

Stationary combustion plants account for 21% of the total Danish NMVOC emission. Table 3A-18 and Figure 3A-31 present the NMVOC emission inventory for the stationary combustion subsectors.

Residential plants are the largest emission source accounting for 74% of the total emission from stationary combustion plants. For residential plants, NMVOC is mainly emitted from wood and straw combustion, see Figure 3A-32. In 2006 the Danish Energy Authority revised the national statistics for wood consumption in the residential sector. This meant a significant increase from 2000 onwards.

Electricity and heat production is also a considerable emission source, accounting for 16% of the total 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-32). The gas engines are either natural gas or biogas fuelled.

Time-series for NMVOC emission from stationary combustion are shown in Figure 3A-33. The emission has increased by 66% from 1985 and 70% from 1990. The increased emission is mainly a result of higher wood consumption in the residential sector as well as the increased use of lean-burn gas engines in CHP plants as discussed in Chapter 3.

The emission from residential plants is 78% higher in 2006 than in 1990, but the NMVOC emission from wood combustion increased by 139% since 1990 due to increased wood consumption. However the emission from straw combustion in farmhouse boilers has decreased 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-18 NMVOC emission from stationary combustion plants 2006 [1)].

	2006	
1A1a Public electricity and heat production	3 282	Mg
1A1b Petroleum refining	0.5	Mg
1A1c Other energy industries	43	Mg
1A2 Industry	568	Mg
1A4a Commercial / Institutional	722	Mg
1A4b Residential	17 109	Mg
1A4c Agriculture / Forestry / Fisheries	1 458	Mg
Total	23 182	Mg

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

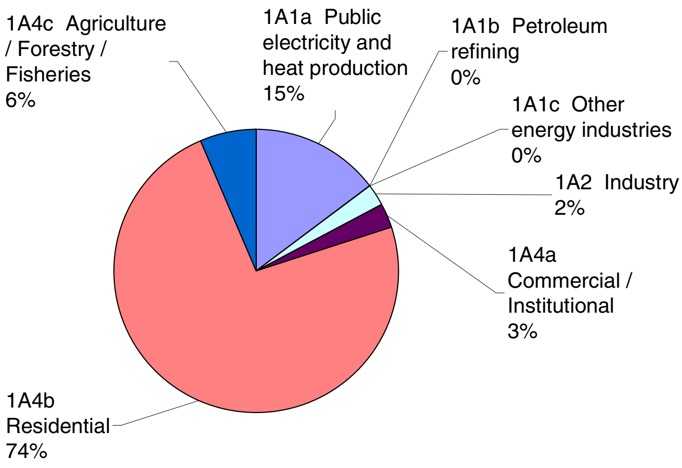

Figure 3A-31 NMVOC emission sources, stationary combustion plants, 2006.

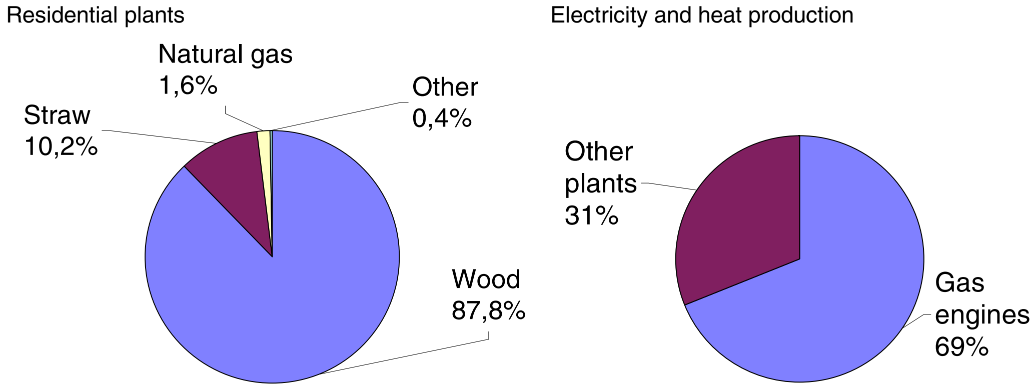

Figure 3A-32 NMVOC emission from residential plants and from electricity and heat production, 2006.

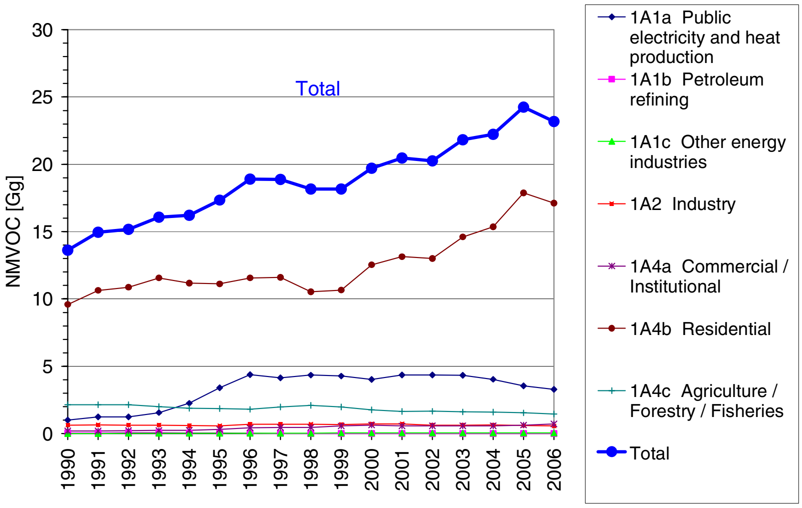

Figure 3A-33 NMVOC emission time-series for stationary combustion.

5.4 CO

Stationary combustion accounts for 50% of the total Danish CO emission. Table 3A-19 and Figure 3A-34 presents the CO emission inventory for stationary combustion subsectors.

Residential plants are the largest emission source, accounting for 90% of the emission. Wood combustion accounts for 95% of the emission from residential plants, see Figure 3A-35. This is in spite of the fact that the fuel consumption share is only 33%. 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-36. The emission has increased by 65% from 1985 and increased 62% 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 has increased by 212% since 1990 leading to an increase in the CO emission. The increase in the CO emission from residential plants is lower than the increase in wood consumption, because CO emission from straw-fired farmhouse boilers has decreased considerably. Both the annual straw consumption in residential plants and the CO emission factor for farmhouse boilers have decreased.

Table 3A-19 CO emission from stationary combustion plants 2006 1).

	2006	
1A1a Public electricity and heat production	9 787	Mg
1A1b Petroleum refining	244	Mg
1A1c Other energy industries	219	Mg
1A2 Industry	12 028	Mg
1A4a Commercial / Institutional	924	Mg
1A4b Residential	265 888	Mg
1A4c Agriculture / Forestry / Fisheries	8 243	Mg
Total	297 333	Mg

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

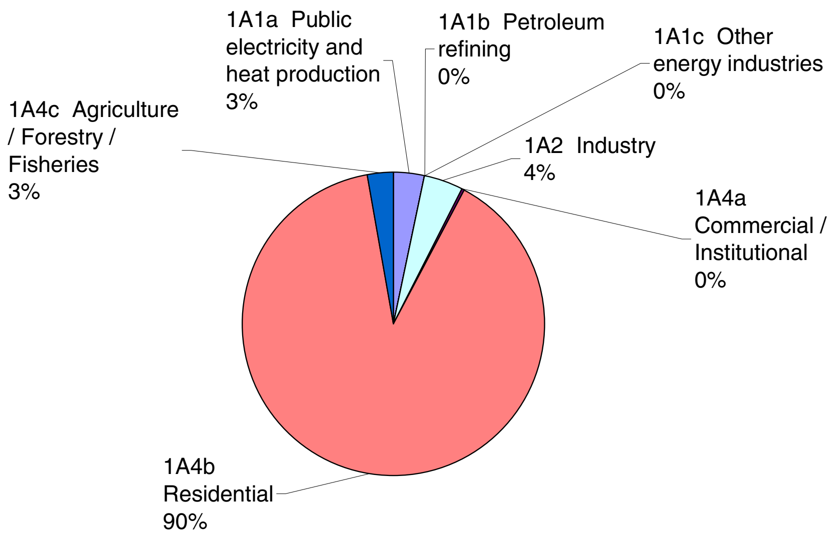

Figure 3A-34 CO emission sources, stationary combustion plants, 2006.

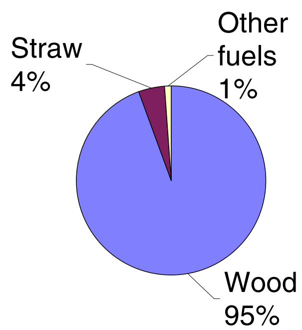

Figure 3A-35 CO emission sources, residential plants, 2006.

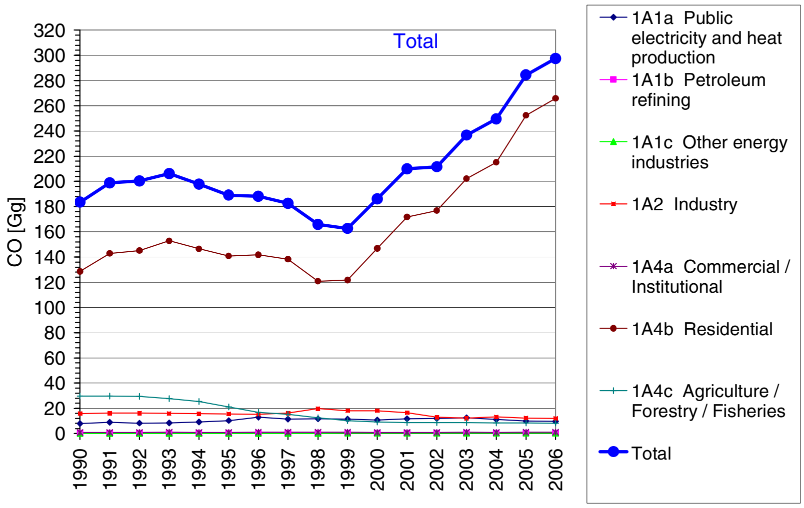

Figure 3A-36 CO emission time-series for stationary combustion.

6 QA/QC and validation

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-20 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		
HM and PM from public power plants	Emissions from the two large power plant operator in DK Elsam & E2	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 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-20 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 not been included in the Danish inventory, to date, but 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.

Data for emission of heavy metals and particles from central power plants, Elsam and Energi E2

The two major Danish power plant operators assess heavy metal emissions from their plants using model calculations based on fuel data and type of flue gas cleaning. NERI's QC of the data consists of a comparison with data from previous years and with data from the plants' annual environmental reports.

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-20.

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-22 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-20.

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 1.6% (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 / operator 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

6.1 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 1996). 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 homepage (DEA 2007b). The fraction of carbon oxidised has been assumed to be 1.00. Considerations regarding this assumption are still ongoing.

The carbon emission factors are default factors originating from the IPCC Reference Manual (IPCC 1996). The country-specific emission factors are not used in the reference approach, this 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. Further consumption for non-energy purposes is subtracted in the reference approach, because non-energy use of fuels is not, as yet, included in the Danish national approach.

Three fuels are used for non-energy purposes: lube oil, bitumen and white spirit. The total consumption for non-energy purposes is relatively low – 12.3 PJ in 2006.

In 2006, the fuel consumption rates in the two approaches differ by -1.44% and the CO_2 emission differs by -0.30%. In the period 1990-2006 fuel consumption and the CO_2 emission differ by less than 1.6%. 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%. The reference approach for 2006 and the comparison with the Danish national approach are provided in Appendix 3A-10. The appendix also includes a correspondence list for the fuel categories (Danish Energy Authority/IPCC reference approach).

A comparison of the national approach and the reference approach is illustrated in Figure 3A-37. In 2006 the national approach includes data from the EU ETS; this causes the discrepancy in the difference between energy consumption and CO_2 emission in 2006.

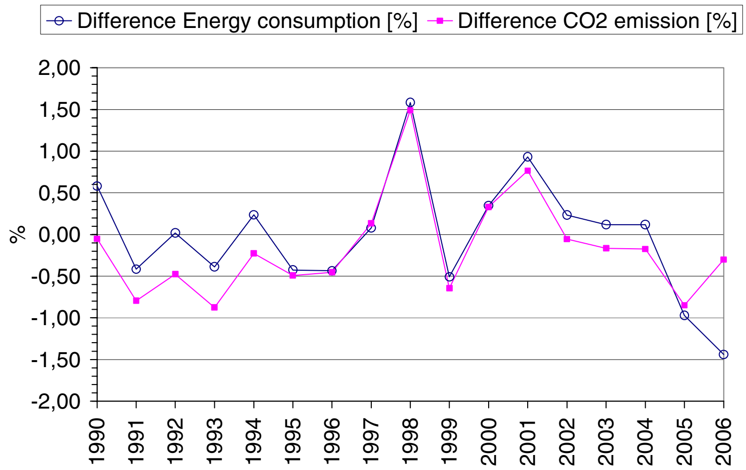

Figure 3A-37 Comparison of the reference approach and the national approach.

6.2 Key source analysis

As part of the reporting for the Climate Convention a key source analysis for the Danish emission inventory has been performed. A key source 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.

Stationary combustion key sources for greenhouse gases are shown in Table 3A-21. The CO_2 emission from eight different fuels is a key source in the Danish inventory. Furthermore, CH_4 emission is a level and trend key source due to the increase in the production of electricity from gas engines.

The key source analysis will be considered in the future QC for stationary combustion.

Table 3A-21 Key sources, stationary combustion

Source		Pollutant	Key source	Level or trend
CO_2 Emission from Stationary Combustion	Coal	CO_2	Yes	Level, Trend
CO_2 Emission from Stationary Combustion	Petroleum coke	CO_2	Yes	Level, Trend
CO_2 Emission from Stationary Combustion	Plastic waste	CO_2	Yes	Level, Trend
CO_2 Emission from Stationary Combustion	Residual oil	CO_2	Yes	Level, Trend
CO_2 Emission from Stationary Combustion	Gas oil	CO_2	Yes	Level, Trend
CO_2 Emission from Stationary Combustion	Kerosene	CO_2	Yes	Trend
CO_2 Emission from Stationary Combustion	Natural gas	CO_2	Yes	Level, Trend
CO_2 Emission from Stationary Combustion	Refinery gas	CO_2	Yes	Level
Non-CO_2 Emission from Stationary Combustion		CH_4	Yes	Level, Trend

7 Uncertainty

According to the IPCC Good Practice Guidance (IPCC 2000), uncertainty estimates should be included in the annual National Inventory Report.

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 ±7.9% and the increase in the GHG emission since 1990 has been estimated to be 4.9% ± 2.0 %-age-points.

7.1 Methodology

The Danish uncertainty estimates for GHGs are based on a methodology included 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

7.1.1 Greenhouse gases

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

- CO_2 emission from each of the fuel categories applied
- 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 the CH_4 emission from gas engines and CH_4 emission from other plants does not follow the recommendations in the IPCC Good Practice Guidance. Disaggregation is applied, because the CH_4 emission from gas engines is much larger in Denmark 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 uncertainty estimates applied 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. A country-specific uncertainty estimate will be estimated for future reporting.

Table 3A-22 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

7.1.2 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 2006 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-23. The uncertainty for fuel consumption in stationary combustion plants was assumed to be 2%.

Table 3A-23 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

7.2 Results

The uncertainty estimates for stationary combustion emission inventories are shown in Table 3A-24. Detailed calculation sheets are provided in Appendix 3A-7.

The uncertainty interval for GHG is estimated to be ±7.9% and the uncertainty for the trend in GHG emission is ±2.0%-age points. The main sources of uncertainty for the GHG emission are N_2O emission (all plants) and CO_2 emission from coal combustion. The main source of uncertainty in the trend in the GHG emission is the N_2O emission (all plants) and CO_2 emission from the combustion of coal and natural gas.

The total emission uncertainty is 7.1% for SO_2, 16% for NO_X, 42% for NMVOC and 46% for CO.

Table 3A-24 Danish uncertainty estimates, 2006.

Pollutant	Uncertainty Total emission [%]	Trend 1990-2006 [%]	Uncertainty Trend [%-age points]
GHG	7.9	4.9	± 2.0
CO_2	3.0	3.5	± 1.6
CH_4	47	280	± 222
N_2O	1000	21	± 3.8
SO_2	7.1	-89	±0.8
NO_X	16	-37	±2.5
NMVOC	42	70	±7.9
CO	46	62	±6.4

8 Improvements/recalculations since reporting in 2007

Improvements and recalculations since the 2007 emission inventory include:

- Update of fuel rates according to the latest energy statistics. The update included the years 1980-2005.
- For natural gas fired gas engines emission factors for CH_4, NMVOC, CO and NO_x were updated in connection with a research project including the higher emission factor during start-up/shut-down in the total emission factor.
- Data from the ETS has been utilised for the first time in the inventory for 2006. It was mainly coal and residual oil fuelled power plants where detailed information was available.
- Based on the in-country review in April 2007 several improvements have been made to the NIR.
    - The greenhouse gas trend discussion has been modified so that it handles each CRF subsector separately, in addition the references to the SNAP nomenclature has been toned down in favour of the CRF nomenclature.
    - A short description of the Danish energy statistics and the transfer to SNAP codes has been included as appendix.
    - As recommended by the ERT Denmark has included data from the EU ETS in the emission inventory.
    - An improved documentation for the use of town gas has been included in the NIR.

9 Future improvements

Some planned improvements of the emission inventories are discussed below.

1) Improved documentation for other 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.

2) QA/QC and validation
The work with implementing and expanding the QA/QC procedures will continue in future years.

3) 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.

4) 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.

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 24% – fossil fuel consumption, however, has increased by 13.1%. The use of coal has decreased, whereas the use of natural gas and renewable fuels has increased. The Danish fuel consumption fluctuates due to variation in the import/export of electricity from year to year.

Stationary combustion plants account for 58% of the total Danish GHG emission. 70% of the Danish CO_2 emission originates from stationary combustion plants, whereas stationary combustion plants account for 8% of the CH_4 emission and 4% of the N_2O emission.

Public power plants represent 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 are the largest stationary combustion emission source for CH_4. Furthermore, these plants are also a considerable emission source for NMVOC.

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 was higher in 2006 than in 1990, CO_2 by 4% and GHG by 5%. However, fluctuations in the GHG emission level are large. 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 has increased by a factor of 3.8 since 1990. This is a result of the considerable number of lean-burn gas engines installed in CHP plants in Denmark during this period.

The SO_2 emission from stationary combustion plants has decreased by 86% since 1990. The considerable emission decrease is largely 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 37% since 1990. The reduced emission is mainly a result of the reduced emission from electricity and heat production. The fluctuations in the emission time-series follow fluctuations in electricity import/export.

The uncertainty level for the Danish greenhouse gas emission from stationary combustion is estimated to be within a range of ±7.9% and the trend uncertainty within a range of ±2.0%-age points. The sources contributing the most to the uncertainty estimates are the N_2O emission (all plants) and the CO_2 emission from coal combustion.

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Appendixes

Appendix 3A-1 The emission inventory for Denmark for the year 2006

Table 3A-25 The emission inventory for Denmark for the year 2006

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2006
Submission 2008 v1.1
DENMARK

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)]	**55.749,21**	**5.512,77**	**6.518,03**	**834,89**	**15,68**	**35,99**	**68.666,58**
1. Energy	**55.837,72**	**594,46**	**470,34**				**56.902,52**
A. Fuel Combustion (Sectoral Approach)	55.422,99	496,89	468,07				56.387,95
1. Energy Industries	29.470,34	239,88	168,26				29.878,49
2. Manufacturing Industries and Construction	5.629,55	24,34	57,83				5.711,72
3. Transport	13.417,24	28,08	137,18				13.582,50
4. Other Sectors	6.779,39	204,46	103,56				7.087,42
5. Other	126,46	0,13	1,24				127,83
B. Fugitive Emissions from Fuels	414,74	97,57	2,26				514,57
1. Solid Fuels	NA,NO	NA,NO	NA,NO				NA,NO
2. Oil and Natural Gas	414,74	97,57	2,26				514,57
2. Industrial Processes	**1.611,40**	**IE,NA,NO**	**IE,NA,NO**	**834,89**	**15,68**	**35,99**	**2.497,97**
A. Mineral Products	1.609,22	IE,NA	IE,NA				1.609,22
B. Chemical Industry	2,18	NA,NO	NA,NO	NA	NA	NA	2,18
C. Metal Production	NA,NO	NA,NO	NO	NA,NO	NO	NA,NO	NA,NO
D. Other Production	NE						NE
E. Production of Halocarbons and SF_6				NA,NO	NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				834,89	15,68	35,99	886,57
G. Other	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**102,00**		**37,29**				**139,29**
4. Agriculture		**3.644,78**	**5.960,36**				**9.605,14**
A. Enteric Fermentation		2.602,45					2.602,45
B. Manure Management		1.042,33	518,75				1.561,08
C. Rice Cultivation		NO					NO
D. Agricultural Soils[(3)]		NE,NO	5.441,61				5.441,61
E. Prescribed Burning of Savannas		NA	NA				NA
F. Field Burning of Agricultural Residues		NA,NO	NA,NO				NA,NO
G. Other		NA	NA				NA
5. Land Use, Land-Use Change and Forestry[(1)]	**-1.801,90**	**-0,49**	**0,07**				**-1.802,32**
A. Forest Land	-2.757,66	NO	NO				-2.757,66
B. Cropland	888,16	NA	NA				888,16
C. Grassland	80,99	NA	NA				80,99
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	NO	NO	NO				NO
6. Waste	**IE,NA,NE,NO**	**1.274,02**	**49,96**				**1.323,98**
A. Solid Waste Disposal on Land	NA,NE,NO	1.028,01					1.028,01
B. Waste-water Handling		246,01	49,96				295,97
C. Waste Incineration	IE	IE	IE				IE
D. Other	NO	NO	NO				NO
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: [(4)]							
International Bunkers	6.015,95	2,81	94,40				6.113,16
Aviation	2.583,30	1,09	27,51				2.611,90
Marine	3.432,65	1,72	66,89				3.501,26
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**11.186,23**						**11.186,23**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	70.468,90
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	68.666,58

(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.

Appendix 3A-2 IPCC/SNAP source correspondence list

Table 3A-26 Correspondence list for IPCC source categories 1A1, 1A2 and 1A4 and SNAP (EMEP/Corinair 2004).

SNAP_id	SNAP_name	IPCC source
01	Combustion in energy and transformation industries	
0101	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
0102	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
0103	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
0104	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
0105	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	
0201	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
0202	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
0203	Plants in agriculture, forestry and aquaculture	1A4c
020301	Combustion plants >= 50 MW (boilers)	1A4c

Continued		
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	
0301	Comb. in boilers, gas turbines and stationary	1A2f
030101	Combustion plants >= 300 MW (boilers)	1A2f
030102	Combustion plants >= 50 and < 300 MW (boilers)	1A2f
030103	Combustion plants < 50 MW (boilers)	1A2f
030104	Gas turbines	1A2f
030105	Stationary engines	1A2f
030106	Other stationary equipments (n)	1A2f
0302	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
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 industry)(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-27 Fuel consumption rate of stationary combustion plants [TJ].

fuel	fuel	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
102	COAL	253 444	344 300	286 838	300 799	323 397	270 346	371 908	276 277	234 285	196 472	164 708	174 309	174 654	238 978	182 497	154 008	231 966
106	BROWN COAL BRI.	116	167	95	128	92	75	56	54	48	38	26	33	19	3	0	0	0
107	COKE OVEN COKE	1 276	1 450	1 181	1 155	1 226	1 273	1 226	1 253	1 346	1 423	1 187	1 110	1 068	995	1 143	980	1 011
110	PETROLEUM COKE	4 460	4 404	4 814	6 179	4 309	4 850	6 381	6 523	5 798	7 284	7 292	8 313	8 282	8 717	9 373	9 339	9 720
111	WOOD AND SIMIL.	18 247	20 042	21 031	22 220	21 940	21 845	23 389	23 459	22 938	24 403	27 522	30 867	31 630	39 002	43 649	49 653	49 789
114	MUNICIP. WASTES	15 499	16 744	17 797	19 410	20 312	22 906	24 952	26 770	26 591	29 138	30 352	32 325	35 057	36 494	37 229	37 765	39 894
117	STRAW	12 481	13 306	13 880	13 366	12 662	13 053	13 546	13 912	13 904	13 668	12 220	13 698	15 651	16 719	17 939	18 483	18 625
118	SEWAGE SLUDGE	0	0	0	0	0	0	0	0	0	0	40	375	65	55	58	58	0
203	RESIDUAL OIL	32 118	38 252	38 505	32 823	46 229	33 009	37 766	26 580	29 985	23 696	18 836	21 091	26 161	28 431	24 500	21 940	26 083
204	GAS OIL	61 449	64 998	56 102	62 025	53 930	53 698	58 019	51 071	48 425	47 555	41 260	43 668	38 674	38 955	35 919	31 852	26 795
206	KEROSENE	5 086	943	784	771	650	581	540	437	417	256	170	287	256	338	215	280	221
215	RAPE & FISH OIL	744	744	744	800	245	251	60	14	14	27	49	191	127	259	650	732	970
225	ORIMULSION	0	0	0	0	0	19 913	36 767	40 488	32 580	34 191	34 148	30 244	23 846	1 921	19	0	0
301	NATURAL GAS	76 092	86 107	90 467	102 475	114 586	132 699	156 277	164 489	178 707	187 877	186 122	193 827	193 609	196 322	194 678	187 456	191 015
303	LPG	2 596	2 549	2 315	2 371	2 398	2 638	2 870	2 363	2 413	2 177	1 885	1 610	1 477	1 554	1 669	1 671	1 720
308	REFINERY GAS	14 169	14 537	14 865	15 405	16 360	20 838	21 476	16 945	15 225	15 724	15 556	15 755	15 197	16 555	15 891	15 347	16 388
309	BIOGAS	752	910	899	1 077	1 279	1 754	1 985	2 390	2 635	2 613	2 871	3 020	3 332	3 545	3 452	3 947	3 919
Total		498 529	609 453	550 318	581 004	619 616	599 728	757 218	653 026	615 310	586 540	544 243	570 722	569 105	628 843	568 879	533 510	618 114

Table 3A-28 Detailed fuel consumption data for stationary combustion plants [TJ]

CRF	fuel_id	Fuel	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1A1a	102A	COAL	236 440	325 286	270 344	283 530	306 808	254 814	357 163	261 547	220 543	184 919	153 176	163 987	166 309	230 009	172 467	144 071	221 608
1A1a	110A	PETROLEUM COKE				1 239											7	2	0
1A1a	111A	WOOD AND SIMIL.	3 217	3 648	4 268	4 266	5 145	5 076	5 462	5 632	6 390	7 233	7 060	7 542	9 019	13 526	16 827	18 204	16 699
1A1a	114A	MUNICIP. WASTES	14 557	15 705	16 689	18 272	19 073	21 572	23 692	25 559	25 842	27 623	29 710	31 250	33 257	33 711	35 113	35 075	37 185
1A1a	117A	STRAW	4 003	4 828	5 402	5 449	5 307	6 255	7 490	7 419	7 609	7 924	7 028	8 857	10 810	11 877	13 097	13 642	13 783
1A1a	203A	RESIDUAL OIL	10 004	12 679	11 611	10 074	23 900	13 064	18 331	9 636	13 426	9 298	5 478	8 788	12 783	17 542	13 899	12 675	13 758
1A1a	204A	GAS OIL	2 241	1 306	1 464	1 271	1 321	1 146	1 808	1 529	1 586	1 201	1 513	1 833	1 023	2 613	1 570	1 130	1 254
1A1a	215A	FISH & RAPE OIL	744	744	744	800	245	251	60	14	14	27	49	191	126	259	650	731	970
1A1a	225A	ORIMULSION						19 913	36 767	40 488	32 580	34 191	34 148	30 244	23 846	1 921	19	0	0
1A1a	301A	NATURAL GAS	17 575	21 738	22 635	27 338	34 720	44 378	56 808	61 004	70 244	75 288	76 291	80 662	82 511	82 342	81 327	74 330	79 628
1A1a	303A	LPG	9	14	11	3	3	1	0	0		0	0	0	0	0	0	0	0
1A1a	308A	REFINERY GAS							35	40									
1A1a	309A	BIOGAS	266	424	412	590	782	931	1 085	1 435	1 717	1 659	1 731	1 748	1 810	1 841	1 590	1 774	1 582
1A1b	203A	RESIDUAL OIL	1 309	2 038	3 569	3 490	3 337	2 334	2 244	1 622	1 106	1 090	1 323	1 443	1 363	907	1 072	746	619
1A1b	204A	GAS OIL		40	44	29	49	33	22	87						3	9	2	10
1A1b	303A	LPG		0	5		8	15	21	18									
1A1b	308A	REFINERY GAS	13 978	14 412	14 763	15 297	16 360	20 838	21 406	16 853	15 199	15 724	15 556	15 755	15 197	16 555	15 891	15 347	16 388
1A1c	204A	GAS OIL													0	0	0	0	0
1A1c	301A	NATURAL GAS	9 484	9 707	11 122	11 239	12 270	12 910	15 248	19 877	22 065	23 984	25 370	24 778	26 571	26 583	27 440	28 124	28 729
1A1c	309A	BIOGAS	7	7	7	7	6	52	60	57	31	29	33	29	31	32	61	100	116
1A2f	102A	COAL	13 869	15 026	13 329	14 301	13 585	13 292	13 171	13 363	12 709	10 765	10 439	9 074	7 474	7 765	8 591	8 140	8 350
1A2f	106A	BROWN COAL BRI.	4	7	4	18	3	2	1	1									
1A2f	107A	COKE OV.COKE/HC	1 169	1 351	1 078	1 073	1 163	1 224	1 189	1 226	1 326	1 411	1 182	1 107	1 066	970	1 116	979	1 010
1A2f	110A	PETROLEUM COKE	2 799	2 991	3 290	3 354	3 469	3 806	5 076	5 263	4 801	6 438	6 760	7 785	7 767	7 944	8 361	7 957	8 447
1A2f	111A	WOOD AND SIMIL.	5 784	5 690	5 751	5 822	4 946	4 667	4 722	4 690	4 688	4 665	4 891	5 028	3 724	3 829	3 768	4 134	4 115
1A2f	114A	MUNICIP. WASTES	28	28	37	39	26	29	28	24	29	35	505	1 062	1 788	1 411	1 930	1 936	1 667
1A2f	117A	STRAW						3			0	0	0	0	0	0	0	0	0
1A2f	118A	SEWAGE SLUDGE											40	375	65	55	58	58	
1A2f	203A	RESIDUAL OIL	18 294	21 155	20 923	16 925	16 148	14 176	13 336	12 054	12 444	10 400	9 870	9 013	10 018	8 843	8 652	7 582	10 337
1A2f	204A	GAS OIL	544	1 377	1 441	956	825	1 472	2 270	1 906	1 818	2 561	2 280	3 028	2 378	2 677	2 567	1 715	684
1A2f	206A	KEROSENE	70	46	38	35	30	24	31	28	16	9	8	26	65	48	20	13	19
1A2f	215A	FISH & RAPE OIL													0	0	0	0	0
1A2f	301A	NATURAL GAS	22 923	24 414	24 590	26 336	31 237	34 776	35 905	38 441	40 077	43 786	41 508	43 458	40 389	40 348	39 033	38 781	37 066
1A2f	303A	LPG	1 576	1 689	1 589	1 451	1 558	1 738	1 920	1 597	1 624	1 355	1 019	761	678	730	749	740	775
1A2f	308A	REFINERY GAS	191	125	102	108	0	0	35	53	27								

Continued			1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1A2f	309A	BIOGAS	0	0	0	0	20	144	114	138	90	49	50	111	128	143	175	101	200
1A4a	102A	COAL	88	9	96	76	90	66	41	43	2						1	0	0
1A4a	106A	BROWN COAL BRI.	1	2		8	1	1	0	0									
1A4a	110A	PETROLEUM COKE	62	104	90	96	92	70	91	98	71	50	12	12	5	9	0	65	9
1A4a	111A	WOOD AND SIMIL.	204	204	204	204	216	273	449	471	495	644	776	665	673	681	681	816	952
1A4a	114A	MUNICIP. WASTES	914	1 011	1 071	1 099	1 213	1 305	1 232	1 188	720	1 480	136	13	13	1 371	186	754	1 042
1A4a	203A	RESIDUAL OIL	1 070	865	601	517	806	755	718	729	384	450	343	173	478	171	108	121	252
1A4a	204A	GAS OIL	11 795	10 623	9 064	9 009	7 348	6 576	6 680	6 152	5 496	5 820	5 030	4 730	4 076	4 319	4 432	3 804	3 061
1A4a	206A	KEROSENE	569	210	207	189	155	124	103	96	128	117	63	80	70	74	77	101	59
1A4a	301A	NATURAL GAS	6 422	7 023	7 660	9 259	7 831	9 072	11 960	10 001	9 693	8 553	8 334	8 466	8 911	10 283	10 306	10 411	11 662
1A4a	303A	LPG	83	77	77	122	125	131	138	128	117	110	122	119	137	170	215	218	211
1A4a	309A	BIOGAS	470	470	471	471	462	607	577	716	736	804	904	944	1 027	939	1 045	1 460	1 213
1A4b i	102A	COAL	589	1 125	866	786	619	377	86	86	127	79	14	13	15	0	0	8	4
1A4b	106A	BROWN COAL BRI.	51	67	39	80	76	62	47	49	44	38	26	33	19	3	0	0	0
1A4b	107A	COKE OV.COKE/HC	107	99	103	81	63	49	37	27	20	11	5	3	3	26	27	0	0
1A4b	110A	PETROLEUM COKE	761	697	961	990	748	734	929	839	726	706	513	513	509	762	1 005	1 315	1 264
1A4b	111A	WOOD AND SIMIL.	8 954	10 412	10 720	11 860	11 564	11 761	12 669	12 569	11 134	11 615	14 625	17 484	18 067	20 855	22 274	26 400	27 924
1A4b	117A	STRAW	5 087	5 087	5 087	4 750	4 414	4 077	3 633	3 892	3 773	3 443	3 112	2 901	2 901	2 901	2 901	2 901	2 905
1A4b	203A	RESIDUAL OIL	217	219	168	130	95	63	66	46	43	50	36	27	149	47	44	49	195
1A4b	204A	GAS OIL	46 463	50 638	42 914	49 967	43 679	43 288	45 296	39 595	37 850	35 675	30 276	31 506	28 998	27 027	25 291	23 863	21 197
1A4b	206A	KEROSENE	4 405	660	512	521	438	411	383	287	252	119	91	159	110	205	111	158	136
1A4b	301A	NATURAL GAS	17 362	20 441	21 939	25 680	25 759	28 042	31 886	29 875	30 732	30 567	29 063	30 782	29 504	31 538	31 397	31 009	30 068
1A4b	303A	LPG	670	522	442	673	589	628	653	510	546	624	651	649	608	596	651	667	689
1A4c	102A	COAL	2 458	2 854	2 204	2 106	2 295	1 798	1 446	1 239	904	708	1 079	1 234	856	1 203	1 437	1 790	2 004
1A4c	106A	BROWN COAL BRI.	60	92	52	22	12	10	7	4	4								
1A4c	110A	PETROLEUM COKE	837	611	473	500	0	240	286	323	201	89	6	3	0	1	0	0	0
1A4c	111A	WOOD AND SIMIL.	87	87	87	68	68	68	87	97	231	245	170	148	147	112	98	98	98
1A4c	117A	STRAW	3 391	3 391	3 391	3 167	2 942	2 718	2 422	2 600	2 521	2 301	2 080	1 940	1 940	1 940	1 940	1 940	1 937
1A4c	203A	RESIDUAL OIL	1 224	1 296	1 634	1 687	1 942	2 617	3 071	2 492	2 582	2 408	1 786	1 647	1 371	920	725	766	921
1A4c	204A	GAS OIL	406	1 014	1 176	794	708	1 182	1 944	1 801	1 675	2 297	2 161	2 570	2 198	2 316	2 050	1 337	589
1A4c	206A	KEROSENE	43	28	26	26	27	21	23	25	21	11	8	23	11	11	7	8	7
1A4c	215A	FISH & RAPE OIL											0	1	0	0	0	0	0
1A4c	301A	NATURAL GAS	2 326	2 784	2 521	2 623	2 767	3 521	4 469	5 291	5 896	5 698	5 555	5 681	5 723	5 229	5 175	4 800	3 863
1A4c	303A	LPG	259	247	192	122	116	125	137	109	126	87	93	80	55	58	53	46	46
1A4c	309A	BIOGAS	10	10	10	10	10	20	149	44	61	72	153	189	336	590	581	512	808

Appendix 3A-4 Emission factors

Table 3A-29 CO_2 emission factors.

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

* Data from the EU ETS were incorporated in the emission inventory. Coal emission factors ranged from 90.01 to 95.31 kg/GJ. Residual oil emission factors ranged from 77.34 to 80.34 kg/GJ.

Time-series for natural gas and municipal waste are shown below. All other emission factors are the same for 1990-2006.

Table 3A-30 CO_2 emission factors, time-series.

Year	Natural gas [kg/GJ]	Municipal waste, plastic [kg/GJ]	Municipal waste biomass [kg/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

Table 3A-31 CH_4 emission factors and references 2006.

Fuel	ipcc_id	SNAP_id	Emission factor [g/GJ]	Reference
COAL	1A1a	010101, 010102, 010103	1.5	EMEP/Corinair 2004
COAL	1A1a, 1A2f, 1A4b, 1A4c	010202, 010203, 0301, 0202, 0203	15	EMEP/Corinair 2004
BROWN COAL BRI.	all	All	15	EMEP/Corinair 2004, assuming same emission factor as for coal
COKE OVEN COKE	all	All	15	EMEP/Corinair 2004, assuming same emission factor as for coal
PETROLEUM COKE	all	All	15	EMEP/Corinair 2004
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	2	Nielsen & Illerup 2003
WOOD AND SIMIL.	1A4a, 1A4b, 1A4c	0201, 0202, 0203	200	EMEP/Corinair 2004
WOOD AND SIMIL.	1A1a, 1A2f	010105, 010202, 010203, 0301, 030102, 030103	32	EMEP/Corinair 2004
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	0.59	Nielsen & Illerup 2003
MUNICIP. WASTES	1A1a, 1A2f, 1A4a	all other	6	EMEP/Corinair 2004
STRAW	1A1a	010102, 010103	0.5	Nielsen & Illerup 2003
STRAW	1A1a, 1A2f, 1A4c	010202, 010203, 020302, 030105	32	EMEP/Corinair 2004
STRAW	1A4b, 1A4c	0202, 0203	200	EMEP/Corinair 2004
RESIDUAL OIL	all	All	3	EMEP/Corinair 2004
GAS OIL	all	All	1.5	EMEP/Corinair 2004
KEROSENE	all	All	7	EMEP/Corinair 2004
FISH & RAPE OIL	all	All	1.5	EMEP/Corinair 2004, assuming same emission factor as gas oil
ORIMULSION	1A1a	010101	3	EMEP/Corinair 2004, assuming same emission factor as residual oil
NATURAL GAS	1A1a	0101, 010101, 010102, 010202	6	DGC 2001
NATURAL GAS	1A1a	010103, 010203	15	Gruijthuijsen & Jensen 2000
NATURAL GAS	1A1a, 1Ac, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010504, 030104, 020104, 020303	1.5	Nielsen & Illerup 2003
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	1) 465	Nielsen et al., 2008
NATURAL GAS	1A1c, 1A2f, 1A4a, 1A4b, 1A4c	010502, 0301, 0201, 0202, 0203	6	DGC 2001
NATURAL GAS	1A2f, 1A4a, 1A4b	030103, 030106, 020103, 020202	15	Gruijthuijsen & Jensen 2000
LPG	all	All	1	EMEP/Corinair 2004
REFINERY GAS	1A1b	010304	1.5	EMEP/Corinair 2004
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010505, 030105, 020105, 020304	1) 323	Nielsen & Illerup 2003
BIOGAS	1A1a, 1A2f, 1A4a, 1A4c	all other	4	EMEP/Corinair 2004

1) 2006 emission factor. Time-series is shown below

Time-series for CH_4 emission factors for gas engines are shown below. All other CH_4 emission factors are the same for 1990-2006.

Table 3A-32 CH_4 emission factors, time-series.

Year	Natural gas fuelled engines Emission factor [g/GJ]	Biogas fuelled engines Emission factor [g/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

Table 3A-33 N_2O emission factors and references 2006.

Fuel	ipcc_id	SNAP_id	Emission factor [g/GJ]	Reference
COAL	1A1a	0101**	0.8	Elsam 2005
COAL	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	All except 0101**	3	EMEP/Corinair 2004
BROWN COAL BRI.	all	All	3	EMEP/Corinair 2004
COKE OVEN COKE	all	All	3	EMEP/Corinair 2004
PETROLEUM COKE	all	All	3	EMEP/Corinair 2004
WOOD AND SIMIL.	1A1a	010102, 010103, 010104	0.8	Nielsen & Illerup 2003
WOOD AND SIMIL.	1A1a	010105, 010202, 010203	4	EMEP/Corinair 2004
WOOD AND SIMIL.	1A2f, 1A4a, 1A4b, 1A4c	All	4	EMEP/Corinair 2004
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	1.2	Nielsen & Illerup 2003
MUNICIP. WASTES	1A1a	010203	4	EMEP/Corinair 2004
MUNICIP. WASTES	1A2f, 1A4a	030102, 0201, 020103	4	EMEP/Corinair 2004
STRAW	1A1a	010102, 010103	1.4	Nielsen & Illerup 2003
STRAW	1A1a	010202, 010203	4	EMEP/Corinair 2004
STRAW	1A2f, 1A4b, 1A4c	All	4	EMEP/Corinair 2004
RESIDUAL OIL	all	All	2	EMEP/Corinair 2004
GAS OIL	all	All	2	EMEP/Corinair 2004
KEROSENE	all	All	2	EMEP/Corinair 2004
FISH & RAPE OIL	all	All	2	EMEP/Corinair 2004, assuming same emission factor as gas oil
ORIMULSION	1A1a	010101	2	EMEP/Corinair 2004, assuming same emission factor as residual oil
NATURAL GAS	1A1a	0101, 010101, 010102, 010103, 010202, 010203	1	EMEP/Corinair 2004
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas turbines: 010104, 010504, 030104, 020104, 020303	2.2	Nielsen & Illerup 2003
NATURAL GAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	1.3	Nielsen & Illerup 2003
NATURAL GAS	1A1c, 1A2f, 1A4a, 1A4b, 1A4c	010502, 0301, 030103, 030106, 0201, 020103, 0202, 020202, 0203	1	EMEP/Corinair 2004
LPG	all	All	2	EMEP/Corinair 2004
REFINERY GAS	all	All	2.2	EMEP/Corinair 2004
BIOGAS	1A1a	010102, 010103, 010203	2	EMEP/Corinair 2004
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010505, 030105, 020105, 020304	0.5	Nielsen & Illerup 2003
BIOGAS	1A2f, 1A4a, 1A4c	0301, 030102, 0201, 020103, 0203	2	EMEP/Corinair 2004

The same N_2O emission factors are applied for 1990-2006.

Table 3A-34 SO_2, NO_X, NMVOC and CO emission factors and references 2006

Fuel	IPCC sector	SNAP	SO_2 [g/GJ]	Ref.	NO_X [g/GJ]	Ref.	NMVOC [g/GJ]	Ref.	CO [g/GJ]	Ref.
COAL	1A1a	010101, 010102, 010103	37	18	109	18	1.5	1	10	3
COAL	1A1a, 1A2f, 1A4c	010202, 010203, 0301, 0203	574	19	95	4	15	1	10	1
COAL	1A4b	0202	574	19	95	4	15	1	2000	32
BROWN COAL BRI.	1A4b	0202	574	29	95	29	15	29	2000	29
COKE OVEN COKE	1A2f	0301	574	29	95	29	15	29	10	29
COKE OVEN COKE	1A4b	0202	574	29	95	29	15	29	2000	29
PETROLEUM COKE	1A2f	0301	605	20	95	29	1.5	1	61	4
PETROLEUM COKE	1A4a, 1A4b, 1A4c	0201, 0202, 0203	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	010105	25	22, 21	90	22, 21, 4	48	1	50	3
WOOD AND SIMIL.	1A1a, 1A2f	010202, 010203, 0301, 030102, 030103	25	22, 21	90	22, 21, 4	48	1	240	4
WOOD AND SIMIL.	1A4a, 1A4c	0201, 020105, 0203	25	22, 21	90	22, 21, 4	600	1	240	4
WOOD AND SIMIL.	1A4b	0202	25	22, 21	120	22	538	40	9000	12, 13
MUNICIP. WASTES	1A1a	010102, 010103, 010104, 010105	23.9	31	124	31	0.98	31	7.4	31
MUNICIP. WASTES	1A1a, 1A2f, 1A4a	010203, 030102, 0201, 020103	67	9	164	9	9	1	10	9
STRAW	1A1a	010102, 010103	47.1	31	131	31	0.8	31	63	31
STRAW	1A1a, 1A2f, 1A4c	010202, 010203, 030105, 020302	130	5	90	4, 28	50	1	325	4, 5
STRAW	1A4b, 1A4c	0201, 0203	130	5	90	4, 28	600	1	4000	1,6,7
RESIDUAL OIL	1A1a	0101, 010101, 010102, 010103, 010104, 010105	308	18	109	18	3	1	15	3
RESIDUAL OIL	1A1a, 1A4a, 1A4b, 1A4c	010202, 010203, 0201, 0202, 0203, 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	1A2f	0301, 030102, 030103	344	25, 10, 24	130	28	3	1	30	1
RESIDUAL OIL	1A2f	030104	344	25, 10, 24	130	28	3	1	15	1
RESIDUAL OIL	1A2f	030105	344	25, 10, 24	130	28	3	1	100	1

Continued										
Fuel	**IPCC sector**	**SNAP**	**SO_2 [g/GJ]**	**Ref.**	**NO_X [g/GJ]**	**Ref.**	**NMVOC [g/GJ]**	**Ref.**	**CO [g/GJ]**	**Ref.**
RESIDUAL OIL	1A4c	020304	344	25, 10, 24	142	4	3	1	100	1
GAS OIL	1A1a	0101, 010101, 010102	23	27	249	18	1.5	1	15	3
GAS OIL	1A1a, 1A2f	Gas turbines: 010104, 030104	23	27	350	9	2	1	15	3
GAS OIL	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Engines: 010105, 010205, 010505, 030105, 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	010202, 010203, 010306, 0301, 030102, 030103, 030106	23	27	65	28	1.5	1	30	1
GAS OIL	1A4a, 1A4c	0201, 020103, 0203	23	27	52	4	3	1	30	1
GAS OIL	1A4b	0202	23	27	52	4	3	1	43	1
KEROSENE	all	all	5	30	50	1	3	1	20	1
FISH & RAPE OIL	1A1a	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	1A2f, 1A4c	030105, 020304	1	37	700	15	100	15	100	15
ORIMULSION	1A1a	010101	12	34	86	34	3	16	15	16
NATURAL GAS	1A1a	0101, 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, 1A2f, 1A4a, 1A4b, 1A4c	Gas engines: 010105, 010205, 010505, 030105, 020105, 020204, 020304	0.3	17	148	39	105	39	115	39
NATURAL GAS	1A1a, 1A2f	010103, 010202, 010203, 0301, 030103, 030106	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	0201, 020103, 0203	0.3	17	30	1, 4, 11	2	14	28	4
NATURAL GAS	1A4b	0202, 020202	0.3	17	30	1, 4, 11	4	11	20	11
LPG	1A1a, 1A2f	010203, 0301	0.13	23	96	32	2	1	25	1
LPG	1A4a, 1A4c	0201, 0203	0.13	23	71	32	2	1	25	1
LPG	1A4b	0202	0.13	23	47	32	2	1	25	1
REFINERY GAS	1A1b	010304	1	2	170	9	1.4	35	6.2	35

Continued

Fuel	IPCC sector	SNAP	SO_2 [g/GJ]	Ref.	NO_X [g/GJ]	Ref.	NMVOC [g/GJ]	Ref.	CO [g/GJ]	Ref.
BIOGAS	1A1a, 1A2f, 1A4a, 1A4c	010102, 010103, 010203, 0301, 0201, 020103, 0203	25	26	28	4	4	1	36	4
BIOGAS	1A1a, 1A1c, 1A2f, 1A4a, 1A4c	Gas engines: 010105, 010505, 030105, 020105, 020304	19.2	31	540	31	14	31	273	31
BIOGAS	1A2f	030102	25	26	59	4	4	1	36	4

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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
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 (11-04-2005)
33. NERI calculation based on plant specific data 2003
34. NERI calculation based on plant specific data 2002
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 value is not correct – the emission factor 65 g/GJ will be applied in future inventories.
39. Nielsen et al., 2008: Revised emission factors for gas engines including start/stop emissions. NERI technical report (In press)

Table 3A-35a SO_2, NO_X, NMVOC and CO emission factors time-series for 1990 to 1999 [g/GJ].

pol.	fuel	snap_id	ipcc_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SO_2	COAL	0101	1A1a	506	571	454	386						
SO_2	COAL	010101	1A1a	506	571	454	386	343	312	420	215	263	193
SO_2	COAL	010102	1A1a	506	571	454	386	343	312	420	215	263	193
SO_2	COAL	010103	1A1a					343	312	420	215	263	193
SO_2	COAL	010104	1A1a					343	312	420	215		
SO_2	PETROLEUM COKE	0201	1A4a	787	787	787	787	787	787	787	787	787	787
SO_2	PETROLEUM COKE	0202	1A4b	787	787	787	787	787	787	787	787	787	787
SO_2	PETROLEUM COKE	0203	1A4c	787	787	787	787	787	787	787	787	787	787
SO_2	PETROLEUM COKE	0301	1A2f	787	787	787	787	787	787	787	787	787	787
SO_2	MUNICIP. WASTES	0101	1A1a	138	116	95	73						
SO_2	MUNICIP. WASTES	010102	1A1a		116	95	73	52	30			26	25
SO_2	MUNICIP. WASTES	010103	1A1a					52	30	29	28	26	25
SO_2	MUNICIP. WASTES	010104	1A1a					52	30	29	28	26	25
SO_2	MUNICIP. WASTES	010105	1A1a										
SO_2	MUNICIP. WASTES	0102	1A1a	138	131	124	117	110	103	95	88		
SO_2	MUNICIP. WASTES	010202	1A1a					110	103				
SO_2	MUNICIP. WASTES	010203	1A1a					110	103	95	88	81	74
SO_2	MUNICIP. WASTES	0201	1A4a	138	131	124	117	110	103	95	88	81	74
SO_2	MUNICIP. WASTES	020103	1A4a					110	103	95	88	81	74
SO_2	MUNICIP. WASTES	0301	1A2f	138	131	124	117	110	103	95	88	81	74
SO_2	RESIDUAL OIL	0101	1A1a	446	470	490	475						
SO_2	RESIDUAL OIL	010101	1A1a						351	408	344	369	369
SO_2	RESIDUAL OIL	010102	1A1a	446	470	490	475	1564	351	408	344	369	369
SO_2	RESIDUAL OIL	010103	1A1a					1564	351	408	344	369	369
SO_2	RESIDUAL OIL	010104	1A1a					1564	351	408	344	369	369
SO_2	RESIDUAL OIL	010105	1A1a	446	470	490	475	1564	351	408	344	369	369
SO_2	RESIDUAL OIL	0102	1A1a	495	495	495	495	495	495	495	344		
SO_2	RESIDUAL OIL	010202	1A1a					495	495	495	344	344	344
SO_2	RESIDUAL OIL	010203	1A1a					495	495	495	344	344	344
SO_2	RESIDUAL OIL	010306	1A1b	643	38	222	389				537	537	537
SO_2	RESIDUAL OIL	0201	1A4a	495	495	495	495	495	495	495	344	344	344
SO_2	RESIDUAL OIL	020103	1A4a					495	495				
SO_2	RESIDUAL OIL	0202	1A4b	495	495	495	495	495	495	495	344	344	344
SO_2	RESIDUAL OIL	0203	1A4c	495	495	495	495	495	495	495	344	344	344
SO_2	RESIDUAL OIL	020302	1A4c									344	344
SO_2	RESIDUAL OIL	020304	1A4c									344	344
SO_2	RESIDUAL OIL	0301	1A2f	495	495	495	495	495	495	495	344	344	344
SO_2	RESIDUAL OIL	030102	1A2f					495	495	495	344	344	344
SO_2	RESIDUAL OIL	030103	1A2f					495	495	495	344	344	344
SO_2	GAS OIL	0101	1A1a	94	94	94	94						
SO_2	GAS OIL	010101	1A1a					94	23	23	23	23	23
SO_2	GAS OIL	010102	1A1a	94	94	94	94	94	23	23	23	23	23
SO_2	GAS OIL	010103	1A1a					94	23	23	23	23	23
SO_2	GAS OIL	010104	1A1a	94	94	94	94	94	23	23	23	23	23
SO_2	GAS OIL	010105	1A1a	94	94	94	94	94	23	23	23	23	23
SO_2	GAS OIL	0102	1A1a	94	94	94	94	94	23	23	23		
SO_2	GAS OIL	010201	1A1a					94	23				
SO_2	GAS OIL	010202	1A1a					94	23	23	23	23	23
SO_2	GAS OIL	010203	1A1a					94	23	23	23	23	23
SO_2	GAS OIL	010205	1A1a					94					23
SO_2	GAS OIL	010306	1A1b		94	94	94	94	23	23	23		
SO_2	GAS OIL	010505	1A1c										
SO_2	GAS OIL	0201	1A4a	94	94	94	94	94	23	23	23	23	23
SO_2	GAS OIL	020102	1A4a					94		23		23	
SO_2	GAS OIL	020103	1A4a					94		23	23	23	23
SO_2	GAS OIL	020105	1A4a			94	94	94	23	23	23	23	23
SO_2	GAS OIL	0202	1A4b	94	94	94	94	94	23	23	23	23	23
SO_2	GAS OIL	0203	1A4c	94	94	94	94	94	23	23	23	23	23
SO_2	GAS OIL	0301	1A2f	94	94	94	94	94	23	23	23	23	23
SO_2	GAS OIL	030103	1A2f					94	23	23	23	23	23
SO_2	GAS OIL	030105	1A2f			94	94	94					
SO_2	GAS OIL	030106	1A2f	94	94	94	94	94	23	23	23	23	23
SO_2	ORIMULSION	010101	1A1a							147	149		
NO_x	COAL	0101	1A1a	342	384	294	289						
NO_x	COAL	010101	1A1a	342	384	294	289	267	239	250	200	177	152
NO_x	COAL	010102	1A1a	342	384	294	289	267	239	250	200	177	152
NO_x	COAL	010103	1A1a					267	239	250	200	177	152

Continued													
pol.	**fuel**	**snap_id**	**ipcc_id**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
NO_x	COAL	010104	1A1a					267	239	250	200		
NO_x	COAL	010202	1A1a					200	200	200	200	200	200
NO_x	COAL	010203	1A1a					200	200	200	200	200	200
NO_x	COAL	0201	1A4a	200	200	200	200	200	200	200	200	200	
NO_x	COAL	0202	1A4b	200	200	200	200	200	200	200	200	200	200
NO_x	COAL	0203	1A4c	200	200	200	200	200	200	200	200	200	200
NO_x	COAL	0301	1A2f	200	200	200	200	200	200	200	200	200	200
NO_x	BROWN COAL BRI.	0202	1A4b	200	200	200	200	200	200	200	200	200	200
NO_x	COKE OVEN COKE	0202	1A4b	200	200	200	200	200	200	200	200	200	200
NO_x	COKE OVEN COKE	0301	1A2f	200	200	200	200	200	200	200	200	200	200
NO_x	PETROLEUM COKE	0301	1A2f	200	200	200	200	200	200	200	200	200	200
NO_x	WOOD AND SIMIL.	010202	1A1a					130	130	130	130	130	90
NO_x	WOOD AND SIMIL.	010203	1A1a					130	130	130	130	130	90
NO_x	WOOD AND SIMIL.	0201	1A4a	130	130	130	130	130	130	130	130	130	90
NO_x	WOOD AND SIMIL.	020105	1A4a									130	90
NO_x	WOOD AND SIMIL.	0203	1A4c	130	130	130	130	130	130	130	130	130	90
NO_x	WOOD AND SIMIL.	020304	1A4c									130	90
NO_x	WOOD AND SIMIL.	0301	1A2f	130	130	130	130	130	130	130	130	130	90
NO_x	WOOD AND SIMIL.	030102	1A2f									130	90
NO_x	WOOD AND SIMIL.	030103	1A2f					130	130	130	130	130	90
NO_x	RESIDUAL OIL	0101	1A1a	342	384	294	289						
NO_x	RESIDUAL OIL	010101	1A1a						239	250	200	177	152
NO_x	RESIDUAL OIL	010102	1A1a	342	384	294	289	267	239	250	200	177	152
NO_x	RESIDUAL OIL	010103	1A1a					267	239	250	200	177	152
NO_x	RESIDUAL OIL	010104	1A1a					267	239	250	200	177	152
NO_x	RESIDUAL OIL	010105	1A1a	342	384	294	289	267	239	250	200	177	152
NO_x	GAS OIL	010103	1A1a					80	75	65	65	65	65
NO_x	GAS OIL	0102	1A1a	100	95	90	85	80	75	70	65		
NO_x	GAS OIL	010201	1A1a					80	75				
NO_x	GAS OIL	010202	1A1a					80	75	70	65	65	65
NO_x	GAS OIL	010203	1A1a					80	75	70	65	65	65
NO_x	GAS OIL	010306	1A1b		95	90	85	80	75	70	65		
NO_x	GAS OIL	0301	1A2f	100	95	90	85	80	75	70	65	65	65
NO_x	GAS OIL	030102	1A2f						75			65	65
NO_x	GAS OIL	030103	1A2f					80	75	70	65	65	65
NO_x	GAS OIL	030106	1A2f	100	95	90	85	80	75	70	65	65	65
NO_x	FISH & RAPE OIL	0102	1A1a	100	95	90	85						
NO_x	FISH & RAPE OIL	010203	1A1a					80	75	70	65	65	65
NO_x	ORIMULSION	010101	1A1a							139	138		
NO_x	NATURAL GAS	0101	1A1a								115	115	115
NO_x	NATURAL GAS	010101	1A1a					115			115		
NO_x	NATURAL GAS	010102	1A1a	115	115	115	115	115	115			115	115
NO_x	NATURAL GAS	010104	1A1a	161	157	153	149	145	141	138	134	131	127
NO_x	NATURAL GAS	010105	1A1a	276	241	235	214	199	194	193	170	167	167
NO_x	NATURAL GAS	010205	1A1a					199	194	193	170	167	167
NO_x	NATURAL GAS	010505	1A1c	276	241	235	214	199	194	193	170	167	167
NO_x	NATURAL GAS	020104	1A4a		157			145	141	138	134	131	127
NO_x	NATURAL GAS	020105	1A4a	276	241	235	214	199	194	193	170	167	167
NO_x	NATURAL GAS	020204	1A4b	276	241	235	214	199	194	193	170	167	167
NO_x	NATURAL GAS	020303	1A4c						141	138	134	131	127
NO_x	NATURAL GAS	020304	1A4c	276	241	235	214	199	194	193	170	167	167
NO_x	NATURAL GAS	030104	1A2f	161				145	141	138	134	131	127
NO_x	NATURAL GAS	030105	1A2f	276	241	235	214	199	194	193	170	167	167
NO_x	BIOGAS	010105	1A1a	711	696	681	665	650	635	616	597	578	559
NO_x	BIOGAS	010505	1A1c	711	696	681	665	650	635	616	597	578	559
NO_x	BIOGAS	020105	1A4a	711	696	681	665	650	635	616	597	578	559
NO_x	BIOGAS	020304	1A4c	711	696	681	665	650	635	616	597	578	559
NO_x	BIOGAS	030105	1A2f									578	559
NMVOC	WOOD AND SIMIL.	0202	1A4b	704	704	704	704	704	704	704	704	704	704
NMVOC	NATURAL GAS	010105	1A1a	60	69	81	127	140	142	138	124	122	122
NMVOC	NATURAL GAS	010205	1A1a	60	69	81	127	140	142	138	124	122	122
NMVOC	NATURAL GAS	010505	1A1c	60	69	81	127	140	142	138	124	122	122
NMVOC	NATURAL GAS	020105	1A4a	60	69	81	127	140	142	138	124	122	122
NMVOC	NATURAL GAS	020204	1A4b	60	69	81	127	140	142	138	124	122	122
NMVOC	NATURAL GAS	020304	1A4c	60	69	81	127	140	142	138	124	122	122
NMVOC	NATURAL GAS	030105	1A2f	60	69	81	127	140	142	138	124	122	122
CO	WOOD AND SIMIL.	0102	1A1a	400	373	347	320	293	267	240	240		

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pol.	fuel	snap_id	ipcc_id	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CO	WOOD AND SIMIL.	010202	1A1a					293	267	240	240	240	240
CO	WOOD AND SIMIL.	010203	1A1a					293	267	240	240	240	240
CO	WOOD AND SIMIL.	0201	1A4a	400	373	347	320	293	267	240	240	240	240
CO	WOOD AND SIMIL.	0203	1A4c	400	373	347	320	293	267	240	240	240	240
CO	WOOD AND SIMIL.	0301	1A2f	400	373	347	320	293	267	240	240	240	240
CO	WOOD AND SIMIL.	030103	1A2f					293	267	240	240	240	240
CO	MUNICIP. WASTES	0102	1A1a	100	85	70	55	40	25	10	10		
CO	MUNICIP. WASTES	010201	1A1a					40					
CO	MUNICIP. WASTES	010202	1A1a					40	25				
CO	MUNICIP. WASTES	010203	1A1a					40	25	10	10	10	10
CO	MUNICIP. WASTES	0201	1A4a	100	85	70	55	40	25	10	10	10	10
CO	MUNICIP. WASTES	020103	1A4a					40	25	10	10	10	10
CO	MUNICIP. WASTES	0301	1A2f	100	85	70	55	40	25	10	10	10	10
CO	STRAW	0102	1A1a	600	554	508	463	417	371	325	325		
CO	STRAW	010202	1A1a					417	371	325	325	325	325
CO	STRAW	010203	1A1a					417	371	325	325	325	325
CO	STRAW	0202	1A4b	8500	8500	8500	8500	8500	7500	6500	5500	4500	4000
CO	STRAW	0203	1A4c	8500	8500	8500	8500	8500	7500	6500	5500	4500	4000
CO	NATURAL GAS	010105	1A1a	189	211	212	227	226	222	221	182	182	182
CO	NATURAL GAS	010205	1A1a	189	211	212	227	226	222	221	182	182	182
CO	NATURAL GAS	010505	1A1c	189	211	212	227	226	222	221	182	182	182
CO	NATURAL GAS	020105	1A4a	189	211	212	227	226	222	221	182	182	182
CO	NATURAL GAS	020204	1A4b	189	211	212	227	226	222	221	182	182	182
CO	NATURAL GAS	020304	1A4c	189	211	212	227	226	222	221	182	182	182
CO	NATURAL GAS	030105	1A2f	189	211	212	227	226	222	221	182	182	182
CO	BIOGAS	010105	1A1a	230	234	239	243	248	252	256	260	265	269
CO	BIOGAS	010505	1A1c	230	234	239	243	248	252	256	260	265	269
CO	BIOGAS	020105	1A4a	230	234	239	243	248	252	256	260	265	269
CO	BIOGAS	020304	1A4c	230	234	239	243	248	252	256	260	265	269
CO	BIOGAS	030105	1A2f									265	269

Table 3A-35b SO_2, NO_X, NMVOC and CO emission factors time-series for 2000 to 2006 [g/GJ]

pol.	fuel	snap_id	ipcc_id	2000	2001	2002	2003	2004	2005	2006
SO_2	COAL	0101	1A1a							
SO_2	COAL	010101	1A1a	64	47	45	61	42	41	37
SO_2	COAL	010102	1A1a	64	47	45	61	42	41	37
SO_2	COAL	010103	1A1a	64	47	45	61	42	41	37
SO_2	COAL	010104	1A1a							
SO_2	PETROLEUM COKE	0201	1A4a	787	605	605	605	605	605	605
SO_2	PETROLEUM COKE	0202	1A4b	787	605	605	605	605	605	605
SO_2	PETROLEUM COKE	0203	1A4c	787	605	605	605	605	605	605
SO_2	PETROLEUM COKE	0301	1A2f	787	605	605	605	605	605	605
SO_2	MUNICIP. WASTES	0101	1A1a							
SO_2	MUNICIP. WASTES	010102	1A1a	23,9	23,9	23,9	23,9	23,9	23,9	23,9
SO_2	MUNICIP. WASTES	010103	1A1a	23,9	23,9	23,9	23,9	23,9	23,9	23,9
SO_2	MUNICIP. WASTES	010104	1A1a	23,9	23,9	23,9	23,9	23,9	23,9	23,9
SO_2	MUNICIP. WASTES	010105	1A1a	23,9	23,9	23,9	23,9	23,9	23,9	23,9
SO_2	MUNICIP. WASTES	0102	1A1a							
SO_2	MUNICIP. WASTES	010202	1A1a							
SO_2	MUNICIP. WASTES	010203	1A1a	67	67	67	67	67	67	67
SO_2	MUNICIP. WASTES	0201	1A4a	67	67	67	67	67	67	67
SO_2	MUNICIP. WASTES	020103	1A4a	67	67	67	67	67	67	67
SO_2	MUNICIP. WASTES	0301	1A2f							
SO_2	RESIDUAL OIL	0101	1A1a	403	315	290	334	349	283	308
SO_2	RESIDUAL OIL	010101	1A1a	403	315	290	334	349	283	308
SO_2	RESIDUAL OIL	010102	1A1a	403	315	290	334	349	283	308
SO_2	RESIDUAL OIL	010103	1A1a	403	315	290	334	349	283	308
SO_2	RESIDUAL OIL	010104	1A1a	403	315	290	334	349	283	308
SO_2	RESIDUAL OIL	010105	1A1a	403	315	290	334	349	283	308
SO_2	RESIDUAL OIL	0102	1A1a							
SO_2	RESIDUAL OIL	010202	1A1a	344	344	344	344	344	344	344
SO_2	RESIDUAL OIL	010203	1A1a	344	344	344	344	344	344	344
SO_2	RESIDUAL OIL	010306	1A1b	537	537	537	537	537	537	537
SO_2	RESIDUAL OIL	0201	1A4a	344	344	344	344	344	344	344
SO_2	RESIDUAL OIL	020103	1A4a							
SO_2	RESIDUAL OIL	0202	1A4b	344	344	344	344	344	344	344
SO_2	RESIDUAL OIL	0203	1A4c	344	344	344	344	344	344	344
SO_2	RESIDUAL OIL	020302	1A4c	344	344	344	344	344	344	344
SO_2	RESIDUAL OIL	020304	1A4c	344	344	344	344	344	344	344
SO_2	RESIDUAL OIL	0301	1A2f	344	344	344	344	344	344	344
SO_2	RESIDUAL OIL	030102	1A2f	344	344	344	344	344	344	344
SO_2	RESIDUAL OIL	030103	1A2f	344	344	344	344	344	344	344
SO_2	GAS OIL	0101	1A1a	23	23	23	23	23	23	23
SO_2	GAS OIL	010101	1A1a	23	23	23	23	23	23	23
SO_2	GAS OIL	010102	1A1a	23	23	23	23	23	23	23
SO_2	GAS OIL	010103	1A1a	23	23	23	23	23	23	23
SO_2	GAS OIL	010104	1A1a	23	23	23	23	23	23	23
SO_2	GAS OIL	010105	1A1a	23	23	23	23	23	23	23
SO_2	GAS OIL	0102	1A1a							
SO_2	GAS OIL	010201	1A1a					23	23	23
SO_2	GAS OIL	010202	1A1a	23	23	23	23	23	23	23
SO_2	GAS OIL	010203	1A1a	23	23	23	23	23	23	23
SO_2	GAS OIL	010205	1A1a	23	23	23	23	23	23	23
SO_2	GAS OIL	010306	1A1b				23	23	23	23
SO_2	GAS OIL	010505	1A1c			23	23	23	23	23
SO_2	GAS OIL	0201	1A4a	23	23	23	23	23	23	23
SO_2	GAS OIL	020102	1A4a							
SO_2	GAS OIL	020103	1A4a	23	23	23	23	23	23	23
SO_2	GAS OIL	020105	1A4a	23	23	23	23	23	23	23
SO_2	GAS OIL	0202	1A4b	23	23	23	23	23	23	23
SO_2	GAS OIL	0203	1A4c	23	23	23	23	23	23	23
SO_2	GAS OIL	0301	1A2f	23	23	23	23	23	23	23
SO_2	GAS OIL	030103	1A2f	23	23	23	23	23	23	23
SO_2	GAS OIL	030105	1A2f	23	23	23	23	23	23	23
SO_2	GAS OIL	030106	1A2f	23	23	23	23	23	23	23
SO_2	ORIMULSION	010101	1A1a		10	12	12	12	12	12
NO_x	COAL	0101	1A1a							
NO_x	COAL	010101	1A1a	129	122	130	144	131	127	109
NO_x	COAL	010102	1A1a	129	122	130	144	131	127	109
NO_x	COAL	010103	1A1a	129	122	130	144	131	127	109

Continued										
pol.	**fuel**	**snap_id**	**ipcc_id**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
NO_x	COAL	010104	1A1a							
NO_x	COAL	010202	1A1a	95	95	95	95	95	95	95
NO_x	COAL	010203	1A1a	95	95	95	95	95	95	95
NO_x	COAL	0201	1A4a					95	95	95
NO_x	COAL	0202	1A4b	95	95	95	95	95	95	95
NO_x	COAL	0203	1A4c	95	95	95	95	95	95	95
NO_x	COAL	0301	1A2f	95	95	95	95	95	95	95
NO_x	BROWN COAL BRI.	0202	1A4b	95	95	95	95	95	95	95
NO_x	COKE OVEN COKE	0202	1A4b	95	95	95	95	95	95	95
NO_x	COKE OVEN COKE	0301	1A2f	95	95	95	95	95	95	95
NO_x	PETROLEUM COKE	0301	1A2f	95	95	95	95	95	95	95
NO_x	WOOD AND SIMIL.	010202	1A1a	90	90	90	90	90	90	90
NO_x	WOOD AND SIMIL.	010203	1A1a	90	90	90	90	90	90	90
NO_x	WOOD AND SIMIL.	0201	1A4a	90	90	90	90	90	90	90
NO_x	WOOD AND SIMIL.	020105	1A4a		90	90	90	90	90	90
NO_x	WOOD AND SIMIL.	0203	1A4c	90	90	90	90	90	90	90
NO_x	WOOD AND SIMIL.	020304	1A4c	90	90					
NO_x	WOOD AND SIMIL.	0301	1A2f	90	90	90	90	90	90	90
NO_x	WOOD AND SIMIL.	030102	1A2f	90	90	90	90	90	90	90
NO_x	WOOD AND SIMIL.	030103	1A2f	90	90	90	90	90	90	90
NO_x	RESIDUAL OIL	0101	1A1a	129	122	130	144	131	127	109
NO_x	RESIDUAL OIL	010101	1A1a	129	122	130	144	131	127	109
NO_x	RESIDUAL OIL	010102	1A1a	129	122	130	144	131	127	109
NO_x	RESIDUAL OIL	010103	1A1a	129	122	130	144	131	127	109
NO_x	RESIDUAL OIL	010104	1A1a	129	122	130	144	131	127	109
NO_x	RESIDUAL OIL	010105	1A1a	129	122	130	144	131	127	109
NO_x	GAS OIL	010103	1A1a	65	65	65	65	65	65	65
NO_x	GAS OIL	0102	1A1a							
NO_x	GAS OIL	010201	1A1a					65	65	65
NO_x	GAS OIL	010202	1A1a	65	65	65	65	65	65	65
NO_x	GAS OIL	010203	1A1a	65	65	65	65	65	65	65
NO_x	GAS OIL	010306	1A1b				65	65	65	65
NO_x	GAS OIL	0301	1A2f	65	65	65	65	65	65	65
NO_x	GAS OIL	030102	1A2f	65	65	65	65	65	65	65
NO_x	GAS OIL	030103	1A2f	65	65	65	65	65	65	65
NO_x	GAS OIL	030106	1A2f	65	65	65	65	65	65	65
NO_x	FISH & RAPE OIL	0102	1A1a							
NO_x	FISH & RAPE OIL	010203	1A1a	65	65	65	65	65	65	65
NO_x	ORIMULSION	010101	1A1a		88	86	86	86	86	86
NO_x	NATURAL GAS	0101	1A1a	115	115	115	115	97	97	97
NO_x	NATURAL GAS	010101	1A1a		115	115	115	97	97	97
NO_x	NATURAL GAS	010102	1A1a	115	115	115	115	97	97	97
NO_x	NATURAL GAS	010104	1A1a	124	124	124	124	124	124	124
NO_x	NATURAL GAS	010105	1A1a	168	168	168	168	161	154	148
NO_x	NATURAL GAS	010205	1A1a	168	168	168	168	161	154	148
NO_x	NATURAL GAS	010505	1A1c	168	168	168	168	161	154	148
NO_x	NATURAL GAS	020104	1A4a	124	124	124	124	124	124	124
NO_x	NATURAL GAS	020105	1A4a	168	168	168	168	161	154	148
NO_x	NATURAL GAS	020204	1A4b	168	168	168	168	161	154	148
NO_x	NATURAL GAS	020303	1A4c	124	124	124	124	124	124	124
NO_x	NATURAL GAS	020304	1A4c	168	168	168	168	161	154	148
NO_x	NATURAL GAS	030104	1A2f	124	124	124	124	124	124	124
NO_x	NATURAL GAS	030105	1A2f	168	168	168	168	161	154	148
NO_x	BIOGAS	010105	1A1a	540	540	540	540	540	540	540
NO_x	BIOGAS	010505	1A1c	540	540	540	540	540	540	540
NO_x	BIOGAS	020105	1A4a	540	540	540	540	540	540	540
NO_x	BIOGAS	020304	1A4c	540	540	540	540	540	540	540
NO_x	BIOGAS	030105	1A2f	540	540	540	540	540	540	540
NMVOC	WOOD AND SIMIL.	0202	1A4b	704	630	602	599	594	598	538
NMVOC	NATURAL GAS	010105	1A1a	121	121	121	121	115	110	105
NMVOC	NATURAL GAS	010205	1A1a	121	121	121	121	115	110	105
NMVOC	NATURAL GAS	010505	1A1c	121	121	121	121	115	110	105
NMVOC	NATURAL GAS	020105	1A4a	121	121	121	121	115	110	105
NMVOC	NATURAL GAS	020204	1A4b	121	121	121	121	115	110	105
NMVOC	NATURAL GAS	020304	1A4c	121	121	121	121	115	110	105
NMVOC	NATURAL GAS	030105	1A2f	121	121	121	121	115	110	105
CO	WOOD AND SIMIL.	0102	1A1a							

Continued

pol.	fuel	snap_id	ipcc_id	2000	2001	2002	2003	2004	2005	2006
CO	WOOD AND SIMIL.	010202	1A1a	240	240	240	240	240	240	240
CO	WOOD AND SIMIL.	010203	1A1a	240	240	240	240	240	240	240
CO	WOOD AND SIMIL.	0201	1A4a	240	240	240	240	240	240	240
CO	WOOD AND SIMIL.	0203	1A4c	240	240	240	240	240	240	240
CO	WOOD AND SIMIL.	0301	1A2f	240	240	240	240	240	240	240
CO	WOOD AND SIMIL.	030103	1A2f	240	240	240	240	240	240	240
CO	MUNICIP. WASTES	0102	1A1a							
CO	MUNICIP. WASTES	010201	1A1a							
CO	MUNICIP. WASTES	010202	1A1a							
CO	MUNICIP. WASTES	010203	1A1a	10	10	10	10	10	10	10
CO	MUNICIP. WASTES	0201	1A4a	10	10	10	10	10	10	10
CO	MUNICIP. WASTES	020103	1A4a	10	10	10	10	10	10	10
CO	MUNICIP. WASTES	0301	1A2f							
CO	STRAW	0102	1A1a							
CO	STRAW	010202	1A1a	325	325	325	325	325	325	325
CO	STRAW	010203	1A1a	325	325	325	325	325	325	325
CO	STRAW	0202	1A4b	4000	4000	4000	4000	4000	4000	4000
CO	STRAW	0203	1A4c	4000	4000	4000	4000	4000	4000	4000
CO	NATURAL GAS	010105	1A1a	183	183	183	183	160	137	115
CO	NATURAL GAS	010205	1A1a	183	183	183	183	160	137	115
CO	NATURAL GAS	010505	1A1c	183	183	183	183	160	137	115
CO	NATURAL GAS	020105	1A4a	183	183	183	183	160	137	115
CO	NATURAL GAS	020204	1A4b	183	183	183	183	160	137	115
CO	NATURAL GAS	020304	1A4c	183	183	183	183	160	137	115
CO	NATURAL GAS	030105	1A2f	183	183	183	183	160	137	115
CO	BIOGAS	010105	1A1a	273	273	273	273	273	273	273
CO	BIOGAS	010505	1A1c	273	273	273	273	273	273	273
CO	BIOGAS	020105	1A4a	273	273	273	273	273	273	273
CO	BIOGAS	020304	1A4c	273	273	273	273	273	273	273
CO	BIOGAS	030105	1A2f	273	273	273	273	273	273	273

Appendix 3A-5 Large point sources

Table 3A-38 Large point sources, fuel consumption [GJ] in 2006 (1A1, 1A2 and 1A4).

lps_id	lps_name	fuel_id	fuel	Fuel Consumption GJ	ipcc_id
001	Amagervaerket	102A	COAL	15 969 680	1A1a
001	Amagervaerket	111A	WOOD AND SIMIL.	406 011	1A1a
001	Amagervaerket	117A	STRAW	730 023	1A1a
001	Amagervaerket	203A	RESIDUAL OIL	108 580	1A1a
002	Svanemoellevaerket	204A	GAS OIL	80 282	1A1a
002	Svanemoellevaerket	301A	NATURAL GAS	6 484 370	1A1a
003	H.C.Oerstedsvaerket	203A	RESIDUAL OIL	1 686 495	1A1a
003	H.C.Oerstedsvaerket	301A	NATURAL GAS	3 517 303	1A1a
004	Kyndbyvaerket	203A	RESIDUAL OIL	594 130	1A1a
004	Kyndbyvaerket	204A	GAS OIL	36 234	1A1a
005	Masnedoevaerket	111A	WOOD AND SIMIL.	34 007	1A1a
005	Masnedoevaerket	117A	STRAW	515 955	1A1a
005	Masnedoevaerket	204A	GAS OIL	18 883	1A1a
007	Stigsnaesvaerket	102A	COAL	17 142 233	1A1a
007	Stigsnaesvaerket	203A	RESIDUAL OIL	292 047	1A1a
007	Stigsnaesvaerket	204A	GAS OIL	3 300	1A1a
008	Asnaesvaerket	102A	COAL	43 572 774	1A1a
008	Asnaesvaerket	203A	RESIDUAL OIL	422 592	1A1a
009	Statoil Raffinaderi	203A	RESIDUAL OIL	780	1A1b
009	Statoil Raffinaderi	204A	GAS OIL	6 973	1A1b
009	Statoil Raffinaderi	308A	REFINERY GAS	9 083 090	1A1b
010	Avedoerevaerket	102A	COAL	15 016 901	1A1a
010	Avedoerevaerket	111A	WOOD AND SIMIL.	2 608 713	1A1a
010	Avedoerevaerket	117A	STRAW	2 539 975	1A1a
010	Avedoerevaerket	203A	RESIDUAL OIL	8 500 063	1A1a
010	Avedoerevaerket	204A	GAS OIL	5 438	1A1a
010	Avedoerevaerket	301A	NATURAL GAS	12 521 178	1A1a
011	Fynsvaerket+Odense kraftvarmevaerk	102A	COAL	22 106 430	1A1a
011	Fynsvaerket+Odense kraftvarmevaerk	114A	MUNICIP. WASTES	2 842 000	1A1a
011	Fynsvaerket+Odense kraftvarmevaerk	203A	RESIDUAL OIL	270 970	1A1a
011	Fynsvaerket+Odense kraftvarmevaerk	204A	GAS OIL	27 000	1A1a
011	Fynsvaerket+Odense kraftvarmevaerk	301A	NATURAL GAS	13 220	1A1a
012	Studstrupvaerket	102A	COAL	32 646 380	1A1a
012	Studstrupvaerket	117A	STRAW	1 982 080	1A1a
012	Studstrupvaerket	203A	RESIDUAL OIL	384 980	1A1a
014	Nordjyllandsvaerket	102A	COAL	27 602 510	1A1a
014	Nordjyllandsvaerket	203A	RESIDUAL OIL	240 960	1A1a
014	Nordjyllandsvaerket	204A	GAS OIL	3 566	1A1a
017	Shell Raffinaderi	203A	RESIDUAL OIL	465 077	1A1b
017	Shell Raffinaderi	308A	REFINERY GAS	7 305 106	1A1b
018	Skaerbaekvaerket	204A	GAS OIL	382 000	1A1a
018	Skaerbaekvaerket	301A	NATURAL GAS	15 482 000	1A1a
019	Enstedvaerket	102A	COAL	22 710 000	1A1a
019	Enstedvaerket	111A	WOOD AND SIMIL.	288 790	1A1a
019	Enstedvaerket	117A	STRAW	1 709 590	1A1a
019	Enstedvaerket	203A	RESIDUAL OIL	114 160	1A1a
020	Esbjergvaerket	102A	COAL	21 552 000	1A1a
020	Esbjergvaerket	203A	RESIDUAL OIL	128 000	1A1a
020	Esbjergvaerket	303A	LPG	108	1A1a
022	Oestkraft	102A	COAL	637 323	1A1a
022	Oestkraft	111A	WOOD AND SIMIL.	22 640	1A1a

Continued					
lps_id	lps_name	fuel_id	fuel	Fuel Consumption GJ	ipcc_id
022	Oestkraft	203A	RESIDUAL OIL	247 025	1A1a
023	Danisco Grindsted	102A	COAL	518 172	1A2f
023	Danisco Grindsted	301A	NATURAL GAS	22 177	1A2f
024	Nybro Gasbehandlingsanlaeg	301A	NATURAL GAS	379 491	1A1c
025	Horsens Kraftvarmevaerk	114A	MUNICIP. WASTES	817 964	1A1a
025	Horsens Kraftvarmevaerk	301A	NATURAL GAS	843 038	1A1a
026	Herningvaerket	111A	WOOD AND SIMIL.	2 573 000	1A1a
026	Herningvaerket	203A	RESIDUAL OIL	487 000	1A1a
026	Herningvaerket	301A	NATURAL GAS	607 000	1A1a
027	I/S Vestforbraending	114A	MUNICIP. WASTES	5 256 279	1A1a
027	I/S Vestforbraending	204A	GAS OIL	8 752	1A1a
027	I/S Vestforbraending	301A	NATURAL GAS	15 985	1A1a
028	Amagerforbraending	114A	MUNICIP. WASTES	4 510 660	1A1a
029	Energi Randers Produktion	102A	COAL	1 989 984	1A1a
029	Energi Randers Produktion	111A	WOOD AND SIMIL.	1 221 491	1A1a
029	Energi Randers Produktion	204A	GAS OIL	38 769	1A1a
029	Energi Randers Produktion	309A	BIOGAS	16 560	1A1a
030	Grenaa Kraftvarmevaerk	102A	COAL	661 624	1A1a
030	Grenaa Kraftvarmevaerk	111A	WOOD AND SIMIL.	38 142	1A1a
030	Grenaa Kraftvarmevaerk	117A	STRAW	543 028	1A1a
030	Grenaa Kraftvarmevaerk	203A	RESIDUAL OIL	34 100	1A1a
030	Grenaa Kraftvarmevaerk	204A	GAS OIL	4 340	1A1a
031	Hilleroed Kraftvarmevaerk	301A	NATURAL GAS	2 880 454	1A1a
032	Helsingoer Kraftvarmevaerk	301A	NATURAL GAS	1 599 088	1A1a
033	DanSteel	301A	NATURAL GAS	1 305 612	1A2f
034	Dalum Papir	111A	WOOD AND SIMIL.	8 586	1A2f
034	Dalum Papir	204A	GAS OIL	10 294	1A2f
034	Dalum Papir	301A	NATURAL GAS	965 155	1A2f
035	Danisco Sugar Assens	102A	COAL	166 306	1A2f
035	Danisco Sugar Assens	203A	RESIDUAL OIL	265 770	1A2f
036	Kolding Forbraendingsanlaeg	114A	MUNICIP. WASTES	776 695	1A1a
037	Maabjergvaerket	111A	WOOD AND SIMIL.	392 000	1A1a
037	Maabjergvaerket	114A	MUNICIP. WASTES	1 838 000	1A1a
037	Maabjergvaerket	117A	STRAW	430 000	1A1a
037	Maabjergvaerket	301A	NATURAL GAS	119 740	1A1a
038	Soenderborg Kraftvarmevaerk	114A	MUNICIP. WASTES	717 612	1A1a
038	Soenderborg Kraftvarmevaerk	301A	NATURAL GAS	1 174 463	1A1a
039	I/S Kara Affaldsforbraendingsanlaeg	114A	MUNICIP. WASTES	2 052 656	1A1a
039	I/S Kara Affaldsforbraendingsanlaeg	301A	NATURAL GAS	6 822	1A1a
040	Viborg Kraftvarme	301A	NATURAL GAS	2 203 851	1A1a
042	I/S Nordforbraending	114A	MUNICIP. WASTES	1 287 930	1A1a
045	Aalborg Portland	102A	COAL	4 364 609	1A2f
045	Aalborg Portland	110A	PETROLEUM COKE	8 283 791	1A2f
045	Aalborg Portland	114A	MUNICIP. WASTES	1 403 179	1A2f
045	Aalborg Portland	203A	RESIDUAL OIL	978 754	1A2f
046	Affaldscenter aarhus - Forbraendsanlaegget	114A	MUNICIP. WASTES	2 409 173	1A1a
047	I/S Reno Nord	114A	MUNICIP. WASTES	1 780 267	1A1a
048	Silkeborg Kraftvarmevaerk	301A	NATURAL GAS	3 325 919	1A1a
049	Rensningsanlaegget Lynetten	114A	MUNICIP. WASTES	182 700	1A4a
049	Rensningsanlaegget Lynetten	204A	GAS OIL	31 510	1A4a
049	Rensningsanlaegget Lynetten	309A	BIOGAS	137 540	1A4a
050	Fasan+Naestved Kraftvarmevaerk	114A	MUNICIP. WASTES	1 199 720	1A1a
051	AVV Forbraendingsanlaeg	114A	MUNICIP. WASTES	848 516	1A1a

Continued

lps_name		fuel_id	fuel	Fuel Consumption GJ	ipcc_id
052	Affaldsforbraendingsanlaeg I/S REFA	114A	MUNICIP. WASTES	1 188 338	1A1a
053	Svendborg Kraftvarmevaerk	114A	MUNICIP. WASTES	529 431	1A1a
053	Svendborg Kraftvarmevaerk	301A	NATURAL GAS	3 802	1A1a
054	Kommunekemi	114A	MUNICIP. WASTES	1 545 564	1A1a
054	Kommunekemi	203A	RESIDUAL OIL	105 047	1A1a
054	Kommunekemi	204A	GAS OIL	13 558	1A1a
055	I/S Faelles Forbraending	114A	MUNICIP. WASTES	309 488	1A1a
056	Vestfyns Forbraendingsanlaeg	114A	MUNICIP. WASTES	79 729	1A1a
058	I/S Reno Syd	114A	MUNICIP. WASTES	648 722	1A1a
059	I/S Kraftvarmevaerk Thisted	114A	MUNICIP. WASTES	545 822	1A1a
059	I/S Kraftvarmevaerk Thisted	117A	STRAW	3 683	1A1a
060	Knudmosevaerket	114A	MUNICIP. WASTES	494 025	1A1a
060	Knudmosevaerket	301A	NATURAL GAS	43 670	1A1a
061	Kavo I/S Energien+Slagelse Kraftvarme-vaerk	114A	MUNICIP. WASTES	690 319	1A1a
065	Haderslev Kraftvarmevaerk	114A	MUNICIP. WASTES	639 184	1A1a
065	Haderslev Kraftvarmevaerk	301A	NATURAL GAS	68	1A1a
066	Frederiskhavn Affaldskraftvarmevaerk	114A	MUNICIP. WASTES	338 500	1A1a
066	Frederiskhavn Affaldskraftvarmevaerk	204A	GAS OIL	1 400	1A1a
067	Vejen Kraftvarmevaerk	114A	MUNICIP. WASTES	360 000	1A1a
068	Bofa I/S	114A	MUNICIP. WASTES	208 535	1A1a
069	DTU	301A	NATURAL GAS	1 343 550	1A1a
070	Naestved Kraftvarmevaerk	301A	NATURAL GAS	138 222	1A1a
071	Maricogen	301A	NATURAL GAS	1 232 251	1A2f
072	Hjoerring Varmeforsyning	301A	NATURAL GAS	324 789	1A1a
075	Rockwool A/S Hedehusene	301A	NATURAL GAS	46 800	1A2f
076	Rockwool A/S Vamdrup	107A	COKE OV.COKE/HC	403 920	1A2f
076	Rockwool A/S Vamdrup	301A	NATURAL GAS	269 280	1A2f
077	Rockwool A/S Doense	107A	COKE OV.COKE/HC	360 720	1A2f
077	Rockwool A/S Doense	301A	NATURAL GAS	240 480	1A2f
078	Rexam Glass Holmegaard A/S	204A	GAS OIL	554	1A2f
078	Rexam Glass Holmegaard A/S	301A	NATURAL GAS	827 157	1A2f
081	Haldor Topsoee	204A	GAS OIL	1 300	1A2f
081	Haldor Topsoee	301A	NATURAL GAS	520 100	1A2f
081	Haldor Topsoee	303A	LPG	200	1A2f
082	Danisco Sugar Nakskov	102A	COAL	547 172	1A2f
082	Danisco Sugar Nakskov	203A	RESIDUAL OIL	550 645	1A2f
082	Danisco Sugar Nakskov	204A	GAS OIL	2 727	1A2f
082	Danisco Sugar Nakskov	309A	BIOGAS	43 406	1A2f
083	Danisco Sugar Nykoebing	203A	RESIDUAL OIL	789 620	1A2f
085	L90 Affaldsforbraending	114A	MUNICIP. WASTES	2 127 311	1A1a
085	L90 Affaldsforbraending	203A	RESIDUAL OIL	10 870	1A1a
086	Hammel Fjernvarme	114A	MUNICIP. WASTES	335 811	1A1a

Table 3A-39 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	01	1A1a	010101	x	x		
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		
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		
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	51	1A1a	010104	x	x		
004	Kyndbyvaerket	52	1A1a	010104	x	x		
005	Masnedoevaerket	12	1A1a	010102	x			
005	Masnedoevaerket	31	1A1a	010104	x	x		
007	Stigsnaesvaerket	01	1A1a	010101	x	x		
007	Stigsnaesvaerket	02	1A1a	010101	x	x		
007	Stigsnaesvaerket	03	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			
010	Avedoerevaerket	01	1A1a	010101	x	x		
010	Avedoerevaerket	02	1A1a	010104	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	Vendsysselvaerket	02	1A1a	010101	x	x		
014	Vendsysselvaerket	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		
019	Enstedvaerket	03	1A1a	010101	x	x		
019	Enstedvaerket	04	1A1a	010101	x	x		
020	Esbjergvaerket	03	1A1a	010101	x	x		
022	Oestkraft	05	1A1a	010102	x	x		
022	Oestkraft	06	1A1a	010102	x	x		
023	Danisco Ingredients	01	1A2f	030102	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		

Continued								
LPS_id	LPS name	LPS part	Sector (IPCC)	Sector (SNAP)	SO_2	NO_x	NMVOC	CO
032	Helsingoervaerket	01	1A1a	010104		x		
032	Helsingoervaerket	02	1A1a	010105		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	02	1A1a	010103	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		
042	Nordforbraendingen	01	1A1a	010102	x			x
045	Aalborg Portland	01/03	1A2f	030311	x	x		x
046	Aarhus Nord	01	1A1a	010102	x			
047	Reno Nord	01	1A1a	010103	x			x
048	Silkeborg Kraftvarmevaerk	01	1A1a	010104		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
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
056	Vestfyns Forbrænding	01	1A1a	010203	x	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
062	VEGA (Vestforbraending Taastrup)	01	1A1a	010203	x	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		
070	Næstved Kraftvarmeværk	01	1A1a	010104		x		x
071	Maricogen	01	1A2f	030104		x		
072	Hjørring KVV	01	1A1a	010104		x		
075	Rockwool A/S Hedehusene	01	1A2f	030318	x		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
085	L90 Affaldsforbrænding	01	1A1a	010102	x	x		x
086	Hammel Fjernvarme	01	1A1a	010203	x	x		x
	Total of emissions for plants with plant specific data (Mg)				12 634	44 772	16	10 890

1) Emission of the pollutants marked with “x” is plant specific. Emission of other pollutants is estimated based on emission factors.

Appendix 3A-6 Uncertainty estimates

Table 3A-40 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	Input data	Input data	Input data							
		Gg CO_2 eq	Gg CO_2 eq	%	%	%	%	%	%	%	%	%
Stationary Combustion, Coal	CO_2	24 077	21 517	1	5	5.099	2.747	-0.098	0.565	-0.489	0.800	0.937
Stationary Combustion, BKB	CO_2	11	0	3	5	5.831	0.000	0.000	0.000	-0.002	0.000	0.002
Stationary Combustion, Coke	CO_2	138	109	3	5	5.831	0.016	-0.001	0.003	-0.005	0.012	0.013
Stationary Combustion, Petroleum coke	CO_2	410	947	3	5	5.831	0.138	0.014	0.025	0.068	0.106	0.126
Stationary Combustion, Plastic waste	CO_2	349	702	5	5	7.071	0.124	0.009	0.018	0.044	0.130	0.138
Stationary Combustion, Residual oil	CO_2	2 505	2 021	2	2	2.828	0.143	-0.016	0.053	-0.032	0.150	0.154
Stationary Combustion, Gas oil	CO_2	4 547	1 983	4	5	6.403	0.318	-0.073	0.052	-0.366	0.295	0.470
Stationary Combustion, Kerosene	CO_2	366	16	4	5	6.403	0.003	-0.010	0.000	-0.048	0.002	0.048
Stationary Combustion, Natural gas	CO_2	4 320	10 846	3	1	3.162	0.859	0.166	0.285	0.166	1.209	1.220
Stationary Combustion, LPG	CO_2	169	112	4	5	6.403	0.018	-0.002	0.003	-0.009	0.017	0.019
Stationary Combustion, Refinery gas	CO_2	806	932	3	5	5.831	0.136	0.002	0.025	0.011	0.104	0.105
Stationary combustion plants, gas engines	CH_4	7	277	2.2	40	40.060	0.277	0.007	0.007	0.283	0.023	0.284
Stationary combustion plants, other	CH_4	115	184	2.2	100	100.024	0.462	0.002	0.005	0.168	0.015	0.168
Stationary combustion plants	N_2O	240	291	2.2	1000	1000.002	7.294	0.001	0.008	1.026	0.024	1.026
Total		38 060	39 939				61.951					3.823

Total uncertainties	Overall uncertainty in the year (%):	7.871	Trend uncertainty (%):	1.955

Table 3A-41 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	Input data	Input data	Input data							
		Gg CO_2	Gg CO_2	%	%	%	%	%	%	%	%	%
Stationary Combustion. Coal	CO_2	24 077	21 517	1	5	5.099	2.800	-0.093	0.571	-0.463	0.807	0.930
Stationary Combustion. BKB	CO_2	11	0	3	5	5.831	0.000	0.000	0.000	-0.002	0.000	0.002
Stationary Combustion. Coke	CO_2	138	109	3	5	5.831	0.016	-0.001	0.003	-0.005	0.012	0.013
Stationary Combustion. Petroleum coke	CO_2	410	947	3	5	5.831	0.141	0.014	0.025	0.069	0.107	0.127
Stationary Combustion. Plastic waste	CO_2	349	702	5	5	7.071	0.127	0.009	0.019	0.045	0.132	0.139
Stationary Combustion. Residual oil	CO_2	2 505	2 021	2	2	2.828	0.146	-0.015	0.054	-0.031	0.152	0.155
Stationary Combustion. Gas oil	CO_2	4 547	1 983	4	5	6.403	0.324	-0.073	0.053	-0.363	0.298	0.470
Stationary Combustion. Kerosene	CO_2	366	16	4	5	6.403	0.003	-0.010	0.000	-0.048	0.002	0.048
Stationary Combustion. Natural gas	CO_2	4 320	10 846	3	1	3.162	0.875	0.168	0.288	0.168	1.221	1.232
Stationary Combustion. LPG	CO_2	169	112	4	5	6.403	0.018	-0.002	0.003	-0.008	0.017	0.019
Stationary Combustion. Refinery gas	CO_2	806	932	3	5	5.831	0.139	0.003	0.025	0.013	0.105	0.106
Total	CO_2	37 698	39 187				8.787					2.678

Total uncertainties	Overall uncertainty in the year (%):	2.964	Trend uncertainty (%):	1.636

Table 3A-42 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	13 170	2,2	40	40.060	24.039	2.072	2.278	82.890	7.089	83.193
Stationary combustion plants. other	CH_4	5 468	8 777	2.2	100	100.024	40.004	-2.054	1.519	-205.395	4.725	205.449
Total	CH_4	5 780	21 947				2178.144					49130.353
Total uncertainties		Overall uncertainty in the year (%):					46.671	Trend uncertainty (%):				221.654

Table 3A-43 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	0.940	2.200	1000	1000.002	1000.002	0.000	1.212	0.000	3.770	3.770
Total	N_2O	0.775	0.940				1000005					14.214
Total uncertainties		Overall uncertainty in the year (%):					1000.002	Trend uncertainty (%):				3.770

Table 3A-44 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	129 601	10 250	2	10	10.198	4.628	-0.052	0.065	-0.522	0.184	0.553
02	SO_2	11 491	4 433	2	20	20.100	3.945	0.018	0.028	0.353	0.079	0.362
03	SO_2	16 708	7 903	2	10	10.198	3.568	0.035	0.050	0.349	0.142	0.377
Total	SO_2	157 800	22 585				49.715					0.579
Total uncertainties				Overall uncertainty in the year (%):			7.051			Trend uncertainty (%):		0.761

Table 3A-45 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	94 738	51 864	2	20	20.100	14.349	-0.067	0.4493	-1.335	1.271	1.843
02	NO_x	7 518	8 288	2	50	50.040	5.709	0.031	0.0718	1.540	0.203	1.553
03	NO_x	13 167	12 498	2	20	20.100	3.458	0.036	0.1083	0.729	0.306	0.790
Total	NO_x	115 423	72 650				250.438					6.434
Total uncertainties				Overall uncertainty in the year (%):			15.825				Trend uncertainty (%):	2.536

Table 3A-46 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	1 075	3 326	2	50	50.040	7.178	0.110	0.2441	5.489	0.690	5.532
02	NMVOC	11 923	19 289	2	50	50.040	41.636	-0.073	1.4157	-3.631	4.004	5.406
03	NMVOC	627	568	2	50	50.040	1.225	-0.037	0.0417	-1.829	0.118	1.833
Total	NMVOC	13 625	23 182				1786.609					63.180
Total uncertainties				Overall uncertainty in the year (%):			42.268		Trend uncertainty (%):			7.949

Table 3A-47 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	8 262	10 251	2	20	20.100	0.693	-0.017	0.056	-0.342	0.158	0.377
02	CO	159 294	275 055	2	50	50.040	46.291	0.091	1.499	4.553	4.241	6.222
03	CO	15 877	12 028	2	20	20.100	0.813	-0.075	0.066	-1.493	0.185	1.505
Total	CO	183 432	297 333				2143.967					41.125
Total uncertainties				Overall uncertainty in the year (%):			46.303		Trend uncertainty (%):			6.413

Appendix 3A-7 Lower Calorific Value (LCV) of fuels

Table 3A-48a Time-series for calorific values of fuels for 1990 to 1999 (Danish Energy Authority, DEA 2007b).

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Crude Oil. Average	GJ / ton	42.40	42.40	42.40	42.70	42.70	42.70	42.70	43.00	43.00	43.00
Crude Oil. Golf	GJ / ton	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 / ton	42.70	42.70	42.70	42.70	42.70	42.70	42.70	43.00	43.00	43.00
Refinery Feedstocks	GJ / ton	41.60	41.60	41.60	41.60	41.60	41.60	41.60	42.70	42.70	42.70
Refinery Gas	GJ / ton	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00
LPG	GJ / ton	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00
Naphtha (LVN)	GJ / ton	44.50	44.50	44.50	44.50	44.50	44.50	44.50	44.50	44.50	44.50
Motor Gasoline	GJ / ton	43.80	43.80	43.80	43.80	43.80	43.80	43.80	43.80	43.80	43.80
Aviation Gasoline	GJ / ton	43.80	43.80	43.80	43.80	43.80	43.80	43.80	43.80	43.80	43.80
JP4	GJ / ton	43.80	43.80	43.80	43.80	43.80	43.80	43.80	43.80	43.80	43.80
Other Kerosene	GJ / ton	43.50	43.50	43.50	43.50	43.50	43.50	43.50	43.50	43.50	43.50
JP1	GJ / ton	43.50	43.50	43.50	43.50	43.50	43.50	43.50	43.50	43.50	43.50
Gas/Diesel Oil	GJ / ton	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70
Fuel Oil	GJ / ton	40.40	40.40	40.40	40.40	40.40	40.40	40.70	40.65	40.65	40.65
Orimulsion	GJ / ton	27.60	27.60	27.60	27.60	27.60	28.13	28.02	27.72	27.84	27.58
Petroleum Coke	GJ / ton	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40
Waste Oil	GJ / ton	41.90	41.90	41.90	41.90	41.90	41.90	41.90	41.90	41.90	41.90
White Spirit	GJ / ton	43.50	43.50	43.50	43.50	43.50	43.50	43.50	43.50	43.50	43.50
Bitumen	GJ / ton	39.80	39.80	39.80	39.80	39.80	39.80	39.80	39.80	39.80	39.80
Lubricants	GJ / ton	41.90	41.90	41.90	41.90	41.90	41.90	41.90	41.90	41.90	41.90
Natural Gas	GJ / 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 / 1000 m3							17.00	17.00	17.00	17.00
Electricity Plant Coal	GJ / ton	25.30	25.40	25.80	25.20	24.50	24.50	24.70	24.96	25.00	25.00
Other Hard Coal	GJ / ton	26.10	26.50	26.50	26.50	26.50	26.50	26.50	26.50	26.50	26.50
Gas Plant Coal	GJ / ton										
Coke	GJ / ton	31.80	29.30	29.30	29.30	29.30	29.30	29.30	29.30	29.30	29.30
Brown Coal Briquettes	GJ / ton	18.30	18.30	18.30	18.30	18.30	18.30	18.30	18.30	18.30	18.30
Straw	GJ / ton	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50
Wood Chips	GJ/Rummeter	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80
Firewood. Hardwood	GJ / m3	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40
Firewood. Conifer	GJ / m3	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60
Wood Pellets	GJ / ton	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50
Wood Waste	GJ / ton	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70
Wood Waste	GJ/Rummeter	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
Biogas	GJ / 1000 m3								23.00	23.00	23.00
Waste Combustion	GJ / ton	8.20	8.20	9.00	9.40	9.40	10.00	10.50	10.50	10.50	10.50
Liquid Biofuels											37.60
Fish Oil	GJ / ton	37.20	37.20	37.20	37.20	37.20	37.20	37.20	37.20	37.20	37.20

Table 3A-48b Time-series for calorific values of fuels for 2000 to 2006 (Danish Energy Authority, DEA 2007b).

		2000	2001	2002	2003	2004	2005	2006
Crude Oil. Average	GJ / ton	43.00	43.00	43.00	43.00	43.00	43.00	43.00
Crude Oil. Golf	GJ / ton	41.80	41.80	41.80	41.80	41.80	41.80	41.80
Crude Oil. North Sea	GJ / ton	43.00	43.00	43.00	43.00	43.00	43.00	43.00
Refinery Feedstocks	GJ / ton	42.70	42.70	42.70	42.70	42.70	42.70	42.70
Refinery Gas	GJ / ton	52.00	52.00	52.00	52.00	52.00	52.00	52.00
LPG	GJ / ton	46.00	46.00	46.00	46.00	46.00	46.00	46.00
Naphtha (LVN)	GJ / ton	44.50	44.50	44.50	44.50	44.50	44.50	44.50
Motor Gasoline	GJ / ton	43.80	43.80	43.80	43.80	43.80	43.80	43.80
Aviation Gasoline	GJ / ton	43.80	43.80	43.80	43.80	43.80	43.80	43.80
JP4	GJ / ton	43.80	43.80	43.80	43.80	43.80	43.80	43.80
Other Kerosene	GJ / ton	43.50	43.50	43.50	43.50	43.50	43.50	43.50
JP1	GJ / ton	43.50	43.50	43.50	43.50	43.50	43.50	43.50
Gas/Diesel Oil	GJ / ton	42.70	42.70	42.70	42.70	42.70	42.70	42.70
Fuel Oil	GJ / ton	40.65	40.65	40.65	40.65	40.65	40.65	40.65
Orimulsion	GJ / ton	27.62	27.64	27.71	27.65	27.65	27.65	27.65
Petroleum Coke	GJ / ton	31.40	31.40	31.40	31.40	31.40	31.40	31.40
Waste Oil	GJ / ton	41.90	41.90	41.90	41.90	41.90	41.90	41.90
White Spirit	GJ / ton	43.50	43.50	43.50	43.50	43.50	43.50	43.50
Bitumen	GJ / ton	39.80	39.80	39.80	39.80	39.80	39.80	39.80
Lubricants	GJ / ton	41.90	41.90	41.90	41.90	41.90	41.90	41.90
Natural Gas	GJ / 1000 Nm3	40.15	39.99	40.06	39.94	39.77	39.67	39.54
Town Gas	GJ / 1000 m3	17.01	16.88	17.39	16.88	17.58	17.51	17.20
Electricity Plant Coal	GJ / ton	24.80	24.90	25.15	24.73	24.60	24.40	24.80
Other Hard Coal	GJ / ton	26.50	26.50	26.50	26.50	26.50	26.50	26.50
Gas Plant Coal	GJ / ton							
Coke	GJ / ton	29.30	29.30	29.30	29.30	29.30	29.30	29.30
Brown Coal Briquettes	GJ / ton	18.30	18.30	18.30	18.30	18.30	18.30	18.30
Straw	GJ / ton	14.50	14.50	14.50	14.50	14.50	14.50	14.50
Wood Chips	GJ/Rummeter	2.80	2.80	2.80	2.80	2.80	2.80	2.80
Firewood. Hardwood	GJ / m3	10.40	10.40	10.40	10.40	10.40	10.40	10.40
Firewood. Conifer	GJ / m3	7.60	7.60	7.60	7.60	7.60	7.60	7.60
Wood Pellets	GJ / ton	17.50	17.50	17.50	17.50	17.50	17.50	17.50
Wood Waste	GJ / ton	14.70	14.70	14.70	14.70	14.70	14.70	14.70
Wood Waste	GJ/Rummeter	3.20	3.20	3.20	3.20	3.20	3.20	3.20
Biogas	GJ / 1000 m3	23.00	23.00	23.00	23.00	23.00	23.00	23.00
Waste Combustion	GJ / ton	10.50	10.50	10.50	10.50	10.50	10.50	10.50
Liquid Biofuels		37.60	37.60	37.60	37.60	37.60	37.60	37.60
Fish Oil	GJ / ton	37.20	37.20	37.20	37.20	37.20	37.20	37.20

Table 3A-49 Fuel category correspondence list, Danish Energy Authority, NERI and Climate convention reporting (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-8 Adjustment of CO_2 emission

Table 3A-50 Adjustment of CO_2 emission (ref. Danish Energy Authority).

Degree Days		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Actual Degree Days	Degree days	2 926	2 857	3 284	3 022	3 434	3 148	3 297	3 837	3 236	3 217
Normal Degree Days	Degree days	3 419	3 379	3 380	3 359	3 365	3 366	3 378	3 395	3 389	3 375
Net electricity import	TJ	25 373	-7 099	3 486	4 266	-17 424	-2 858	-55 444	-26 107	-15 552	-8 327
Actual CO_2 emission	1 000 000 tonnes	52.7	63.4	57.6	59.9	63.6	60.5	74.0	64.5	60.4	57.5
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
Actual Degree Days	Degree days	3 056	2 902	3 279	3 011	3 150	3 113	3 068
Normal Degree Days	Degree days	3 339	3 304	3 289	3 273	3 271	3 261	3 224
Net electricity import	TJ	2 394	-2 071	-7 453	-30 760	-10 340	4 932	-24 971
Actual CO_2 emission	1 000 000 tonnes	53.1	54.7	54.3	59.4	54.0	50.3	57.6
Adjusted CO_2 emission	1 000 000 tonnes	54.2	53.6	52.2	51.7	50.9	51.0	52.5

Appendix 3A-9 Reference approach

TABLE 1.A(b) SECTORAL BACKGROUND DATA FOR ENERGY
CO_2 from Fuel Combustion Activities - Reference Approach (IPCC Worksheet 1-1)
(Sheet 1 of 1)

FUEL TYPES			Unit	Production	Imports	Exports	International bunkers	Stock change	Apparent consumption	Conversion factor (TJ/Unit)	NCV/ GCV [1]	Apparent consumption (TJ)
Liquid Fossil	Primary Fuels	Crude Oil	TJ	724.416,36	116.460,86	497.478,95		-395,34	343.793,61	1,00	NCV	343.793,61
		Orimulsion	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA
		Natural Gas Liquids	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA
	Secondary Fuels	Gasoline	TJ		40.246,54	47.531,98	1,62	43,17	-7.330,22	1,00	NCV	-7.330,22
		Jet Kerosene	TJ		25.039,78	19.306,10	35.877,55	-5.996,98	-24.146,88	1,00	NCV	-24.146,88
		Other Kerosene	TJ		NA	NA	NA	NA	NA	1,00	NCV	NA
		Shale Oil	TJ		NA	NA		NA	NA	1,00	NCV	NA
		Gas / Diesel Oil	TJ		102.093,10	71.431,95	13.116,25	-4.804,59	22.349,49	1,00	NCV	22.349,49
		Residual Fuel Oil	TJ		42.413,03	46.859,21	31.564,68	1.253,65	-37.264,51	1,00	NCV	-37.264,51
		Liquefied Petroleum Gas (LPG)	TJ		193,29	4.683,86		28,15	-4.518,72	1,00	NCV	-4.518,72
		Ethane	TJ		NA	NA		NA	NA	1,00	NCV	NA
		Naphtha	TJ		NA	298,19		48,64	-346,83	1,00	NCV	-346,83
		Bitumen	TJ		8.924,12	123,18		-245,88	9.046,82	1,00	NCV	9.046,82
		Lubricants	TJ		2.659,02	99,55	134,96	NA	2.424,50	1,00	NCV	2.424,50
		Petroleum Coke	TJ		8.179,42	488,80		-1.403,58	9.094,19	1,00	NCV	9.094,19
		Refinery Feedstocks	TJ		391,09	4.035,32		-329,94	-3.314,29	1,00	NCV	-3.314,29
		Other Oil	TJ		NA	NA		NA	NA	1,00	NCV	NA
Other Liquid Fossil												623,57
White Spirit				NA	697,13	73,56	NA	NA	623,57	1,00	NCV	623,57
Liquid Fossil Totals												310.410,74
Solid Fossil	Primary Fuels	Anthracite [2]	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA
		Coking Coal	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA
		Other Bituminous Coal	TJ	NA	216.242,74	2.740,99	NA	-14.750,83	228.252,57	1,00	NCV	228.252,57
		Sub-bituminous Coal	TJ	NA	NA	NA	NA	NA	NA	1,00	NCV	NA
		Lignite	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA
		Oil Shale	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA
		Peat	TJ	NA	NA	NA		NA	NA	1,00	NCV	NA
	Secondary Fuels	BKB [3] and Patent Fuel	TJ		6,57	6,70		NA	-0,13	1,00	NCV	-0,13
		Coke Oven/Gas Coke	TJ		1.124,53	NA		112,72	1.011,82	1,00	NCV	1.011,82
Other Solid Fossil												8.896,41
Plastic part of municipal waste				8.896,41	NA	NA	NA	NA	8.896,41	1,00	NCV	8.896,41
Solid Fossil Totals												238.160,67
Gaseous Fossil		Natural Gas (Dry)	TJ	390.346,52	NA	196.275,20		4.134,18	189.937,15	1,00	NCV	189.937,15
Other Gaseous Fossil												NA
Gaseous Fossil Totals												189.937,15
Total												738.508,56
Biomass total												104.300,45
		Solid Biomass	TJ	84.318,63	16.062,78	NA		NA	100.381,42	1,00	NCV	100.381,42
		Liquid Biomass	TJ	3.684,80	NA	3.684,80		NA	NA	1,00	NCV	NA
		Gas Biomass	TJ	3.919,04	NA	NA		NA	3.919,04	1,00	NCV	3.919,04

(1) To convert quantities in previous columns to energy units, use net calorific values (NCV) and write NCV in this column. If gross calorific values (GCV) are used, write GCV in this column.
(2) If data for Anthracite are not available separately, include with Other Bituminous Coal.
(3) BKB: Brown coal/peat briquettes.

TABLE 1.A(c) COMPARISON OF CO2 EMISSIONS FROM FUEL COMBUSTION
(Sheet 1 of 1)

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)	310,41	298,32	22.198,00	304,01	22.124,98	-1,87	0,33
Solid Fuels (excluding international bunkers) [5]	238,16	229,26	22.402,27	232,98	21.602,94	-1,59	3,70
Gaseous Fuels	189,94	189,94	10.655,47	191,01	10.952,35	-0,56	-2,71
Other [5]	NA,NO	NO	NA,NO	IE,NA,NO	742,72		-100,00
Total [5]	*738,51*	*717,52*	*55.255,75*	*728,00*	*55.422,99*	*-1,44*	*-0,30*

[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-51 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	Other oil	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-10 Emission inventory 2006 based on CRF sectors

Table 3A-52 Emission inventory 2006 based on CRF sectors.

2006	SO_2 [Gg]	NO_x [Gg]	NMVOC [Gg]	CH_4 [Gg]	CO [Gg]	CO_2 [Tg]	N_2O [Gg]
1A1a	9.83	43.31	3.28	11.34	9.79	26.86	0.45
1A1b	0.41	1.37	0.00	0.00	0.24	0.98	0.03
1A1c	0.01	7.19	0.04	0.09	0.22	1.63	0.06
1A2	7.90	12.50	0.57	1.11	12.03	4.77	0.14
1A4a	0.27	1.23	0.72	0.87	0.92	0.96	0.03
1A4b	2.41	5.92	17.11	7.09	265.89	3.46	0.20
1A4c	1.75	1.14	1.46	1.45	8.24	0.53	0.02
Grand Total	22.59	72.65	23.18	21.95	297.33	39.19	0.94

Appendix 3A-11 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 below.

Table 3A-53 Correspondance 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 & Dieselolie	204B		
- - Fuel Oil	080404	Fuelolie & Spildolie	203W		
- - Lubricants					
Energy Sector					
Extraction and Gasification					
- *Extraction*					
- - Natural Gas	010504	Naturgas	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 & Dieselolie	204A		
- - Fuel Oil	010306	Fuelolie & 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	Naturgas	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 & Dieselolie	2050		
Road					
- LPG	07	LPG	3030		
- Motor Gasoline	07	Benzin og LVN	2080		
- Other Kerosene	0202	Petroleum	206A		
- Gas-/Diesel Oil	07	Gas & Dieselolie	2050		
- Fuel Oil	07	Fuelolie & Spildolie	203V		
Rail					
- Motor Gasoline	0802	Benzin og LVN	2080		
- Other Kerosene	0802	Petroleum	206A		
- Gas-/Diesel Oil	0802	Gas & Dieselolie	2050		
- Electricity					
Domestic Sea Transport					
- LPG	080402	LPG	3030		
- Other Kerosene	080402	Petroleum	206A		
- Gas-/Diesel Oil	080402	Gas & Dieselolie	204B		
- Fuel Oil	080402	Fuelolie & 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		

Annex 3B Transport

Annex 3B-1 Fleet data 1990-2006 for road transport (No. vehicles)

Sector	Subsector	Tech 2	FYear	LYear	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	80 570	46 208	44 014	42 804	36 466	39 959	37 597	37 130	3 434	2 761	2 103
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	333 715	187 911	161 642	139 010	119 424	80 741	67 991	53 302	44 338	31 104	22 511
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	104 223	86 056	79 240	72 588	65 797	49 614	42 976	34 748	25 889	17 458	10 806
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	345 946	301 692	295 677	288 944	280 769	262 502	250 449	233 656	215 509	183 239	147 178
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990		282 011	280 181	278 685	278 152	275 859	272 989	269 953	275 188	264 791	254 032
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996			39 608	73 527	101 489	139 813	169 133	205 235	210 861	208 281	206 803
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000									38 465	74 495	108 508
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	61 592	35 940	34 233	33 292	28 362	31 079	29 242	28 879	2 671	2 148	1 635
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	218 180	127 631	109 640	94 188	80 844	54 600	45 991	36 078	30 465	21 520	15 647
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	60 836	55 062	50 674	46 402	42 040	31 712	27 445	22 173	16 509	11 141	6 870
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	210 574	174 545	170 749	166 595	161 591	150 612	143 385	133 412	122 642	103 931	83 270
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990		190 297	188 949	187 872	187 524	186 044	184 194	182 297	186 155	179 510	172 582
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996			35 647	75 763	119 562	201 007	288 096	375 253	383 870	378 063	375 137
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000									95 358	196 046	274 022
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	5 923	3 423	3 260	3 171	2 701	2 960	2 785	2 750	254	205	156
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	18 532	10 781	9 234	7 914	6 781	4 567	3 849	3 022	2 619	1 881	1 366
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	8 730	4 392	4 043	3 702	3 354	2 531	2 191	1 770	1 318	888	549
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	31 066	24 667	24 157	23 595	22 912	21 429	20 432	19 053	17 571	14 934	12 016
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990		25 679	25 524	25 389	25 338	25 120	24 844	24 546	24 977	23 975	22 975
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996			3 961	8 129	12 434	20 068	27 915	35 770	36 617	36 081	35 808
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000									12 432	27 315	44 923
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	Euro I	1991	1996			4 042	8 018	11 872	18 305	24 557	31 177	31 314	31 730	35 118

Continued

Passenger Cars	Diesel <2,0 l	Euro II	1997	2000									7 046	14 640	23 084
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	75 828	79 714	75 794	72 294	68 535	62 144	58 848	55 004	48 251	43 893	43 004
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996			213	437	668	1 078	1 499	1 921	1 928	1 952	2 161
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000									655	1 478	2 711
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	3 451	3 703	3 556	3 425	3 281	3 040	2 906	2 747	2 461	2 266	2 237
Passenger Cars	LPG	Conventional	0	1990	287	286	286	288	289	289	301	311	172	97	44
Passenger Cars	2-Stroke	Conventional	0	9999	4 823	5 417	4 804	4 308	3 747	3 029	2 443	1 824	1 248	761	400
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	33 049	42 333	43 215	44 179	45 486	47 261	44 601	41 519	37 209	34 454	31 489
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998							4 259	8 524	12 645	17 212	16 632
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001											4 705
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006											
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	121 431	155 543	158 781	162 324	167 129	173 650	163 877	152 553	142 109	131 572	122 992
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998							15 648	31 318	48 292	65 727	64 964
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001											18 376
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006											
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	251	250	255	260	268	279	288	295	261	274	253
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	5 140	5 108	5 214	5 330	5 488	5 205	4 891	4 532	3 999	3 692	3 079
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996						497	1 004	1 506	1 440	1 435	1 269
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001									529	1 087	1 487
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006											
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	10 350	10 286	10 500	10 734	11 052	10 482	9 850	9 126	7 800	6 603	5 613
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996						1 001	2 022	3 033	2 808	2 566	2 314
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001									1 032	1 945	2 710
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006											
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	13 115	13 034	13 306	13 602	14 005	13 283	12 481	11 564	10 720	9 832	8 982
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996						1 268	2 562	3 844	3 859	3 821	3 702
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001									1 419	2 896	4 336
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006											
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	11 517	11 446	11 684	11 944	12 298	11 664	10 960	10 154	9 337	8 720	8 180
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996						1 114	2 250	3 376	3 362	3 389	3 371
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001									1 236	2 568	3 949
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006											
Buses	Urban Buses	Conventional	0	1993	4 712	4 753	4 561	4 522	4 490	4 083	3 635	3 261	2 946	2 792	2 542

Continued															
Buses	Urban Buses	Euro I	1994	1996						390	746	1 084	1 060	972	913
Buses	Urban Buses	Euro II	1997	2001									390	729	1053
Buses	Urban Buses	Euro III	2002	2006											
Buses	Coaches	Conventional	0	1993	3 298	3 327	2 868	3 007	3 086	2 927	4507	4156	3662	3369	3007
Buses	Coaches	Euro I	1994	1996						280	925	1381	1318	1173	1080
Buses	Coaches	Euro II	1997	2001									485	879	1246
Buses	Coaches	Euro III	2002	2006											
Mopeds	<50 cm³	Conventional	0	1999	151 000	120 000	118 000	113 000	109 000	105 000	114167	123333	132500	141667	150833
Mopeds	<50 cm³	Euro I	2000	2003											
Mopeds	<50 cm³	Euro II	2004	9999											
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	6 209	6 617	6 804	6 904	7 111	7 406	7672	8214	8980	9598	10385
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	7 037	7 499	7 712	7 824	8 059	8 394	8695	9310	10177	10878	11769
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003											
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006											
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	19 352	20 622	21 207	21 516	22 162	23 083	23911	25602	27986	29914	32365
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003											
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006											
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	8 796	9 374	9 639	9 780	10 074	10 492	10869	11637	12721	13597	14712
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003											
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006											

Sector	Subsector	Tech 2	FYear	LYear	2000	2001	2002	2003	2004	2005	2006
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	1 744	1 614	1 475	1 392	1 313	1 313	1 313
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	17 980	15 837	14 155	13 149	12 404	12 335	12 279
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	7 298	5 510	4 178	3 128	2 433	2 882	2 869
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	118 979	97 964	79 041	60 723	45 824	25 489	14 555
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	235 890	219 216	194 543	171 430	142 490	133 653	117 770
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	204 184	201 708	197 423	192 152	185 488	183 896	185 747
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	135 030	132 812	130 153	128 898	126 400	133 689	129 230
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005		21 858	47 428	70 311	99 658	126 777	128 423
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010							31 558
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	1 356	1 255	1 147	1 083	1 021	1 021	1 021
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	12 537	11 077	9 923	9 230	8 707	8 852	8 964
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	4 642	3 500	2 659	1 987	1 545	1 858	1 892
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	67 222	55 300	44 572	34 238	25 810	14 529	8 564
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	160 800	149 915	133 745	118 448	99 092	86 463	72 814
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	370 803	367 136	359 959	351 645	340 424	286 124	227 403
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	326 268	320 971	314 678	311 808	305 621	334 798	342 059
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005		49 700	105 323	147 067	195 430	250 309	274 132
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010							52 995
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	129	120	109	103	97	97	97
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	1 110	986	885	825	778	807	836
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	371	280	212	159	123	147	148
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	9 722	8 009	6 459	4 964	3 744	2 045	1 103
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	21 251	19 699	17 377	15 265	12 607	12 107	10 565
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	35 388	35 024	34 329	33 516	32 431	27 636	23 084
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	61 899	60 799	59 506	58 896	57 815	48 867	39 683
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005		15 179	30 712	45 080	65 819	82 828	77 816
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010							22 245
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	39 314	43 578	48 670	53 462	59 968	62 042	63 663
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	31 541	34 764	38 842	43 327	49 262	61 839	72 606
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005		5 482	13 338	21 371	33 648	49 775	62 020
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010							13 028
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	42 604	42 641	42 100	40 525	38 619	38 012	37 146
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	2 420	2 683	2 998	3 295	3 698	3 647	3 556
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	4 232	4 658	5 196	5 790	6 592	6 450	6 112
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005		1 163	2 682	4 432	7 505	10 932	11 986
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010							3 426
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	2 228	2 229	2 187	2 096	1 978	2 005	1 958

Continued											
Passenger Cars	LPG	Conventional	0	1990	32	63	21	15	15	15	15
Passenger Cars	2-Stroke	Conventional	0	9999	300	200	150	100	50		
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	28 488	25 423	21 615	18 838	14 576	12 300	9 827
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	15 979	15 527	15 049	13 949	14 793	14 462	13 766
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	9 299	14 017	13 917	13 805	14 126	14 061	13 667
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006			5 140	10 719	16 724	23 033	29 145
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	115 695	105 397	92 990	82 927	66 760	59 477	51 497
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	64 894	64 370	64 743	61 406	67 753	69 932	72 140
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	37 766	58 112	59 870	60 771	64 697	67 990	71 620
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006			22 112	47 186	76 596	111 375	152 728
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	257	249	249	247	233	252	266
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	2 406	1 979	1 739	1 407	1 069	835	628
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	1 057	951	956	813	903	837	777
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	1 703	1 990	2 064	1 872	2 036	1 936	1 852
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006			484	941	1 541	2 036	2 547
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	5 085	4 210	3 136	2 571	1 639	1281	963
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	2 235	2 024	1 724	1 486	1 384	1284	1192
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	3 600	4 234	3 724	3 421	3 123	2970	2840
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006			872	1 720	2 364	3123	3907
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	7 933	6 814	5 525	4 571	3 110	2431	1826
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	3 486	3 276	3 037	2 642	2 627	2436	2262
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	5 616	6 853	6 560	6 082	5 926	5634	5388
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006			1 537	3 058	4 484	5925	7412
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	7 361	6 527	5 486	4 716	3 282	2565	1927
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	3 234	3 138	3 016	2 726	2 772	2570	2387
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	5 211	6 564	6 514	6 275	6 253	5946	5686
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006			1 526	3 156	4 732	6252	7822
Buses	Urban Buses	Conventional	0	1993	2 319	2 159	1 977	1 859	1 711	1551	1381
Buses	Urban Buses	Euro I	1994	1996	852	792	752	713	663	643	614
Buses	Urban Buses	Euro II	1997	2001	1 345	1 596	1 525	1 447	1 345	1 317	1273
Buses	Urban Buses	Euro III	2002	2006			346	670	951	1 275	1585
Buses	Coaches	Conventional	0	1993	2 724	2 444	2 165	1 962	1 773	1 542	1328
Buses	Coaches	Euro I	1994	1996	1 001	896	823	752	687	639	591
Buses	Coaches	Euro II	1997	2001	1 579	1 807	1 670	1 527	1 394	1 309	1224
Buses	Coaches	Euro III	2002	2006			379	706	986	1 267	1524
Mopeds	<50 cm³	Conventional	0	1999	143 607	136 249	128 209	120 305	112 262	98 369	82388
Mopeds	<50 cm³	Euro I	2000	2003	16 393	28 751	42 791	48 695	46 069	45 882	50386

Continued											
Mopeds	<50 cm³	Euro II	2004	9999					10 669	24 749	36226
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	11 054	11 367	11 582	11 850	12 326	13 158	14241
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	11 670	12 487	12 882	13 380	14 078	14 943	16241
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003	858	918	1 348	1 806	1 816	2 292	2766
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006					604	1 187	1879
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	32 093	34 338	35 424	36 794	38 714	41 092	44663
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003	2 360	2 525	3 707	4 967	4 993	6 302	7606
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006					1 661	3 263	5169
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	14 588	15 608	16 102	16 725	17 597	18 678	20301
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003	1 073	1 148	1 685	2 258	2 270	2 865	3457
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006					755	1 483	2349

Annex 3B-2: Mileage data 1990-2006 for road transport (km)

Sector	Subsector	Tech 2	FYear	LYear	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	9564	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	12115	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	16052	13358	12280	12005	12412	12729	12405	12060	12050	11999	11794
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	18800	16553	17094	17157	16720	16142	14571	12958	12050	11999	11794
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990		20257	20778	21152	20734	20113	18818	17553	16474	14970	13688
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996			24567	25667	25746	26068	24555	23306	22300	20949	19624
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000									26232	25674	24561
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
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
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	16045	13352	12269	12005	12412	12729	12405	12060	12050	11999	11794
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	18883	16515	17059	17121	16659	16068	14525	12940	12050	11999	11794
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990		20402	20935	21291	20886	20231	18942	17667	16584	15142	13875
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996			24567	25726	25975	26475	25307	24084	23002	21643	20226
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000									26232	25700	24547
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
Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	12053	10458	11285	12005	12412	12729	12405	12060	12050	11999	11794
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	16050	13361	12285	12005	12412	12729	12405	12060	12050	11999	11794
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	18834	16582	17121	17200	16793	16180	14593	12966	12050	11999	11794
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990		20101	20643	21047	20575	20005	18715	17452	16353	14779	13551
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996			24567	25712	25924	26398	25184	23952	22880	21524	20119
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000									26232	25727	24744
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	Euro I	1991	1996			42600	42505	41806	41473	40106	38625	36268	33906	32434
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000									41813	40714	39790
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	25365	28694	28549	27996	27386	26630	25416	24032	22779	21643	21021
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996			42600	42529	41894	41615	40354	38857	36471	34109	32607
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000									41813	40769	40104
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005											

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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
Passenger Cars	LPG	Conventional	0	1990	18832	16538	17080	17144	16698	16113	14553	12950	12050	11999	11794
Passenger Cars	2-Stroke	Conventional	0	9999	18832	16538	17080	17144	16698	16113	14553	12950	12050	11999	11794
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	20184	17544	18019	18706	18893	18937	18138	17727	17852	17884	17453
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998							18138	17727	17852	17884	17453
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001											17453
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006											
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	30638	33157	33484	32340	32266	34169	32777	32789	32519	31998	31226
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998							32777	32789	32519	31998	31226
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001											31226
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006											
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	38145	37941	38562	39503	37262	36784	36279	35575	32740	33082	33668
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	35978	48034	48003	45749	42629	44460	43917	44077	36397	37104	39868
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996						44460	43917	44077	36397	37104	39868
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001									36397	37104	39868
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006											
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	50129	58064	58026	55301	51529	53743	53086	53280	51043	49398	46486
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996						53743	53086	53280	51043	49398	46486
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001									51043	49398	46486
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006											
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	69684	80715	80662	76875	71632	74709	73796	74065	76469	76582	79347
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996						74709	73796	74065	76469	76582	79347
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001									76469	76582	79347
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006											
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	69684	80715	80662	76875	71632	74709	73796	74065	76469	76582	79347
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996						74709	73796	74065	76469	76582	79347
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001									76469	76582	79347
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006											
Buses	Urban Buses	Conventional	0	1993	92802	112240	117692	113847	116584	127459	126072	125955	123611	120313	118107
Buses	Urban Buses	Euro I	1994	1996						127459	126072	125955	123611	120313	118107
Buses	Urban Buses	Euro II	1997	2001									123611	120313	118107
Buses	Urban Buses	Euro III	2002	2006											
Buses	Coaches	Conventional	0	1993	58168	72330	84745	77381	79571	85908	62394	73915	74429	73035	72648
Buses	Coaches	Euro I	1994	1996						85908	62394	73915	74429	73035	72648
Buses	Coaches	Euro II	1997	2001									74429	73035	72648
Buses	Coaches	Euro III	2002	2006											

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Mopeds	<50 cm³	Conventional	0	1999	2334	2182	2282	2393	2449	2510	2470	2439	2481	2498	2125
Mopeds	<50 cm³	Euro I	2000	2003											
Mopeds	<50 cm³	Euro II	2004	9999											
Motorcycles	2-stroke >50 cm³	Conventional	0	1999	6702	6470	6493	6824	6987	7148	7131	7033	7076	7168	7072
Motorcycles	4-stroke <250 cm³	Conventional	0	1999	6702	6470	6493	6824	6987	7148	7131	7033	7076	7168	7072
Motorcycles	4-stroke <250 cm³	Euro I	2000	2003											
Motorcycles	4-stroke <250 cm³	Euro II	2004	2006											
Motorcycles	4-stroke 250 - 750 cm³	Conventional	0	1999	6702	6470	6493	6824	6987	7148	7131	7033	7076	7168	7072
Motorcycles	4-stroke 250 - 750 cm³	Euro I	2000	2003											
Motorcycles	4-stroke 250 - 750 cm³	Euro II	2004	2006											
Motorcycles	4-stroke >750 cm³	Conventional	0	1999	6702	6470	6493	6824	6987	7148	7131	7033	7076	7168	7072
Motorcycles	4-stroke >750 cm³	Euro I	2000	2003											
Motorcycles	4-stroke >750 cm³	Euro II	2004	2006											

Sector	Subsector	Tech 2	FYear	LYear	2000	2001	2002	2003	2004	2005	2006
Passenger Cars	Gasoline <1,4 l	PRE ECE	0	1969	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	1970	1978	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	Gasoline <1,4 l	ECE 15/02	1979	1980	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	Gasoline <1,4 l	ECE 15/03	1981	1985	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	Gasoline <1,4 l	ECE 15/04	1986	1990	12800	11946	11628	11611	11646	11093	10706
Passenger Cars	Gasoline <1,4 l	Euro I	1991	1996	18422	17417	16703	15385	14480	12894	11777
Passenger Cars	Gasoline <1,4 l	Euro II	1997	2000	23828	22155	21228	20262	19167	17555	16242
Passenger Cars	Gasoline <1,4 l	Euro III	2001	2005		25033	24933	25811	23998	22096	20028
Passenger Cars	Gasoline <1,4 l	Euro IV	2006	2010							23306
Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	0	1969	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	1970	1978	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	1979	1980	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	1981	1985	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	1986	1990	12961	12030	11628	11611	11646	11093	10706
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro I	1991	1996	18954	17934	17241	16099	15270	13761	12393
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro II	1997	2000	23722	22066	21099	20154	19119	17565	16249
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro III	2001	2005		25033	24924	25554	23855	21973	19956
Passenger Cars	Gasoline 1,4 - 2,0 l	Euro IV	2006	2010							23306
Passenger Cars	Gasoline >2,0 l	PRE ECE	0	1969	11677	11499	11628	11611	11646	11093	10706

Continued

Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	1970	1978	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	Gasoline >2,0 l	ECE 15/02	1979	1980	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	Gasoline >2,0 l	ECE 15/03	1981	1985	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	Gasoline >2,0 l	ECE 15/04	1986	1990	12691	11875	11628	11611	11646	11093	10706
Passenger Cars	Gasoline >2,0 l	Euro I	1991	1996	18864	17845	17147	15980	15139	13657	12287
Passenger Cars	Gasoline >2,0 l	Euro II	1997	2000	24087	22498	21546	20526	19375	17855	16451
Passenger Cars	Gasoline >2,0 l	Euro III	2001	2005		25033	24906	25737	24025	22152	20130
Passenger Cars	Gasoline >2,0 l	Euro IV	2006	2010							23306
Passenger Cars	Diesel <2,0 l	Euro I	1991	1996	30423	28953	27593	25909	25090	23523	21059
Passenger Cars	Diesel <2,0 l	Euro II	1997	2000	38511	36035	34206	33003	32021	30779	28240
Passenger Cars	Diesel <2,0 l	Euro III	2001	2005		40832	40341	39594	40005	38582	34726
Passenger Cars	Diesel <2,0 l	Euro IV	2006	2010							40509
Passenger Cars	Diesel <2,0 l	Conventional	0	1990	20153	19275	18818	18984	19491	19442	18609
Passenger Cars	Diesel >2,0 l	Euro I	1991	1996	30584	29108	27750	26127	25336	23934	21357
Passenger Cars	Diesel >2,0 l	Euro II	1997	2000	39052	36697	34869	33560	32425	31292	28595
Passenger Cars	Diesel >2,0 l	Euro III	2001	2005		40832	40307	39605	40208	38823	34990
Passenger Cars	Diesel >2,0 l	Euro IV	2006	2010							40509
Passenger Cars	Diesel >2,0 l	Conventional	0	1990	20004	19172	18818	18984	19491	19442	18609
Passenger Cars	LPG	Conventional	0	1990	11677	11499	11628	11611	11646	11093	10706
Passenger Cars	2-Stroke	Conventional	0	9999	11677	11499	11628	11611	11646		
Light Duty Vehicles	Gasoline <3,5t	Conventional	0	1994	17611	17712	17891	17762	17528	16747	16885
Light Duty Vehicles	Gasoline <3,5t	Euro I	1995	1998	17611	17712	17891	17762	17528	16747	16885
Light Duty Vehicles	Gasoline <3,5t	Euro II	1999	2001	17611	17712	17891	17762	17528	16747	16885
Light Duty Vehicles	Gasoline <3,5t	Euro III	2002	2006			17891	17762	17528	16747	16885
Light Duty Vehicles	Diesel <3,5 t	Conventional	0	1994	30415	29837	29971	31946	32471	32844	33098
Light Duty Vehicles	Diesel <3,5 t	Euro I	1995	1998	30415	29837	29971	31946	32471	32844	33098
Light Duty Vehicles	Diesel <3,5 t	Euro II	1999	2001	30415	29837	29971	31946	32471	32844	33098
Light Duty Vehicles	Diesel <3,5 t	Euro III	2002	2006			29971	31946	32471	32844	33098
Heavy Duty Vehicles	Gasoline >3,5 t	Conventional	0	9999	34671	40373	41105	41246	41114	38707	39027
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Conventional	0	1993	40778	53031	53758	59444	58769	56318	56753
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro I	1994	1996	40778	53031	53758	59444	58769	56318	56753
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro II	1997	2001	40778	53031	53758	59444	58769	56318	56753
Heavy Duty Vehicles	Diesel 3,5 - 7,5 t	Euro III	2002	2006			53758	59444	58769	56318	56753
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Conventional	0	1993	44710	25187	21988	24031	24839	23803	23987
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro I	1994	1996	44710	25187	21988	24031	24839	23803	23987
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro II	1997	2001	44710	25187	21988	24031	24839	23803	23987
Heavy Duty Vehicles	Diesel 7,5 - 16 t	Euro III	2002	2006			21988	24031	24839	23803	23987

Continued											
Heavy Duty Vehicles	Diesel 16 - 32 t	Conventional	0	1993	76314	82078	82204	87358	91024	87227	87902
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro I	1994	1996	76314	82078	82204	87358	91024	87227	87902
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro II	1997	2001	76314	82078	82204	87358	91024	87227	87902
Heavy Duty Vehicles	Diesel 16 - 32 t	Euro III	2002	2006			82204	87358	91024	87227	87902
Heavy Duty Vehicles	Diesel >32t	Conventional	0	1993	76314	82078	82204	87358	91024	87227	87902
Heavy Duty Vehicles	Diesel >32t	Euro I	1994	1996	76314	82078	82204	87358	91024	87227	87902
Heavy Duty Vehicles	Diesel >32t	Euro II	1997	2001	76314	82078	82204	87358	91024	87227	87902
Heavy Duty Vehicles	Diesel >32t	Euro III	2002	2006			82204	87358	91024	87227	87902
Buses	Urban Buses	Conventional	0	1993	115754	111490	111156	118551	120341	116974	117879
Buses	Urban Buses	Euro I	1994	1996	115754	111490	111156	118551	120341	116974	117879
Buses	Urban Buses	Euro II	1997	2001	115754	111490	111156	118551	120341	116974	117879
Buses	Urban Buses	Euro III	2002	2006			111156	118551	120341	116974	117879
Buses	Coaches	Conventional	0	1993	70600	70379	72342	77550	83860	81513	82144
Buses	Coaches	Euro I	1994	1996	70600	70379	72342	77550	83860	81513	82144
Buses	Coaches	Euro II	1997	2001	70600	70379	72342	77550	83860	81513	82144
Buses	Coaches	Euro III	2002	2006			72342	77550	83860	81513	82144
Mopeds	<50 cm^3	Conventional	0	1999	1919	1526	1550	1547	1529	1460	1472
Mopeds	<50 cm^3	Euro I	2000	2003	1919	1526	1550	1547	1529	1460	1472
Mopeds	<50 cm^3	Euro II	2004	9999					1529	1460	1472
Motorcycles	2-stroke >50 cm^3	Conventional	0	1999	7170	7229	7387	7428	7387	7089	7148
Motorcycles	4-stroke <250 cm^3	Conventional	0	1999	7170	7229	7387	7428	7387	7089	7148
Motorcycles	4-stroke <250 cm^3	Euro I	2000	2003	7170	7229	7387	7428	7387	7089	7148
Motorcycles	4-stroke <250 cm^3	Euro II	2004	2006					7387	7089	7148
Motorcycles	4-stroke 250 - 750 cm^3	Conventional	0	1999	7170	7229	7387	7428	7387	7089	7148
Motorcycles	4-stroke 250 - 750 cm^3	Euro I	2000	2003	7170	7229	7387	7428	7387	7089	7148
Motorcycles	4-stroke 250 - 750 cm^3	Euro II	2004	2006					7387	7089	7148
Motorcycles	4-stroke >750 cm^3	Conventional	0	1999	7170	7229	7387	7428	7387	7089	7148
Motorcycles	4-stroke >750 cm^3	Euro I	2000	2003	7170	7229	7387	7428	7387	7089	7148
Motorcycles	4-stroke >750 cm^3	Euro II	2004	2006					7387	7089	7148

Annex 3B-3: EU directive emission limits for road transportation vehicles

Private cars and light duty vehicles I (<1305 kg)

g/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/test

Light duty vehicles II (1305-1760 kg)

g/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/test

Light duty vehicles III (>1760 kg)

g/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/test

Heavy duty diesel vehicles

(g/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 3B-4: Basis emission factors (g/km)

Sector	Subsector	Tech 2	FCu	FCr	FCh	COu	COr	COh	PMu	PMr	PMh	NOxu	NOxr	NOxh
Passenger Cars	Gasoline <1.4 l	PRE ECE	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	Euro I	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	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	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	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	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	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	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	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	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	Diesel >2.0 l	Conventional	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	LPG	Conventional	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	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	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	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	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	Diesel <3.5 t	Conventional	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	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	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	68.860	58.185	63.660	0.322	0.269	0.347	0.047	0.044	0.061	0.740	0.634	0.664
Heavy Duty Vehicles	Gasoline >3.5 t	Conventional	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	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	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	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	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 7.5 - 16 t	Conventional	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	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	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	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 16 - 32 t	Conventional	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	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	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	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 >32t	Conventional	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	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	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	346.156	276.262	262.095	2.497	1.841	1.759	0.219	0.155	0.143	9.625	7.809	7.238
Buses	Urban Buses	Conventional	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	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	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	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	Coaches	Conventional	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	259.336	198.133	182.616	2.140	1.405	1.179	0.425	0.277	0.227	8.372	6.741	6.409

Continued

Buses	Coaches	Euro II	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	276.957	213.400	197.945	2.202	1.453	1.231	0.202	0.140	0.117	8.039	6.015	5.526
Mopeds	<50 cm³	Conventional	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 cm³	Euro I	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 cm³	Euro II	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 cm³	Conventional	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 cm³	Conventional	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 cm³	Euro I	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 cm³	Euro II	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 - 750 cm³	Conventional	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 cm³	Euro I	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 cm³	Euro II	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 cm³	Conventional	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 cm³	Euro I	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 cm³	Euro II	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	CH4u	CH4r	CH4h	N2Ou	N2Or	N2Oh	NH3u	NH3r	NH3h	VOCu	VOCr	VOCh
Passenger Cars	Gasoline <1.4 l	PRE ECE	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	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	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	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	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	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	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	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 <1.4 l	Euro IV	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	0.092	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	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	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	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	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	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	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	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 1.4 - 2.0 l	Euro IV	0.002	0.002	0.000	0.002	0.000	0.000	0.002	0.029	0.065	0.012	0.014	0.017

Continued													
Passenger Cars	Gasoline >2.0 l	PRE ECE	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	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	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	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	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	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	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	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	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	Euro I	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	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	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	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	0.028	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	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	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	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	0.000	0.000	0.000	0.009	0.004	0.004	0.001	0.001	0.001	0.011	0.006	0.006
Passenger Cars	Diesel >2.0 l	Conventional	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	LPG	Conventional	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	0.150	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	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	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	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	Diesel <3.5 t	Conventional	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	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	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	0.003	0.000	0.000	0.009	0.004	0.004	0.001	0.001	0.001	0.081	0.065	0.063
Heavy Duty Vehicles	Gasoline >3.5 t	Conventional	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	0.085	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	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	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	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 7.5 - 16 t	Conventional	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	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	0.054	0.020	0.019	0.030	0.030	0.030	0.003	0.003	0.003	0.355	0.231	0.193

Continued														
Heavy Duty Vehicles	Diesel 7.5 - 16 t	Euro III	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 16 - 32 t	Conventional	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	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	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	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 >32t	Conventional	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	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	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	0.098	0.074	0.064	0.030	0.030	0.030	0.003	0.003	0.003	0.493	0.315	0.260
Buses	Urban Buses	Conventional	0.175	0.080	0.070	0.030	0.030	0.030	0.003	0.003	0.003	1.830	1.116	0.865
Buses	Urban Buses	Euro I	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	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	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	Coaches	Conventional	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	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	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	0.103	0.047	0.041	0.030	0.030	0.030	0.003	0.003	0.003	0.575	0.354	0.289
Mopeds	<50 cm³	Conventional	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 cm³	Euro I	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 cm³	Euro II	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 cm³	Conventional	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 cm³	Conventional	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 cm³	Euro I	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 cm³	Euro II	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 - 750 cm³	Conventional	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 cm³	Euro I	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 cm³	Euro II	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 cm³	Conventional	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 cm³	Euro I	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 cm³	Euro II	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 3B-5: Reduction factors for road transport emission factors

Sector	Subsector	Tech 2	FCuR	FCrR	FChR	COuR	COrR	COhR	PMuR	PMrR	PMhR	NOxuR	NOxrR	NOxhR	VOCuR	VOCrR	VOChR
Passenger Cars	Gasoline <1.4 l	PRE ECE	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	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	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	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	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	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	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	-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	-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	0.0	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	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	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	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	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	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	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	-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	-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	0.0	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	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	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	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	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	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	-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	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	-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	Euro I	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	-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	-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	-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	0.0	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	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	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	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	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	Diesel >2.0 l	Conventional	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	LPG	Conventional	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	0.0	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	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	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	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	Diesel <3.5 t	Conventional	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	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	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	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
Heavy Duty Vehicles	Gasoline >3.5 t	Conventional	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	0.0	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	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	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	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 7.5 - 16 t	Conventional	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	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	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	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 16 - 32 t	Conventional	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	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	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	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 >32t	Conventional	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	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	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	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
Buses	Urban Buses	Conventional	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	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	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	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	Coaches	Conventional	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	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

Continued																	
Buses	Coaches	Euro II	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	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
Mopeds	<50 cm³	Conventional	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 cm³	Euro I	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 cm³	Euro II	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 cm³	Conventional	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 cm³	Conventional	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 cm³	Euro I	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 cm³	Euro II	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 - 750 cm³	Conventional	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 cm³	Euro I	-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 cm³	Euro II	-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 cm³	Conventional	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 cm³	Euro I	-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 cm³	Euro II	-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 3B-6: Fuel use factors (MJ/km) and emission factors (g/km)

Sector	ForecastYear	FCu (MJ)	FCr (MJ)	FCh (MJ)	CO2u	CO2r	CO2h	CH4u	CH4r	CH4h	N2Ou	N2Or	N2Oh	SO2u	SO2r	SO2h	NOxu	NOxr	NOxh
Passenger Cars	1985	3.883	2.059	1.651	284	150	121	0.172	0.027	0.017	0.011	0.006	0.004	0.075	0.038	0.032	2.245	2.170	1.942
Passenger Cars	1986	3.844	2.049	1.638	281	150	120	0.171	0.027	0.017	0.011	0.006	0.004	0.049	0.025	0.021	2.236	2.169	1.949
Passenger Cars	1987	3.829	2.038	1.623	280	149	119	0.171	0.027	0.017	0.011	0.006	0.004	0.051	0.026	0.022	2.234	2.162	1.943
Passenger Cars	1988	3.742	2.026	1.606	273	148	117	0.169	0.027	0.017	0.011	0.006	0.004	0.051	0.026	0.022	2.206	2.152	1.937
Passenger Cars	1989	3.707	2.020	1.598	271	148	117	0.168	0.027	0.017	0.011	0.006	0.004	0.037	0.019	0.016	2.194	2.148	1.940
Passenger Cars	1990	3.691	2.018	1.593	270	147	116	0.168	0.027	0.017	0.011	0.006	0.004	0.036	0.019	0.015	2.200	2.159	1.954
Passenger Cars	1991	3.624	2.059	1.584	265	150	116	0.158	0.027	0.016	0.011	0.006	0.004	0.034	0.018	0.015	2.050	2.070	1.838
Passenger Cars	1992	3.440	2.057	1.819	251	150	133	0.145	0.026	0.018	0.012	0.006	0.005	0.023	0.013	0.012	1.856	1.942	1.996
Passenger Cars	1993	3.452	2.054	1.811	252	150	132	0.138	0.025	0.018	0.012	0.006	0.004	0.013	0.008	0.007	1.781	1.825	1.884
Passenger Cars	1994	3.339	2.101	1.802	244	154	132	0.122	0.024	0.017	0.013	0.007	0.004	0.012	0.008	0.007	1.595	1.667	1.697
Passenger Cars	1995	3.198	2.103	2.035	234	154	149	0.109	0.023	0.018	0.013	0.007	0.005	0.012	0.008	0.008	1.427	1.514	1.757
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	3.011	2.066	2.200	220	151	161	0.036	0.009	0.008	0.009	0.004	0.003	0.001	0.001	0.001	0.616	0.463	0.592
Light Duty Vehicles	1985	4.614	2.619	2.391	341	193	177	0.056	0.015	0.008	0.002	0.001	0.001	0.895	0.526	0.490	2.387	1.117	0.978
Light Duty Vehicles	1986	4.590	2.621	2.396	339	194	177	0.054	0.015	0.008	0.002	0.001	0.001	0.543	0.320	0.298	2.364	1.093	0.954
Light Duty Vehicles	1987	4.599	2.621	2.397	340	194	177	0.054	0.015	0.008	0.002	0.001	0.001	0.545	0.321	0.299	2.370	1.091	0.952
Light Duty Vehicles	1988	4.540	2.621	2.397	335	194	177	0.054	0.015	0.008	0.002	0.001	0.001	0.539	0.321	0.299	2.332	1.087	0.949
Light Duty Vehicles	1989	4.514	2.623	2.401	333	194	177	0.052	0.015	0.008	0.002	0.001	0.001	0.361	0.216	0.201	2.311	1.072	0.934
Light Duty Vehicles	1990	4.505	2.624	2.403	333	194	178	0.052	0.015	0.008	0.001	0.001	0.001	0.363	0.217	0.202	2.302	1.061	0.924
Light Duty Vehicles	1991	4.541	2.623	2.402	335	194	178	0.052	0.015	0.008	0.001	0.001	0.001	0.365	0.217	0.202	2.326	1.065	0.928
Light Duty Vehicles	1992	4.431	2.622	2.598	327	194	192	0.052	0.015	0.009	0.002	0.001	0.001	0.230	0.140	0.141	2.271	1.083	1.024
Light Duty Vehicles	1993	4.468	2.622	2.597	330	194	192	0.052	0.015	0.009	0.002	0.001	0.001	0.090	0.054	0.055	2.293	1.086	1.027
Light Duty Vehicles	1994	4.059	2.790	2.801	300	206	207	0.046	0.016	0.010	0.001	0.001	0.001	0.082	0.058	0.059	2.066	1.141	1.091
Light Duty Vehicles	1995	4.051	2.770	2.780	299	205	205	0.044	0.015	0.009	0.002	0.001	0.001	0.082	0.058	0.059	2.009	1.123	1.076

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	1.083	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	3.704	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	3.670	2.576	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
Heavy Duty Vehicles	1985	13.245	9.672	9.165	980	716	678	0.160	0.063	0.055	0.035	0.030	0.026	3.087	2.259	2.143	13.200	10.127	9.435
Heavy Duty Vehicles	1986	13.246	9.673	9.166	980	716	678	0.160	0.063	0.055	0.035	0.030	0.026	1.853	1.356	1.286	13.204	10.128	9.436
Heavy Duty Vehicles	1987	13.246	9.673	9.166	980	716	678	0.160	0.063	0.055	0.035	0.030	0.026	1.853	1.356	1.286	13.204	10.128	9.436
Heavy Duty Vehicles	1988	13.246	9.673	9.166	980	716	678	0.160	0.063	0.055	0.035	0.030	0.026	1.854	1.356	1.286	13.204	10.128	9.437
Heavy Duty Vehicles	1989	13.247	9.674	9.167	980	716	678	0.160	0.063	0.055	0.035	0.030	0.026	1.236	0.904	0.858	13.207	10.128	9.437
Heavy Duty Vehicles	1990	13.110	9.604	9.122	970	711	675	0.159	0.063	0.054	0.035	0.030	0.026	1.223	0.898	0.853	13.056	10.050	9.389
Heavy Duty Vehicles	1991	13.463	9.815	8.625	996	726	638	0.163	0.064	0.051	0.035	0.031	0.025	1.256	0.917	0.807	13.401	10.270	8.883
Heavy Duty Vehicles	1992	13.462	9.814	8.624	996	726	638	0.163	0.064	0.051	0.035	0.031	0.025	0.816	0.596	0.524	13.398	10.270	8.882
Heavy Duty Vehicles	1993	13.200	9.319	9.493	977	690	702	0.160	0.061	0.056	0.035	0.029	0.027	0.308	0.218	0.222	13.145	9.747	9.780
Heavy Duty Vehicles	1994	10.754	9.711	10.013	796	719	741	0.132	0.064	0.060	0.029	0.031	0.029	0.251	0.227	0.234	10.530	9.982	10.135
Heavy Duty Vehicles	1995	10.631	9.541	10.038	787	706	743	0.132	0.064	0.060	0.029	0.030	0.030	0.248	0.223	0.235	10.234	9.631	9.989
Heavy Duty Vehicles	1996	10.945	9.279	9.945	810	687	736	0.137	0.063	0.060	0.030	0.030	0.030	0.255	0.217	0.233	10.358	9.206	9.721
Heavy Duty Vehicles	1997	11.147	9.392	9.962	825	695	737	0.137	0.064	0.061	0.030	0.030	0.030	0.260	0.220	0.233	10.430	9.182	9.585
Heavy Duty Vehicles	1998	11.114	9.367	9.901	822	693	733	0.134	0.064	0.061	0.030	0.030	0.030	0.259	0.219	0.232	10.268	9.026	9.381
Heavy Duty Vehicles	1999	11.210	9.423	9.892	829	697	732	0.133	0.065	0.062	0.030	0.030	0.030	0.144	0.121	0.127	10.246	8.963	9.244
Heavy Duty Vehicles	2000	11.134	9.363	9.821	824	693	727	0.129	0.064	0.062	0.030	0.030	0.030	0.026	0.022	0.023	10.084	8.809	9.068
Heavy Duty Vehicles	2001	11.399	9.535	9.869	844	706	730	0.131	0.067	0.063	0.030	0.030	0.030	0.027	0.022	0.023	10.181	8.837	8.973
Heavy Duty Vehicles	2002	11.355	9.506	9.815	840	703	726	0.126	0.067	0.063	0.030	0.030	0.030	0.027	0.022	0.023	9.822	8.513	8.617
Heavy Duty Vehicles	2003	11.310	9.475	9.774	837	701	723	0.121	0.067	0.062	0.030	0.030	0.030	0.026	0.022	0.023	9.507	8.225	8.313
Heavy Duty Vehicles	2004	11.173	9.380	9.673	827	694	716	0.115	0.066	0.062	0.030	0.030	0.030	0.026	0.022	0.023	9.043	7.814	7.886
Heavy Duty Vehicles	2005	11.109	9.330	9.619	822	690	712	0.111	0.066	0.062	0.030	0.030	0.030	0.005	0.004	0.005	8.744	7.542	7.605
Heavy Duty Vehicles	2006	11.053	9.286	9.572	818	687	708	0.107	0.066	0.061	0.030	0.030	0.030	0.005	0.004	0.004	8.471	7.293	7.348
Buses	1985	13.991	10.503	5.954	1035	777	441	0.186	0.082	0.047	0.032	0.031	0.020	3.277	2.460	1.394	14.555	11.430	6.449
Buses	1986	13.991	10.501	5.955	1035	777	441	0.186	0.082	0.047	0.032	0.031	0.020	1.966	1.476	0.837	14.552	11.425	6.448
Buses	1987	13.992	10.509	5.954	1035	778	441	0.186	0.082	0.047	0.032	0.031	0.020	1.966	1.477	0.837	14.561	11.442	6.452

Continued

Buses	1988	13.992	10.522	5.952	1035	779	440	0.186	0.082	0.047	0.032	0.031	0.020	1.966	1.479	0.836	14.575	11.469	6.458
Buses	1989	13.992	10.516	5.953	1035	778	440	0.186	0.082	0.047	0.032	0.031	0.020	1.311	0.985	0.558	14.569	11.457	6.455
Buses	1990	13.991	10.493	5.956	1035	776	441	0.186	0.082	0.047	0.032	0.031	0.020	1.311	0.983	0.558	14.544	11.408	6.444
Buses	1991	13.496	10.905	5.956	999	807	441	0.180	0.085	0.047	0.031	0.032	0.020	1.264	1.022	0.558	14.023	11.865	6.443
Buses	1992	13.908	10.558	5.956	1029	781	441	0.185	0.082	0.047	0.032	0.031	0.020	0.847	0.643	0.363	14.467	11.471	6.444
Buses	1993	13.871	10.273	6.927	1026	760	513	0.185	0.080	0.055	0.032	0.030	0.023	0.325	0.241	0.162	14.385	11.178	7.500
Buses	1994	13.194	10.262	7.822	976	759	579	0.178	0.081	0.062	0.030	0.030	0.027	0.309	0.240	0.183	13.459	10.885	8.301
Buses	1995	12.975	9.788	8.658	960	724	641	0.177	0.079	0.070	0.030	0.030	0.030	0.304	0.229	0.203	12.890	10.097	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
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	
Mopeds	2001	1.019	1.019		74	74		0.188	0.188		0.001	0.001		0.002	0.002		0.020	0.020	

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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	
Motorcycles	1985	1.252	1.284	1.916	91	94	140	0.184	0.188	0.234	0.002	0.002	0.002	0.003	0.003	0.004	0.117	0.222	0.412
Motorcycles	1986	1.252	1.284	1.916	91	94	140	0.184	0.188	0.234	0.002	0.002	0.002	0.003	0.003	0.004	0.117	0.222	0.412
Motorcycles	1987	1.252	1.284	1.916	91	94	140	0.184	0.188	0.234	0.002	0.002	0.002	0.003	0.003	0.004	0.117	0.222	0.412
Motorcycles	1988	1.252	1.284	1.916	91	94	140	0.184	0.188	0.234	0.002	0.002	0.002	0.003	0.003	0.004	0.117	0.222	0.412
Motorcycles	1989	1.252	1.284	1.916	91	94	140	0.184	0.188	0.234	0.002	0.002	0.002	0.003	0.003	0.004	0.117	0.222	0.412
Motorcycles	1990	1.252	1.284	1.916	91	94	140	0.184	0.188	0.234	0.002	0.002	0.002	0.003	0.003	0.004	0.117	0.222	0.412
Motorcycles	1991	1.447	1.149	1.578	106	84	115	0.213	0.168	0.193	0.002	0.002	0.002	0.003	0.003	0.004	0.135	0.199	0.340
Motorcycles	1992	1.252	1.351	1.690	91	99	123	0.184	0.197	0.206	0.002	0.002	0.002	0.003	0.003	0.004	0.117	0.234	0.364
Motorcycles	1993	1.475	1.149	1.465	108	84	107	0.217	0.168	0.179	0.002	0.002	0.002	0.003	0.003	0.003	0.137	0.199	0.315
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	1.224	1.250	2.141	89	91	156	0.180	0.183	0.261	0.002	0.002	0.003	0.003	0.003	0.005	0.114	0.217	0.461
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	96	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

Sector	ForecastYear	NMVOCu (exh)	NMVOCr (exh)	NMVOCh (exh)	NMVOCu (tot)	NMVOCr (tot)	NMVOCh (tot)	COu	COr	COh
Passenger Cars	1985	3.771	1.039	0.641	6.054	1.425	0.692	44.742	10.034	7.308
Passenger Cars	1986	3.647	1.016	0.623	5.938	1.404	0.675	42.147	9.531	6.866
Passenger Cars	1987	3.594	0.991	0.601	5.854	1.373	0.653	40.275	8.943	6.387
Passenger Cars	1988	3.299	0.958	0.573	5.638	1.353	0.627	35.045	8.169	5.738
Passenger Cars	1989	3.175	0.938	0.558	5.539	1.338	0.612	32.921	7.766	5.367
Passenger Cars	1990	3.125	0.927	0.548	5.491	1.327	0.602	31.831	7.477	5.087

Continued

Sector	ForecastYear	NMVOCu (exh)	NMVOCr (exh)	NMVOCh (exh)	NMVOCu (tot)	NMVOCr (tot)	NMVOCh (tot)	COu	COr	COh
Passenger Cars	1991	3.047	0.884	0.510	5.209	1.249	0.560	31.150	7.128	4.726
Passenger Cars	1992	2.775	0.824	0.549	4.812	1.169	0.595	28.220	6.664	5.092
Passenger Cars	1993	2.761	0.767	0.510	4.580	1.074	0.552	28.020	6.214	4.764
Passenger Cars	1994	2.466	0.692	0.449	4.108	0.969	0.487	24.599	5.641	4.206
Passenger Cars	1995	2.299	0.620	0.457	3.748	0.865	0.490	22.737	5.137	4.389
Passenger Cars	1996	2.248	0.542	0.455	3.478	0.750	0.483	22.063	4.570	4.511
Passenger Cars	1997	1.889	0.453	0.382	2.966	0.635	0.406	17.933	3.774	3.853
Passenger Cars	1998	1.732	0.388	0.328	2.608	0.536	0.348	16.485	3.314	3.426
Passenger Cars	1999	1.517	0.333	0.282	2.276	0.462	0.299	14.324	2.921	3.070
Passenger Cars	2000	1.388	0.294	0.249	1.898	0.381	0.260	13.097	2.649	2.831
Passenger Cars	2001	1.339	0.264	0.224	1.779	0.339	0.234	12.853	2.465	2.693
Passenger Cars	2002	1.167	0.232	0.198	1.551	0.297	0.207	11.308	2.251	2.517
Passenger Cars	2003	1.084	0.204	0.174	1.411	0.259	0.182	10.696	2.046	2.336
Passenger Cars	2004	0.908	0.175	0.151	1.186	0.222	0.157	9.023	1.837	2.147
Passenger Cars	2005	0.860	0.147	0.127	1.109	0.189	0.133	8.885	1.606	1.921
Passenger Cars	2006	0.727	0.122	0.106	0.945	0.159	0.111	7.579	1.385	1.690
Light Duty Vehicles	1985	0.814	0.173	0.114	1.130	0.222	0.123	7.660	1.673	1.618
Light Duty Vehicles	1986	0.760	0.167	0.111	1.055	0.212	0.120	7.110	1.618	1.560
Light Duty Vehicles	1987	0.765	0.166	0.111	1.056	0.211	0.119	7.148	1.614	1.555
Light Duty Vehicles	1988	0.712	0.165	0.111	1.012	0.212	0.119	6.685	1.606	1.547
Light Duty Vehicles	1989	0.672	0.161	0.109	0.961	0.206	0.117	6.296	1.572	1.511
Light Duty Vehicles	1990	0.652	0.158	0.107	0.929	0.202	0.115	6.093	1.548	1.485
Light Duty Vehicles	1991	0.684	0.159	0.108	0.961	0.202	0.116	6.381	1.557	1.495
Light Duty Vehicles	1992	0.687	0.164	0.119	0.985	0.210	0.128	6.448	1.596	1.665
Light Duty Vehicles	1993	0.719	0.165	0.120	1.008	0.210	0.128	6.736	1.603	1.673
Light Duty Vehicles	1994	0.643	0.172	0.127	0.929	0.216	0.135	6.014	1.673	1.764
Light Duty Vehicles	1995	0.631	0.166	0.124	0.893	0.206	0.131	5.904	1.576	1.668
Light Duty Vehicles	1996	0.625	0.159	0.129	0.851	0.194	0.136	5.804	1.473	1.676
Light Duty Vehicles	1997	0.563	0.152	0.125	0.773	0.185	0.131	5.250	1.371	1.567
Light Duty Vehicles	1998	0.552	0.148	0.123	0.736	0.177	0.128	5.173	1.293	1.486
Light Duty Vehicles	1999	0.510	0.141	0.119	0.678	0.168	0.124	4.740	1.197	1.381
Light Duty Vehicles	2000	0.478	0.136	0.116	0.595	0.154	0.119	4.448	1.115	1.293
Light Duty Vehicles	2001	0.478	0.131	0.113	0.580	0.147	0.116	4.404	1.034	1.207
Light Duty Vehicles	2002	0.418	0.121	0.106	0.504	0.135	0.108	3.855	0.920	1.080
Light Duty Vehicles	2003	0.381	0.112	0.099	0.448	0.122	0.101	3.426	0.809	0.954

Continued

Sector	ForecastYear	NMVOCu (exh)	NMVOCr (exh)	NMVOCh (exh)	NMVOCu (tot)	NMVOCr (tot)	NMVOCh (tot)	COu	COr	COh
Light Duty Vehicles	2004	0.316	0.102	0.092	0.365	0.110	0.094	2.801	0.684	0.816
Light Duty Vehicles	2005	0.301	0.095	0.087	0.340	0.101	0.088	2.571	0.599	0.719
Light Duty Vehicles	2006	0.271	0.089	0.083	0.300	0.094	0.084	2.232	0.529	0.641
Heavy Duty Vehicles	1985	1.220	0.666	0.431	1.220	0.666	0.431	3.534	2.176	1.834
Heavy Duty Vehicles	1986	1.217	0.664	0.431	1.217	0.664	0.431	3.496	2.157	1.825
Heavy Duty Vehicles	1987	1.216	0.664	0.431	1.216	0.664	0.431	3.494	2.155	1.824
Heavy Duty Vehicles	1988	1.216	0.664	0.431	1.216	0.664	0.431	3.488	2.152	1.823
Heavy Duty Vehicles	1989	1.214	0.663	0.430	1.214	0.663	0.430	3.465	2.141	1.818
Heavy Duty Vehicles	1990	1.220	0.665	0.431	1.220	0.665	0.431	3.448	2.134	1.813
Heavy Duty Vehicles	1991	1.229	0.680	0.410	1.229	0.680	0.410	3.505	2.184	1.724
Heavy Duty Vehicles	1992	1.232	0.681	0.411	1.232	0.681	0.411	3.531	2.198	1.730
Heavy Duty Vehicles	1993	1.241	0.641	0.454	1.241	0.641	0.454	3.527	2.078	1.911
Heavy Duty Vehicles	1994	0.988	0.659	0.475	0.988	0.659	0.475	2.827	2.140	1.997
Heavy Duty Vehicles	1995	0.948	0.628	0.475	0.948	0.628	0.475	2.753	2.064	1.997
Heavy Duty Vehicles	1996	0.934	0.601	0.464	0.934	0.601	0.464	2.760	1.985	1.954
Heavy Duty Vehicles	1997	0.864	0.559	0.435	0.864	0.559	0.435	2.645	1.914	1.890
Heavy Duty Vehicles	1998	0.811	0.527	0.410	0.811	0.527	0.410	2.572	1.872	1.848
Heavy Duty Vehicles	1999	0.759	0.496	0.387	0.759	0.496	0.387	2.489	1.824	1.805
Heavy Duty Vehicles	2000	0.719	0.471	0.368	0.719	0.471	0.368	2.438	1.793	1.775
Heavy Duty Vehicles	2001	0.674	0.444	0.346	0.674	0.444	0.346	2.441	1.795	1.760
Heavy Duty Vehicles	2002	0.626	0.412	0.323	0.626	0.412	0.323	2.397	1.764	1.726
Heavy Duty Vehicles	2003	0.585	0.385	0.303	0.585	0.385	0.303	2.338	1.726	1.693
Heavy Duty Vehicles	2004	0.527	0.349	0.277	0.527	0.349	0.277	2.234	1.661	1.636
Heavy Duty Vehicles	2005	0.496	0.328	0.261	0.496	0.328	0.261	2.213	1.642	1.615
Heavy Duty Vehicles	2006	0.467	0.309	0.246	0.467	0.309	0.246	2.191	1.623	1.594
Buses	1985	1.557	0.876	0.366	1.557	0.876	0.366	4.522	2.742	1.229
Buses	1986	1.556	0.875	0.365	1.556	0.875	0.365	4.520	2.739	1.228
Buses	1987	1.559	0.878	0.367	1.559	0.878	0.367	4.527	2.747	1.231
Buses	1988	1.563	0.882	0.369	1.563	0.882	0.369	4.537	2.758	1.235
Buses	1989	1.561	0.880	0.368	1.561	0.880	0.368	4.533	2.753	1.233
Buses	1990	1.553	0.873	0.364	1.553	0.873	0.364	4.513	2.732	1.226
Buses	1991	1.496	0.909	0.364	1.496	0.909	0.364	4.349	2.845	1.225
Buses	1992	1.547	0.876	0.364	1.547	0.876	0.364	4.494	2.744	1.225
Buses	1993	1.529	0.857	0.425	1.529	0.857	0.425	4.447	2.681	1.428
Buses	1994	1.414	0.816	0.470	1.414	0.816	0.470	4.145	2.570	1.575

Continued

Sector	ForecastYear	NMVOCu (exh)	NMVOCr (exh)	NMVOCh (exh)	NMVOCu (tot)	NMVOCr (tot)	NMVOCh (tot)	COu	COr	COh
Buses	1995	1.312	0.736	0.493	1.312	0.736	0.493	3.891	2.335	1.669
Buses	1996	1.204	0.701	0.465	1.204	0.701	0.465	3.611	2.235	1.587
Buses	1997	1.124	0.660	0.443	1.124	0.660	0.443	3.436	2.137	1.528
Buses	1998	1.073	0.634	0.428	1.073	0.634	0.428	3.332	2.080	1.492
Buses	1999	1.015	0.604	0.411	1.015	0.604	0.411	3.206	2.009	1.450
Buses	2000	0.963	0.578	0.397	0.963	0.578	0.397	3.098	1.949	1.413
Buses	2001	0.922	0.557	0.385	0.922	0.557	0.385	3.011	1.900	1.384
Buses	2002	0.873	0.531	0.371	0.873	0.531	0.371	2.932	1.856	1.359
Buses	2003	0.837	0.512	0.361	0.837	0.512	0.361	2.882	1.830	1.345
Buses	2004	0.800	0.492	0.349	0.800	0.492	0.349	2.822	1.794	1.327
Buses	2005	0.756	0.470	0.338	0.756	0.470	0.338	2.753	1.758	1.305
Buses	2006	0.713	0.448	0.326	0.713	0.448	0.326	2.686	1.721	1.284
Mopeds	1985	13.691	13.691		14.001	14.001		13.800	13.800	
Mopeds	1986	13.691	13.691		14.008	14.008		13.800	13.800	
Mopeds	1987	13.691	13.691		14.006	14.006		13.800	13.800	
Mopeds	1988	13.691	13.691		14.027	14.027		13.800	13.800	
Mopeds	1989	13.691	13.691		14.041	14.041		13.800	13.800	
Mopeds	1990	13.691	13.691		14.034	14.034		13.800	13.800	
Mopeds	1991	13.691	13.691		14.019	14.019		13.800	13.800	
Mopeds	1992	13.691	13.691		14.022	14.022		13.800	13.800	
Mopeds	1993	13.691	13.691		14.001	14.001		13.800	13.800	
Mopeds	1994	13.691	13.691		14.013	14.013		13.800	13.800	
Mopeds	1995	13.691	13.691		14.014	14.014		13.800	13.800	
Mopeds	1996	13.691	13.691		14.001	14.001		13.800	13.800	
Mopeds	1997	13.691	13.691		14.017	14.017		13.800	13.800	
Mopeds	1998	13.691	13.691		14.002	14.002		13.800	13.800	
Mopeds	1999	13.691	13.691		14.037	14.037		13.800	13.800	
Mopeds	2000	12.563	12.563		12.849	12.849		12.960	12.960	
Mopeds	2001	11.773	11.773		12.084	12.084		12.371	12.371	
Mopeds	2002	10.937	10.937		11.256	11.256		11.748	11.748	
Mopeds	2003	10.520	10.520		10.837	10.837		11.437	11.437	
Mopeds	2004	9.924	9.924		10.241	10.241		10.776	10.776	
Mopeds	2005	8.923	8.923		9.274	9.274		9.743	9.743	
Mopeds	2006	7.805	7.805		8.166	8.166		8.676	8.676	
Motorcycles	1985	2.526	1.963	2.442	3.345	2.182	2.476	19.177	21.616	33.899

Continued										
Sector	ForecastYear	NMVOCu (exh)	NMVOCr (exh)	NMVOCh (exh)	NMVOCu (tot)	NMVOCr (tot)	NMVOCh (tot)	COu	COr	COh
Motorcycles	1986	2.526	1.963	2.442	3.353	2.184	2.476	19.177	21.616	33.899
Motorcycles	1987	2.526	1.963	2.442	3.348	2.183	2.476	19.177	21.616	33.899
Motorcycles	1988	2.526	1.963	2.442	3.383	2.192	2.477	19.177	21.616	33.899
Motorcycles	1989	2.526	1.963	2.442	3.403	2.198	2.478	19.177	21.616	33.899
Motorcycles	1990	2.526	1.963	2.442	3.396	2.196	2.478	19.177	21.616	33.899
Motorcycles	1991	2.919	1.756	2.011	3.772	1.984	2.046	22.160	19.341	27.917
Motorcycles	1992	2.526	2.066	2.155	3.388	2.297	2.190	19.177	22.754	29.911
Motorcycles	1993	2.975	1.756	1.867	3.797	1.976	1.901	22.586	19.341	25.923
Motorcycles	1994	2.639	2.014	2.011	3.490	2.242	2.046	20.029	22.185	27.917
Motorcycles	1995	2.470	1.911	2.729	3.318	2.138	2.764	18.751	21.047	37.887
Motorcycles	1996	2.639	2.014	2.011	3.459	2.234	2.045	20.029	22.185	27.917
Motorcycles	1997	2.639	2.014	2.011	3.496	2.244	2.047	20.029	22.185	27.917
Motorcycles	1998	2.639	2.014	2.011	3.467	2.236	2.045	20.029	22.185	27.917
Motorcycles	1999	2.639	2.014	2.011	3.496	2.244	2.046	20.029	22.185	27.917
Motorcycles	2000	2.607	1.998	1.998	3.283	2.179	2.026	19.468	21.623	27.259
Motorcycles	2001	2.568	1.961	1.961	3.233	2.139	1.989	19.445	21.600	27.257
Motorcycles	2002	2.517	1.918	1.919	3.195	2.099	1.947	19.204	21.360	27.001
Motorcycles	2003	2.466	1.875	1.878	3.139	2.055	1.906	18.978	21.134	26.761
Motorcycles	2004	2.414	1.826	1.830	3.097	2.009	1.858	18.614	20.684	26.249
Motorcycles	2005	2.354	1.774	1.780	3.084	1.969	1.810	18.150	20.155	25.645
Motorcycles	2006	2.299	1.725	1.733	3.047	1.925	1.764	17.761	19.704	25.135

Annex 3B-7: Fuel use (PJ) 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	525859	4647	177	47	1445
1986	Passenger Cars	64	809	53053	70377	1865	504301	4686	180	47	1428
1987	Passenger Cars	65	843	53628	70105	1888	485508	4723	182	48	1423
1988	Passenger Cars	66	871	54803	69859	1923	440334	4788	187	49	1398
1989	Passenger Cars	65	635	54414	68390	1903	412681	4736	185	49	1363
1990	Passenger Cars	68	650	57926	71825	2021	421933	5004	197	52	1392
1991	Passenger Cars	73	669	58348	72370	2045	435763	5315	218	230	1374
1992	Passenger Cars	76	498	58769	71376	2017	425232	5576	238	422	1320
1993	Passenger Cars	78	296	57113	69068	1983	425670	5724	253	604	1270
1994	Passenger Cars	81	303	53865	64627	1871	392516	5920	277	926	1148
1995	Passenger Cars	82	308	50703	59763	1732	369784	5991	287	1170	1057
1996	Passenger Cars	83	313	47345	55267	1611	356898	6055	296	1393	973
1997	Passenger Cars	85	318	43689	48921	1513	303940	6204	304	1820	836
1998	Passenger Cars	87	327	39819	43527	1419	282165	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	226197	6332	291	2587	670
2001	Passenger Cars	86	196	30435	28938	1109	216041	6274	273	2457	655
2002	Passenger Cars	87	199	28247	25657	1014	195346	6350	260	2390	636
2003	Passenger Cars	88	201	26162	23300	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	151966	6396	212	2035	662
2006	Passenger Cars	87	40	19506	15319	658	130112	6372	193	1860	655
1985	Light Duty Vehicles	14	2852	6760	2304	126	16496	1064	5	5	1526
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	417	9376	2983	170	21319	1507	7	7	2144
1994	Light Duty Vehicles	22	455	9949	3098	174	21892	1632	7	8	2323
1995	Light Duty Vehicles	22	448	9656	2949	164	21020	1610	10	15	2172
1996	Light Duty Vehicles	22	456	9633	2872	157	20882	1640	13	22	2135

Continued											
Year	Sector	FC (PJ)	SO_2	NO_X	NMVOC	CH_4	CO	CO_2	N_2O	NH_3	TSP
1997	Light Duty Vehicles	22	462	9550	2709	152	19531	1660	16	29	1964
1998	Light Duty Vehicles	23	467	9566	2644	149	19393	1687	20	37	1853
1999	Light Duty Vehicles	23	263	9454	2502	141	18150	1704	23	46	1735
2000	Light Duty Vehicles	24	55	9489	2303	135	17514	1744	27	55	1639
2001	Light Duty Vehicles	24	56	9533	2283	128	17410	1784	32	65	1585
2002	Light Duty Vehicles	25	59	9432	2128	119	16129	1859	37	68	1459
2003	Light Duty Vehicles	28	65	9902	2116	114	15856	2052	43	68	1489
2004	Light Duty Vehicles	30	71	10165	1967	105	14463	2232	51	73	1348
2005	Light Duty Vehicles	34	16	10886	2048	100	14653	2494	60	73	1399
2006	Light Duty Vehicles	38	18	11690	2080	96	14432	2790	71	76	1398
1985	Heavy Duty Vehicles	32	7559	33484	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	39943	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	37	854	37783	2792	317	8914	2702	104	10	1565
1994	Heavy Duty Vehicles	39	909	39595	2858	332	9249	2878	113	11	1628
1995	Heavy Duty Vehicles	40	924	39449	2803	341	9180	2925	116	12	1618
1996	Heavy Duty Vehicles	41	950	39768	2791	356	9222	3007	120	12	1631
1997	Heavy Duty Vehicles	41	963	39714	2616	357	8918	3046	122	12	1562
1998	Heavy Duty Vehicles	42	971	39572	2501	356	8800	3073	123	12	1499
1999	Heavy Duty Vehicles	43	550	40244	2411	362	8762	3164	127	13	1463
2000	Heavy Duty Vehicles	41	97	38402	2227	345	8325	3051	123	12	1344
2001	Heavy Duty Vehicles	42	98	38394	2098	349	8262	3091	124	12	1291
2002	Heavy Duty Vehicles	41	97	36864	1954	341	8058	3063	123	12	1195
2003	Heavy Duty Vehicles	44	103	38064	1965	357	8414	3254	131	13	1193
2004	Heavy Duty Vehicles	45	106	37752	1878	363	8430	3345	136	14	1127
2005	Heavy Duty Vehicles	44	21	35659	1731	348	8112	3249	133	13	1025
2006	Heavy Duty Vehicles	45	21	35587	1679	352	8234	3332	137	14	983
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											
Year	Sector	FC (PJ)	SO_2	NO_X	NMVOC	CH_4	CO	CO_2	N_2O	NH_3	TSP
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	15287	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	210	4092	184	18743	100	2	2	65
1985	Total	111	11621	92561	80996	2378	561271	8160	275	62	4431
1986	Total	117	7862	98284	80718	2437	540938	8625	289	64	4764
1987	Total	118	7847	98292	80084	2450	521944	8636	289	64	4781
1988	Total	118	7857	99080	79593	2481	476251	8694	293	66	4722
1989	Total	120	5488	100344	77996	2472	448416	8789	295	66	4796
1990	Total	126	5767	105933	81811	2619	459539	9275	312	70	5053
1991	Total	132	5903	107409	82697	2658	474997	9690	335	248	5179
1992	Total	134	3820	106683	81762	2627	465106	9863	352	441	5026
1993	Total	136	1569	104339	79515	2592	466804	9987	365	623	5044
1994	Total	143	1669	103482	75265	2502	435050	10487	398	946	5164
1995	Total	144	1682	99888	70480	2370	412018	10585	414	1198	4917
1996	Total	147	1721	96827	66214	2265	399617	10764	430	1428	4814
1997	Total	149	1744	93041	60042	2176	346233	10978	442	1862	4444
1998	Total	152	1768	89052	54906	2090	325320	11166	447	2226	4191

Continued											
Year	Sector	FC (PJ)	SO_2	NO_X	NMVOC	CH_4	CO	CO_2	N_2O	NH_3	TSP
1999	Total	154	1088	85941	48977	1980	290786	11312	450	2492	3986
2000	Total	153	352	81108	41599	1861	267325	11202	443	2657	3732
2001	Total	153	353	78485	37854	1740	256942	11223	429	2536	3599
2002	Total	155	357	74679	34307	1636	235566	11352	421	2472	3360
2003	Total	161	371	74275	31872	1572	225428	11806	420	2376	3386
2004	Total	165	381	72201	28154	1480	200562	12115	421	2281	3177
2005	Total	166	77	68519	25947	1376	192046	12229	406	2123	3150
2006	Total	171	79	66993	23171	1290	171521	12594	402	1951	3101

Annex 3B-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	2001	2002	2003	2004	2005	2006
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	1.09	1.11	1.11	1.10	1.05	1.06
	Diesel (fuel ratio)	DEA:COPERT IV	1.22	1.29	1.25	1.25	1.28	1.39	1.43	1.40	1.41	1.51	1.49	1.51	1.51	1.49	1.46	1.42	1.38	1.38	1.45	1.47	1.43	1.43
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	1.09	1.11	1.11	1.10	1.05	1.06
	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	1.54	1.50	1.46	1.47	1.57	1.61	1.57	1.58
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	1.13	1.14	1.13	1.12	1.07	1.08
	Diesel (fuel ratio)	DEA:COPERT IV	1.13	1.16	1.13	1.13	1.17	1.27	1.36	1.34	1.34	1.40	1.37	1.38	1.38	1.36	1.34	1.32	1.29	1.27	1.31	1.32	1.29	1.30
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	1.13	1.14	1.13	1.12	1.07	1.08
	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	1.43	1.44	1.41	1.40	1.38	1.35	1.34	1.38	1.41	1.38	1.40

Annex 3B-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 [P=kW]	Emission Level	NO_x	VOC	CO	N_2O [g/kWh]	NH_3	TSP	Fuel
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

Continued

Engine size	Emission Level	NO_x	VOC	CO	N_2O	NH_3	TSP	Fuel
[P=kW]				[g/kWh]				
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 [S=ccm]	Emission Level	NO_x	VOC	CO	N_2O [g/kWh]	NH_3	TSP	Fuel
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/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 [g/kWh]	VOC [g/kWh]	CO [g/kWh]	NH_3 [g/kWh]	N_2O [g/kWh]	TSP [g/kWh]	FC [g/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 [g/GJ]	VOC [g/GJ]	CO [g/GJ]	NH_3 [g/GJ]	N_2O [g/GJ]	TSP [g/GJ]	Fuel [kg/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/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/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/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 3B-10: Stock data for non-road working machinery and equipment

Stock data for diesel tractors 1985-2006

Size (kW)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
37	<1981	3882	3234	3106	2922	2861	2610	2605	2273	2193	1918	1796	1601	1449	1298	1148	993	833	664
37	1981-1990	635	879	889	883	915	887	945	883	918	869	888	871	876	882	892	900	906	903
37	1991-Stage I			25	107	153	201	278	354	445	496	554	568	572	576	582	587	592	590
37	Stage I													33	56	83	84	84	84
37	Stage II																23	53	162
45	<1981	25988	21650	20796	19563	19154	17475	17441	15219	14684	12840	12025	10715	9700	8690	7685	6646	5577	4447
45	1981-1990	5740	8770	8867	8805	9128	8848	9419	8807	9151	8668	8856	8681	8731	8800	8894	8974	9037	9006
45	1991-Stage I			203	202	209	203	216	202	210	199	203	199	200	202	204	206	207	207
49	1991-Stage I				154	281	485	602	618	702	749	765	750	754	760	768	775	780	778
52	1991-Stage I											247	358	360	363	367	370	373	372
52	Stage I													132	242	377	381	383	382
52	Stage II																68	147	241
56	1991-Stage I				201	338	428	747	943	1181	1280	1307	1281	1289	1299	1313	1325	1334	1329
60	<1981	54651	45529	43732	41140	40278	36747	36676	32004	30879	27001	25287	22533	20397	18273	16162	13976	11729	9351
60	1981-1990	11751	20542	20770	20624	21380	20725	22063	20628	21434	20304	20744	20333	20451	20612	20834	21019	21167	21096
60	1991-Stage I			863	857	888	861	917	857	891	844	862	845	850	856	866	873	879	876
63	1991-Stage I				468	855	1325	2014	2384	2837	3011	3076	3015	3033	3057	3090	3117	3139	3128
67	1991-Stage I											671	1343	1351	1361	1376	1388	1398	1393
67	Stage I													533	835	1113	1123	1131	1127
67	Stage II																375	729	1144
71	1991-Stage I				411	715	1179	1949	2507	3344	3594	3672	3600	3620	3649	3688	3721	3747	3735
78	<1981	14558	12128	11649	10959	10729	9789	9770	8525	8226	7192	6736	6002	5433	4868	4305	3723	3124	2491
78	1981-1990	4592	11323	11448	11368	11785	11424	12162	11371	11815	11192	11434	11208	11273	11361	11484	11586	11668	11628
78	1991-Stage I			1233	1503	1713	1945	2429	2561	2946	2994	3287	3436	3727	3756	3797	3830	3857	3844
78	Stage I														325	329	332	334	333
78	Stage II															227	310	400	463
86	1991-Stage I				108	193	333	589	880	1364	1532	1718	1876	2023	2039	2061	2079	2094	2087
86	Stage I														134	136	137	138	137
86	Stage II															91	343	530	760
93	1991-Stage I											149	245	325	327	331	334	336	335
93	Stage I														114	115	116	117	116
93	Stage II															107	186	313	512

Continued

Size (kW)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
97	1991-Stage I				71	175	443	962	1556	2327	2638	2695	2642	2657	2678	2707	2731	2750	2741
101	<1981	4659	3881	3728	3507	3433	3132	3126	2728	2632	2302	2156	1921	1739	1558	1378	1191	1000	797
101	1981-1990	1158	2377	2403	2387	2474	2398	2553	2387	2480	2350	2400	2353	2367	2385	2411	2432	2449	2441
101	1991-Stage I			266	264	274	266	283	264	275	260	696	1116	1567	1579	1596	1611	1622	1616
101	Stage I														232	234	236	238	237
101	Stage II															136	357	635	776
112	1991-Stage I				63	114	166	252	422	690	790	978	1265	1626	1639	1656	1671	1683	1677
112	Stage I														465	470	474	478	476
112	Stage II															337	732	1170	1763
127	1991-Stage I				12	36	81	193	279	408	457	590	707	847	854	863	871	877	874
127	Stage I														152	154	155	156	156
127	Stage II															78	268	453	591
131	<1981	798	665	639	601	588	537	536	467	451	394	369	329	298	267	236	204	171	137
131	1981-1990	288	887	897	890	923	895	952	890	925	876	895	878	883	890	899	907	914	911
131	1991-Stage I			97	97	100	97	103	97	100	95	97	95	96	96	97	98	99	99
157	1981-1990		15	15	15	16	15	16	15	16	15	15	15	15	15	15	16	16	16
157	1991-Stage I			9	23	39	102	232	357	545	648	784	900	905	912	922	930	937	934
157	Stage I													89	89	90	91	92	91
157	Stage II														149	415	695	1089	1085
157	Stage IIIA																		623
186	1991-Stage I											23	53	54	54	55	55	56	55
186	Stage I													47	48	48	49	49	49
186	Stage II														68	207	320	481	480
186	Stage IIIA																		272

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 certi-fied	<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 1985-2006

Size Group	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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
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
50<S<=60	1991-Stage I			8	8	8	8	8	9	9	9	9	10	10	10	10	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
60<S<=70	1991-Stage I			8	16	18	21	22	24	23	24	24	25	26	27	27	29	30	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
70<S<=80	1991-Stage I			72	77	83	86	87	96	91	98	96	102	107	108	111	118	120	118
70<S<=80	Stage I											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
80<S<=90	1991-Stage I			61	158	181	200	200	217	207	222	217	231	242	244	251	267	272	265
80<S<=90	Stage I											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
90<S<=100	1991-Stage I			180	257	320	329	351	382	367	393	385	410	429	433	445	473	481	471
90<S<=100	Stage I											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
100<S<=120	1991-Stage I			129	253	316	375	440	567	586	673	660	702	734	740	762	811	824	805
100<S<=120	Stage I											2	2	2	2	2	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
120<S<=140	1991-Stage I			70	148	189	215	319	484	626	804	860	918	964	972	1001	1064	1082	1057
120<S<=140	Stage I											21	26	30	31	32	34	34	33
120<S<=140	Stage II																3	3	3
120<S<=140	Stage IIIA																		1
140<S<=160	1991-Stage I				8	36	69	112	271	354	554	632	715	784	791	814	866	880	860

Continued																			
Size Group	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
140<S<=160	Stage II														22	38	50	57	56
140<S<=160	Stage IIIA																		5
160<S<=180	1991-Stage I							26	69	200	374	440	533	594	599	617	655	666	651
160<S<=180	Stage II														44	76	95	107	105
160<S<=180	Stage IIIA																		8
180<S<=200	1991-Stage I								20	67	117	193	249	296	299	308	327	333	325
180<S<=200	Stage II														66	99	120	132	129
180<S<=200	Stage IIIA																		8
200<S<=220	1991-Stage I										45	92	142	185	186	192	204	207	203
200<S<=220	Stage II														44	76	95	107	105
200<S<=220	Stage IIIA																		8
220<S<=240	1991-Stage I											3	48	149	150	154	164	167	163
220<S<=240	Stage II														78	124	170	220	215
220<S<=240	Stage IIIA																		55
240<S<=260	1991-Stage I											3	71	140	141	145	154	157	153
240<S<=260	Stage II														78	137	207	295	289
240<S<=260	Stage IIIA																		102
260<S<=280	1991-Stage I											14	61	129	130	134	142	145	141
260<S<=280	Stage II														78	137	207	295	289
260<S<=280	Stage IIIA																		102
280<S<=300	1991-Stage I													33	33	34	36	37	36
280<S<=300	Stage II														78	137	207	295	289
280<S<=300	Stage IIIA																		102
300<S<=320	Stage II															28	61	104	102
300<S<=320	Stage IIIA																		51

Stock data for fork lifts 1985-2006

FuelCode	Size (kW)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Diesel	35	<1981	387	260	234	209	183	158	133	107	84	58	30							
Diesel	35	1981-1990	120	297	297	297	297	297	297	297	297	297	297	297	277	249	232	198	177	135
Diesel	35	1991-Stage I			26	49	65	93	131	168	218	247	275	304	304	304	304	304	304	304
Diesel	35	Stage II													23	53	75	89	117	152
Diesel	45	<1981	1612	1082	976	870	764	658	552	446	349	243	126							
Diesel	45	1981-1990	499	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233	1151	1036	964	820	734	559
Diesel	45	1991-Stage I			108	203	270	386	544	699	905	1063	1063	1063	1063	1063	1063	1063	1063	1063
Diesel	45	Stage I											151	303	422	524	664	664	664	664
Diesel	45	Stage II																104	232	452
Diesel	50	<1981	2173	1459	1316	1174	1031	888	745	602	471	328	170							
Diesel	50	1981-1990	673	1662	1662	1662	1662	1662	1662	1662	1662	1662	1662	1662	1551	1396	1299	1105	989	753
Diesel	50	1991-Stage I			145	273	363	519	732	940	1217	1469	1469	1469	1469	1469	1469	1469	1469	1469
Diesel	50	Stage I											240	461	682	897	1135	1135	1135	1135
Diesel	50	Stage II																187	447	818
Diesel	75	<1981	497	334	301	269	236	203	170	138	108	75	39							
Diesel	75	1981-1990	154	382	382	382	382	382	382	382	382	382	382	382	357	321	299	255	228	174
Diesel	75	1991-Stage I			33	63	84	120	169	217	281	354	354	354	354	354	354	354	354	354
Diesel	75	Stage I											70	162	234	311	311	311	311	311
Diesel	75	Stage II															58	129	208	326
Diesel	120	<1981	111	74	67	60	52	45	38	31	24	17	9							
Diesel	120	1981-1990	34	85	85	85	85	85	85	85	85	85	85	85	80	72	67	57	51	39
Diesel	120	1991-Stage I			7	14	19	27	38	49	63	97	97	97	97	97	97	97	97	97
Diesel	120	Stage I											32	71	89	118	118	118	118	118
Diesel	120	Stage II															16	38	58	112
LPG	33		5420	5215	5156	5068	4947	4863	4835	4792	4732	4765	4712	4718	4677	4655	4595	4494	4345	4220
LPG	40		4917	4730	4676	4596	4486	4410	4384	4344	4289	4295	4223	4218	4214	4244	4224	4166	4116	4048
LPG	50		2149	2067	2044	2008	1960	1926	1915	1897	1874	1926	1941	1897	1938	2003	2020	2018	2029	2061
LPG	78		97	93	92	91	89	88	88	87	86	90	92	88	95	98	99	104	104	114
LPG	120											1	2	2	2	3	3	3	3	3

Stock data for construction machinery 1985-2006

EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Track type dozers	<1981	125																	
Track type dozers	1981-1990	125	250	221	193	166	139	114	89	66	43	21							
Track type dozers	1991-Stage I			25	48	71	93	114	134	153	172	189	206	201	177	154	132	128	125.00
Track type dozers	Stage II														20	38	56	86	100.00
Track type dozers	Stage IIIA																		25.00
Track type loaders	<1981	50																	
Track type loaders	1981-1990	50	100	89	79	68	58	48	38	28	19	9							
Track type loaders	1991-Stage I			10	20	29	39	48	57	66	75	83	91	91	81	71	62	61	70.50
Track type loaders	Stage II														9	18	26	40	56.40
Track type loaders	Stage IIIA																		14.10
Wheel loaders (0-5 tons)	1981-1990			186	331	434	496	517	496	434	331	186							
Wheel loaders (0-5 tons)	1991-Stage I			21	83	186	331	517	744	1013	1323	1674	2067	2046	1984	1881	1736	1444	1268.80
Wheel loaders (0-5 tons)	Stage II													227	496	806	1158	1444	1903.20
Wheel loaders (> 5,1 tons)	<1981	1250																	
Wheel loaders (> 5,1 tons)	1981-1990	1250	2500	2228	1960	1698	1441	1188	941	698	460	228							
Wheel loaders (> 5,1 tons)	1991-Stage I			248	490	728	960	1188	1411	1629	1841	1822	1802	1559	1322	1089	861	677	484.60
Wheel loaders (> 5,1 tons)	Stage I											228	450	668	881	871	861	902	969.20
Wheel loaders (> 5,1 tons)	Stage II															218	431	677	969.20
Wheel type excavators	<1981	500																	
Wheel type excavators	1981-1990	500	1000	862	732	611	498	394	298	211	132	62							
Wheel type excavators	1991-Stage I			96	183	262	332	394	447	491	528	493	459	372	293	223	162	118	74.00
Wheel type excavators	Stage I											62	115	160	196	179	162	157	148.00
Wheel type excavators	Stage II															45	81	118	148.00
Track type excavators (0-5 tons)	1981-1990			459	816	1071	1224	1275	1224	1071	816	459							
Track type excavators (0-5 tons)	1991-Stage I			51	204	459	816	1275	1837	2500	3265	4132	5101	5050	4897	4642	4285	3889	3599.20
Track type excavators (0-5 tons)	Stage II													561	1224	1990	2857	3889	5398.80
Track type excavators (>5,1 tons)	<1981	1000																	
Track type excavators (>5,1 tons)	1981-1990	1000	2000	1798	1596	1394	1194	993	794	594	396	198							
Track type excavators (>5,1 tons)	1991-Stage I			200	399	598	796	993	1190	1387	1583	1581	1579	1380	1181	983	785	683	536.40
Track type excavators (>5,1 tons)	Stage I											198	395	591	787	786	785	910	1072.80
Track type excavators (>5,1 tons)	Stage II															197	393	683	1072.80
Excavators/Loaders	<1981	2100																	
Excavators/Loaders	1981-1990	2100	4200	3807	3408	3003	2592	2175	1752	1323	888	447							
Excavators/Loaders	1991-Stage I			423	852	1287	1728	2175	2628	3087	3552	3575	3599	3170	2735	2295	1848	1370	937.60
Excavators/Loaders	Stage I											447	900	1359	1824	2295	2310	2283	2344.00

Continued

EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Excavators/Loaders	Stage II																462	913	1406.40
Dump trucks	<1981	250																	
Dump trucks	1981-1990	250	500	489	469	441	404	358	304	241	169	89							
Dump trucks	1991-Stage I			54	117	189	269	358	455	561	676	711	745	682	611	530	442	385	300.80
Dump trucks	Stage I											89	186	292	407	530	552	642	752.00
Dump trucks	Stage II																110	257	451.20
Mini loaders	<1981	1800	800	635	447	235													
Mini loaders	1981-1990	1000	2000	2118	2237	2355	2473	2332	2168	1980	1768	1532	1273	990	684	354			
Mini loaders	1991-Stage I			212	447	706	989	1296	1626	1980	2357	2758	3183	3301	3419	3537	3656	2756	2293.71
Mini loaders	Stage II													330	684	1061	1462	1531	1720.29
Telescopic loaders	1981-1990							149	265	348	398	414	398	348	265	149			
Telescopic loaders	1991-Stage I							83	199	348	530	746	994	1160	1326	1491	1657	1740	1837.14
Telescopic loaders	Stage II													116	265	447	663	966	1377.86

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 mover (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														

Continued

EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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 (for-estry)	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
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 (professional)	1981-1990	2000	2000	1650	1200	650													
Shrub clearers (professional)	1991-Stage I			550	1200	1950	2800	3000	3200	3400	3600	3800	4000	5500	7000	8500	10000	7500	5000
Shrub clearers (professional)	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	Stage I																	7360	14720

(private)

Continued

EquipmentName (Eng)	Emission Level	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Hedge cutters (professional)	1981-1990	1300	1300	1178	920	528													
Hedge cutters (professional)	1991-Stage I			393	920	1583	2380	2650	2920	3190	3460	3730	4000	4600	5200	5800	6400	4800	3200
Hedge cutters (professional)	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 1985-2006

Motortype	Boat type	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Diesel	Motor boats (27-34 ft)	1550	2228	2397	2567	2736	2906	3075	3244	3414	3583	3753	3922	4092	4261	4431	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
Diesel	Motor boats <(27 ft)	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
Diesel	Sailing boats (> 26 ft)	7500	9167	9583	10000	10417	10833	11250	11667	12083	12500	12917	13333	13750	14167	14583	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
2-takt	Yawls and cabin boats	4000	4222	4278	4333	4389	4444	4500	4556	4565	4527	4439	4300	4108	3862	3560	3200	2750	2250
2-takt	Sailing boats (< 26 ft)	19000	18111	17889	17667	17444	17222	17000	16778	16390	15843	15144	14300	13317	12201	10960	9600	8250	6750
2-takt	Speed boats	3000	3000	3000	3000	3000	3000	3000	3000	2970	2910	2820	2700	2550	2370	2160	1920	1650	1350
2-takt	Water scooters	1000	1000	1000	1000	1000	1000	1000	1000	990	970	940	900	850	790	720	640	550	450
4-takt	Other boats (< 20 ft)									46	140	283	478	725	1027	1384	1800	2250	2750
4-takt	Yawls and cabin boats									46	140	283	478	725	1027	1384	1800	2250	2750
4-takt	Sailing boats (< 26 ft)									166	490	967	1589	2350	3243	4262	5400	6750	8250
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
4-takt	Speed boats (out board eng.)									30	90	180	300	450	630	840	1080	1350	1650
4-takt	Water scooters									10	30	60	100	150	210	280	360	450	550

Engine sizes (kW) for recreational craft 1985-2006

Motor type		1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
2-takt	Other boats (< 20 ft)	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
2-takt	Sailing boats (< 26 ft)	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
2-takt	Water scooters	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
4-takt	Yawls and cabin boats									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
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
4-takt	Speed boats (out board eng.)									40	42	43	44	46	47	49	50	50	50
4-takt	Water scooters									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
Diesel	Motor boats (> 34 ft)	120	149	156	163	171	178	185	192	199	207	214	221	228	236	243	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
Diesel	Motor sailors	20	22	23	23	24	24	25	26	26	27	27	28	28	29	29	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

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

Ferry service	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Korsør-Nyborg, DSB	9305	9167	9237	8959	8813	8789	8746	3258	0	0	0	0	0	0	0	0	0
Korsør-Nyborg, Vognmandsruten	7512	7363	7468	7496	7502	7828	7917	8302	3576	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
Kalundborg-Juelsminde	0	1326	1733	1542	1541	1508	856	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
Sjællands Odde-Ebeltoft	3908	3978	4008	3988	4325	4569	5712	8153	7851	7720	4775	4226	3597	3191	2906	2889	2690
Sjællands Odde-Århus	0	0	0	0	0	0	0	0	0	2339	1799	1817	1825	2359	2863	2795	2853
Hundested-Grenaa	1026	1025	1032	1030	718	602	67	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
Køge-Rønne	0	0	0	0	0	0	0	0	0	0	0	0	0	0	154	488	436
Kalundborg-Samsø	873	873	860	881	826	811	813	823	824	850	828	817	833	831	841	867	862
Tårs-Spodsbjerg	7656	8835	9488	9535	9402	9562	9000	9129	7052	6442	6477	6498	6468	6516	6497	6494	6460
Local ferries	176891	179850	181834	178419	202445	209129	182750	197489	200027	202054	201833	200130	208396	208501	206297	205564	203413

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/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

Ferry service	Ferry name	Engine year	Main engine MCR (kW)	Engine type	Sfc (g/kWh)	Aux engine (kW)
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

Ferry service	Ferry name	Engine year	Main engine MCR (kW)	Engine type	Sfc (g/kWh)	Aux engine (kW)
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
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

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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 3B-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/kWh) per engine year for diesel ship engines

Year	High speed 4-stroke sfc (g/kWh)	Medium speed 4-stroke sfc (g/kWh)	Slow speed 2-stroke sfc (g/kWh)	High speed 4-stroke NO_X (g/kWh)	Medium speed 4-stroke NO_X (g/kWh)	Slow speed 2-stroke NO_X (g/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						
	High speed	Medium speed	Slow speed	High speed	Medium speed	Slow speed
Year	4-stroke	4-stroke	2-stroke	4-stroke	4-stroke	2-stroke
	sfc (g/kWh)	sfc (g/kWh)	sfc (g/kWh)	NO_X (g/kWh)	NO_X (g/kWh)	NO_X (g/kWh)
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/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

	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
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

Continued

	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
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
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/kg fuel and g/GJ) per fuel type for diesel ship engines

Fuel type	SNAPCode	Year	S %	SO_2 (g/kg)	TSP (g/kg)	PM_{10} (g/kg)	$PM_{2,5}$ (g/kg)	SO_2 (g/GJ)	TSP (g/GJ)	PM_{10} (g/GJ)	$PM_{2,5}$ (g/GJ)
Fuel	National sea	1990	2.6	52.8	6.1	6.0	6.0	1291.0	149.2	147.8	147.0
Fuel	National sea	1991	2.4	47.0	4.9	4.9	4.8	1149.1	120.2	119.0	118.4
Fuel	National sea	1992	1.8	36.0	3.3	3.2	3.2	880.2	79.8	79.0	78.6
Fuel	National sea	1993	2.4	47.8	5.1	5.0	5.0	1168.7	123.9	122.6	122.0
Fuel	National sea	1994	2.6	52.4	6.0	6.0	5.9	1281.2	147.0	145.6	144.8
Fuel	National sea	1995	3	59.0	7.7	7.6	7.6	1442.5	188.0	186.1	185.2
Fuel	National sea	1996	2.6	51.4	5.8	5.7	5.7	1256.7	141.7	140.2	139.5
Fuel	National sea	1997	2.7	54.8	6.6	6.5	6.5	1339.9	160.8	159.2	158.4
Fuel	National sea	1998	2	39.4	3.7	3.7	3.6	963.3	90.6	89.7	89.2
Fuel	National sea	1999	2	39.4	3.7	3.7	3.6	963.3	90.6	89.7	89.2
Fuel	National sea	2000	1.8	36.2	3.3	3.3	3.2	885.1	80.4	79.6	79.2
Fuel	National sea	2001	1.7	34.0	3.0	3.0	3.0	831.3	74.1	73.4	73.0
Fuel	National sea	2002	1.5	30.2	2.6	2.6	2.6	738.4	64.3	63.7	63.3
Fuel	National sea	2003	1.6	32.4	2.9	2.8	2.8	792.2	69.8	69.1	68.8
Fuel	National sea	2004	2	39.6	3.7	3.7	3.7	968.2	91.3	90.4	89.9
Fuel	National sea	2005	2	40.0	3.8	3.8	3.7	978.0	92.6	91.7	91.3
Fuel	National sea	2006	1.9	38.8	3.6	3.6	3.6	948.7	88.6	87.7	87.3
Fuel	National sea	2007	1.3	25.0	2.2	2.1	2.1	611.2	53.0	52.5	52.2
Fuel	National sea	2008	1.3	25.0	2.2	2.1	2.1	611.2	53.0	52.5	52.2
Fuel	International sea	1990	3	59.2	7.7	7.7	7.6	1447.4	189.4	187.5	186.6
Fuel	International sea	1991	2.9	57.8	7.4	7.3	7.2	1413.2	179.8	178.0	177.1
Fuel	International sea	1992	2.9	57.6	7.3	7.2	7.2	1408.3	178.5	176.7	175.8
Fuel	International sea	1993	3.2	64.0	9.3	9.2	9.1	1564.8	226.5	224.2	223.1
Fuel	International sea	1994	3	60.6	8.2	8.1	8.0	1481.7	199.6	197.6	196.6
Fuel	International sea	1995	3.3	66.0	10.0	9.9	9.8	1613.7	244.0	241.6	240.4
Fuel	International sea	1996	3.4	68.4	10.9	10.8	10.8	1672.4	266.9	264.2	262.9
Fuel	International sea	1997	3.5	69.0	11.2	11.0	11.0	1687.0	272.9	270.2	268.8
Fuel	International sea	1998	3.4	68.4	10.9	10.8	10.8	1672.4	266.9	264.2	262.9
Fuel	International sea	1999	3.5	69.0	11.2	11.0	11.0	1687.0	272.9	270.2	268.8
Fuel	International sea	2000	3.4	67.2	10.4	10.3	10.3	1643.0	255.2	252.6	251.4
Fuel	International sea	2001	3.4	68.4	10.9	10.8	10.8	1672.4	266.9	264.2	262.9
Fuel	International sea	2002	3.4	68.8	11.1	11.0	10.9	1682.2	270.9	268.2	266.8
Fuel	International sea	2003	3.1	62.2	8.7	8.6	8.5	1520.8	211.8	209.7	208.6
Fuel	International sea	2004	3.2	64.0	9.3	9.2	9.1	1564.8	226.5	224.2	223.1
Fuel	International sea	2005	3.5	70.0	11.6	11.5	11.4	1711.5	283.2	280.4	279.0

Continued											
Fuel type	SNAPCode	Year	S %	SO_2 (g/kg)	TSP (g/kg)	PM_{10} (g/kg)	$PM_{2,5}$ (g/kg)	SO_2 (g/GJ)	TSP (g/GJ)	PM_{10} (g/GJ)	$PM_{2,5}$ (g/GJ)
Fuel	International sea	2006	3.4	67.0	10.4	10.3	10.2	1638.1	253.3	250.8	249.5
Fuel	International sea	2007	1.5	30.0	2.6	2.6	2.6	733.5	63.8	63.2	62.9
Fuel	International sea	2008	1.5	30.0	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

Categories	1985	1990	1995	2000	2001	2002	2003	2004	2005	2006
Agriculture and forestry, DEA statistics										
- LPG	88	438	204	179	190	159	153	138	121	117
- gasoline	425	274	161	38	39	28	42	51	52	20
- gas/diesel oil	9 199	10 528	11 585	13 689	13 437	13 706	13 463	12 934	12 440	12 988
Gartneri, DEA statistics										
- LPG	8	50	23	19	20	17	16	14	12	12
- gasoline	10	10	18	4	4	3	5	6	6	2
- gas/diesel oil	1 705	1 409	1 138	698	581	529	556	488	431	450
Fishery, DEA statistics										
- LPG	-	42	16	13	19	21	20	18	20	20
- gasoline	-	9	8	67	3	3	0	0	0	1
- kerosene	7	26	4	25	1	1	1	1	1	0
- gas/diesel oil	9 152	10 422	8 277	9 347	8 908	8 888	8 428	7 337	7 340	7 762
- fuel oil	27	285	19	-	-	4	84	35	126	86
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
- gasoline	262	177	110	97	69	42	26	30	21	32
- gas/diesel oil	15 576	12 259	10 401	8 635	10 099	9 155	9 964	10 515	10 023	9 130
- fuel oil	29 465	15 989	14 000	8 221	7 395	7 818	6 916	6 940	6 055	8 527
Building and construction, DEA statistics										
- LPG	305	500	501	165	179	236	226	228	224	248
- gasoline	19	34	25	33	24	26	27	27	27	27
- gas/diesel oil	5 313	3 548	5 317	5 950	6 356	6 226	6 226	6 227	6 338	6 187
Housing, DEA statistics										
- gasoline	1 006	1 131	1 233	1 355	1 317	1 313	1 303	1 288	1 250	1 228
Road transport, DEA statistics										
- gasoline	66 037	74 326	80 998	88 975	86 474	86 247	85 611	84 629	82 118	80 631
- gas/diesel oil	45 609	54 746	58 561	64 282	66 254	66 814	70 875	75 422	79 686	86 422
- bioethanol	-	-	-	-	-	-	-	-	-	151
Non-road categories sum, DEA statistics										
- LPG	2 955	2 520	2 461	2 018	1 736	1 581	1 641	1 640	1 612	1 610
- gasoline	1 722	1 626	1 547	1 525	1 453	1 412	1 404	1 402	1 356	1 308
- gas/diesel oil	31 793	27 744	28 441	28 972	30 473	29 616	30 209	30 164	29 232	28 755
Non-road, NERI model										
- LPG	1232	1185	1099	1071	1073	1084	1079	1065	1049	1038

Continued										
Categories	1985	1990	1995	2000	2001	2002	2003	2004	2005	2006
- gas/diesel oil	26357	26800	25798	24630	24893	25053	25233	25558	26199	27495
Recreational craft, NERI model										
- gasoline	270	309	358	396	400	403	404	404	393	382
- gas/diesel oil	219	343	537	777	831	886	944	1 002	1 002	1 002
Non-road, added 0203 and 0301										
- gas/diesel oil	5436	944	2642	4342	5580	4563	4976	4606	3033	1260
- LPG	1724	1335	1362	947	662	497	563	575	562	572
Non-road, added 0203										
- gas/diesel oil	1864	406	1182	2156	2567	2193	2309	2050	1335	589
- LPG	56	259	125	93	80	55	58	53	46	46
Non-road, added 0301										
- gas/diesel oil	3572	538	1460	2186	3013	2370	2667	2557	1697	671
- LPG	1668	1076	1237	854	582	442	505	522	516	526
Non-road, added road transport										
- gasoline	-1276	-1145	-975	-932	-1169	-1421	-1686	-1990	-2248	-2499
Fisheries, added national sea transport										
- fuel oil	27	285	19	0	0	4	84	35	126	86
Fisheries, consumed by recreational craft										
- gasoline	0	9	8	67	3	3	0	0	0	1
National sea transport, input NERI model										
- LPG	3	2	2	0	-	-	0	0	0	0
- kerosene	5	0	1	1	1	1	1	1	1	0
- gas/diesel oil	3 074	2 782	6 049	3 367	3 240	3 780	3 828	3 463	4 358	3 699
- fuel oil	2 541	3 845	1 592	1 509	1 513	2 068	1 907	1 704	1 506	1 367
Fisheries, input NERI model										
- LPG	-	42	16	13	19	21	20	18	20	20
- gasoline	-	-	-	-	-	-	-	-	-	-
- kerosene	7	26	4	25	1	1	1	1	1	0
- gas/diesel oil	8 932	10 080	7 740	8 570	8 077	8 001	7 484	6 335	6 338	6 760
National sea transport, output NERI model										
- gas/diesel oil	4 942	4 942	6 655	4 371	4 173	4 083	4 081	4 182	4 135	4 087
- fuel oil	3 843	3 843	2 653	715	671	659	647	673	679	645
- kerosene	5	0	1	1	1	1	1	1	1	-
- LPG	3	2	2	0	-	-	0	0	0	-
Fisheries, output NERI model										
- gas/diesel oil	7 064	7 920	7 134	7 566	7 145	7 699	7 230	5 616	6 561	6 371

Continued										
Categories	1985	1990	1995	2000	2001	2002	2003	2004	2005	2006
National sea transport, added 0301										
- fuel oil	-1 302	3	-1 061	794	842	1 409	1 260	1 032	826	722
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	77 751
- gas/diesel oil	45 609	54 746	58 561	64 282	66 254	66 814	70 875	75 422	79 686	86 422
- bioethanol	-	-	-	-	-	-	-	-	-	151
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
- gas/diesel oil	49 016	59 947	64 013	69 196	70 916	72 552	78 766	84 209	88 474	95 210
- bioethanol	-	-	-	-	-	-	-	-	-	151

Annex 3B-14: Emission factors and total emissions for 1990 and 2006 in CollectER format

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	SO_2 [g/GJ]	NO_X [g/GJ]	NMVOC [g/GJ]	CH_4 [g/GJ]	CO [g/GJ]	CO_2 [kg/GJ]	N_2O [g/GJ]
1990	070101	Passenger cars	Diesel	Highway driving	666655	93.68	254.03	25.07	3.74	179.70	74	0.00
1990	070101	Passenger cars	Gasoline 2-stroke	Highway driving	29026	2.28	288.90	2357.34	10.03	3490.86	73	2.61
1990	070101	Passenger cars	Gasoline conventional	Highway driving	7515158	2.28	1317.10	364.60	11.09	3459.92	73	2.77
1990	070101	Passenger cars	LPG	Highway driving	1527	0.00	1151.70	187.09	10.06	3914.25	65	0.00
1990	070102	Passenger cars	Diesel	Rural driving	1898541	93.68	253.60	42.09	6.82	268.08	74	0.00
1990	070102	Passenger cars	Gasoline 2-stroke	Rural driving	116542	2.28	352.84	2476.82	13.84	2594.44	73	2.25
1990	070102	Passenger cars	Gasoline conventional	Rural driving	23176807	2.28	1140.07	483.50	13.92	3992.26	73	3.11
1990	070102	Passenger cars	LPG	Rural driving	4406	0.00	1248.46	305.18	16.91	1146.38	65	0.00
1990	070103	Passenger cars	Diesel	Urban driving	2836128	93.68	208.50	79.41	8.78	310.69	74	0.00
1990	070103	Passenger cars	Gasoline 2-stroke	Urban driving	222806	2.28	53.06	4365.48	30.02	7114.48	73	1.69
1990	070103	Passenger cars	Gasoline conventional	Urban driving	31997478	2.28	634.09	890.32	48.94	9372.17	73	3.24
1990	070103	Passenger cars	LPG	Urban driving	6537	0.00	642.80	431.03	24.31	1249.98	65	0.00
1990	070201	Light duty vehicles	Diesel	Highway driving	1906443	93.68	270.67	30.19	2.60	344.14	74	0.00
1990	070201	Light duty vehicles	Gasoline conventional	Highway driving	220436	2.28	1369.26	170.29	10.11	2987.40	73	2.63
1990	070202	Light duty vehicles	Diesel	Rural driving	6824381	93.68	299.25	33.22	4.26	358.42	74	0.00
1990	070202	Light duty vehicles	Gasoline conventional	Rural driving	915549	2.28	1188.86	262.59	15.25	2316.18	73	2.48
1990	070203	Light duty vehicles	Diesel	Urban driving	7966383	93.68	489.77	53.27	6.54	403.83	74	0.00
1990	070203	Light duty vehicles	Gasoline conventional	Urban driving	1336101	2.28	638.11	689.36	40.67	7008.46	73	2.28
1990	070301	Heavy duty vehicles	Diesel	Highway driving	8665327	93.68	1032.66	47.58	6.07	190.41	74	2.91
1990	070301	Heavy duty vehicles	Gasoline	Highway driving	10264	2.28	1037.78	474.61	9.69	7610.35	73	0.83
1990	070302	Heavy duty vehicles	Diesel	Rural driving	15837441	93.68	1055.19	70.91	6.79	215.24	74	3.09
1990	070302	Heavy duty vehicles	Gasoline	Rural driving	29859	2.28	1141.55	820.40	16.74	8371.39	73	0.91
1990	070303	Heavy duty vehicles	Diesel	Urban driving	13345616	93.68	1013.26	98.07	12.56	267.09	74	2.51
1990	070303	Heavy duty vehicles	Gasoline	Urban driving	34524	2.28	456.62	696.09	14.21	7102.99	73	0.61
1990	0704	Mopeds	Gasoline	Mopeds and Motorcycles < 50 cm3	286683	2.28	18.26	12503.20	200.00	12602.74	73	0.91
1990	070501	Motorcycles	Gasoline	Highway driving	76549	2.28	215.28	1274.65	122.02	17695.34	73	1.27
1990	070502	Motorcycles	Gasoline	Rural driving	142895	2.28	173.21	1528.99	146.11	16838.71	73	1.52
1990	070503	Motorcycles	Gasoline	Urban driving	167965	2.28	93.24	2017.69	147.20	15315.93	73	1.53

Year	SNAP ID	Category	Fuel type	Mode	Fuel [GJ]	SO_2 [g/GJ]	NO_X [g/GJ]	NMVOC [g/GJ]	CH_4 [g/GJ]	CO [g/GJ]	CO_2 [kg/GJ]	N_2O [g/GJ]
1990	0801	Military	Diesel		146162	93.68	782.10	64.64	7.58	274.45	74	1.80
1990	0801	Military	Jet fuel	< 3000 ft	149678	22.99	250.57	24.94	2.65	229.89	72	2.30
1990	0801	Military	Jet fuel	> 3000 ft	1347105	22.99	250.57	24.94	2.65	229.89	72	2.30
1990	0801	Military	Gasoline		986	2.28	890.75	1175.82	32.66	6684.91	73	3.08
1990	0801	Military	Aviation gasoline		4913	22.83	859.00	1242.60	21.90	6972.00	73	2.00
1990	0802	Railways	Diesel		4010007	93.68	1225.13	79.94	3.07	223.21	74	2.04
1990	0802	Railways	Kerosene		70	5.00	50.00	3.00	7.00	20.00	72	2.00
1990	0802	Railways	Gasoline		0	2.28	871.06	1129.29	33.78	6687.29	73	2.24
1990	0803	Inland waterways	Diesel		342623	93.68	983.64	171.79	2.79	453.65	74	2.96
1990	0803	Inland waterways	Gasoline		309136	2.28	291.33	3606.55	50.38	13853.27	73	0.78
1990	080402	Maritime activities	Residual oil		3842534	1290.95	1601.17	53.33	1.65	175.95	78	4.89
1990	080402	Maritime activities	Diesel		4942218	93.68	1100.31	50.67	1.57	167.17	74	4.68
1990	080402	Maritime activities	Kerosene		452	2.30	50.00	3.00	7.00	20.00	72	0.00
1990	080402	Maritime activities	LPG		1794		1249.00	384.94	20.26	443.00	65	0.00
1990	080403	Maritime activities	Residual oil		0	1466.99	1393.64	56.92	1.76	180.93	78	4.89
1990	080403	Maritime activities	Diesel		7919928	93.68	1052.12	49.13	1.52	162.08	74	4.68
1990	080403	Maritime activities	Kerosene		25787	2.30	50.00	3.00	7.00	20.00	72	0.00
1990	080403	Maritime activities	Gasoline		0	2.28	64.34	10809.58	108.10	18485.08	73	0.52
1990	080403	Maritime activities	LPG		42320		1249.00	384.94	20.26	443.00	65	0.00
1990	080404	Maritime activities	Residual oil		28543368	1447.43	1689.57	53.98	1.67	178.09	78	4.89
1990	080404	Maritime activities	Diesel		11632674	93.68	1208.60	49.46	1.53	163.17	74	4.68
1990	080501	Air traffic	Jet fuel	Dom. < 3000 ft	422173	22.99	314.51	14.93	1.59	90.41	72	5.70
1990	080501	Air traffic	Aviation gasoline		104947	22.83	859.00	1242.60	21.90	6972.00	73	2.00
1990	080502	Air traffic	Jet fuel	Int. < 3000 ft	132339	22.99	309.25	16.47	1.75	168.98	72	7.10
1990	080502	Air traffic	Aviation gasoline		30660	22.83	859.00	1242.60	21.90	6972.00	73	2.00
1990	080503	Air traffic	Jet fuel	Dom. > 3000 ft	1026021	22.99	330.11	12.36	1.31	90.75	72	2.30
1990	080504	Air traffic	Jet fuel	Int. > 3000 ft	1611915	22.99	244.20	6.48	0.69	54.10	72	2.30
1990	0806	Agriculture	Diesel		16496273	93.68	758.87	156.85	2.55	635.53	74	2.93
1990	0806	Agriculture	Gasoline		708864	2.28	31.60	949.55	88.42	47524.17	73	1.28
1990	0807	Forestry	Diesel		145346	93.68	857.48	156.47	2.54	645.65	74	2.97
1990	0807	Forestry	Gasoline		341430	2.28	40.39	7206.91	60.42	18057.40	73	0.37
1990	0808	Industry	Diesel		10158406	93.68	933.58	178.23	2.90	655.80	74	2.94
1990	0808	Industry	Gasoline		175227	2.28	136.27	1610.77	120.61	14797.46	73	1.33
1990	0808	Industry	LPG		1184856	0.00	1328.11	146.09	7.69	104.85	65	3.50

Continued												
Year	SNAP ID	Category	Fuel type	Mode	Fuel	SO_2	NO_X	NMVOC	CH_4	CO	CO_2	N_2O
					[GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[kg/GJ]	[g/GJ]
1990	080501	Air traffic, Copenhagen airport	Aviation gasoline		8642	22.83	859.00	1242.60	21.90	6972.00	73	2.00
1990	080502	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	2001204	22.99	324.87	34.25	3.64	157.15	72	3.79
1990	080502	Air traffic, Copenhagen airport	Aviation gasoline		5612	22.83	859.00	1242.60	21.90	6972.00	73	2.00
1990	080503	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	1305208	22.99	314.86	11.78	1.25	84.05	72	2.30
1990	080504	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	20330315	22.99	290.20	10.08	1.07	37.65	72	2.30

Year	SNAP ID	Category	Fuel type	Mode	Fuel	SO_2	NO_X	NMVOC	CH_4	CO	CO_2	N_2O
					[GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[kg/GJ]	[g/GJ]
2006	70101	Passenger cars	Diesel	Highway driving	3047512	0.47	319.73	8.50	0.91	43.43	74.00	1.99
2006	70101	Passenger cars	Gasoline 2-stroke	Highway driving	0	2.28	288.90	2357.34	10.03	3490.86	73.00	2.01
2006	70101	Passenger cars	Gasoline conventional	Highway driving	1166772	0.46	1343.32	329.92	11.55	2679.96	72.76	2.89
2006	70101	Passenger cars	Gasoline catalyst	Highway driving	10850179	0.46	139.28	29.28	3.57	765.90	72.76	0.84
2006	70101	Passenger cars	LPG	Highway driving	76	0.00	1151.70	187.09	10.06	3914.25	65.00	0.00
2006	70102	Passenger cars	Diesel	Rural driving	6706578	0.47	298.46	11.92	1.93	70.03	74.00	2.19
2006	70102	Passenger cars	Gasoline 2-stroke	Rural driving	0	2.28	352.84	2476.82	13.84	2594.44	73.00	1.73
2006	70102	Passenger cars	Gasoline conventional	Rural driving	2563993	0.46	1160.25	451.68	14.24	3105.49	72.76	3.18
2006	70102	Passenger cars	Gasoline catalyst	Rural driving	24974459	0.46	108.34	31.59	3.99	581.58	72.76	1.66
2006	70102	Passenger cars	LPG	Rural driving	153	0.00	1248.46	305.18	16.91	1146.38	65.00	0.00
2006	70103	Passenger cars	Diesel	Urban driving	6925310	0.47	277.96	29.76	3.10	153.91	74.00	2.64
2006	70103	Passenger cars	Gasoline 2-stroke	Urban driving	0	2.28	51.89	4470.04	43.97	7400.54	73.00	0.82
2006	70103	Passenger cars	Gasoline conventional	Urban driving	2993855	0.46	635.40	867.63	52.03	7933.84	72.76	3.19
2006	70103	Passenger cars	Gasoline catalyst	Urban driving	28058644	0.46	140.53	226.74	9.85	2522.10	72.76	2.93
2006	70103	Passenger cars	LPG	Urban driving	192	0.00	615.77	445.18	23.44	1341.15	65.00	0.00
2006	70201	Light duty vehicles	Diesel	Highway driving	4788870	0.47	302.09	29.56	0.80	174.62	74.00	1.38
2006	70201	Light duty vehicles	Gasoline conventional	Highway driving	61484	0.46	1370.99	170.51	10.12	2991.20	72.76	2.63
2006	70201	Light duty vehicles	Gasoline catalyst	Highway driving	416547	0.46	106.70	12.03	2.79	470.62	72.76	1.77
2006	70202	Light duty vehicles	Diesel	Rural driving	14589910	0.47	318.07	33.03	1.68	159.08	74.00	1.51
2006	70202	Light duty vehicles	Gasoline conventional	Rural driving	217332	0.46	1190.37	262.92	15.27	2319.12	72.76	2.48
2006	70202	Light duty vehicles	Gasoline catalyst	Rural driving	1470765	0.46	93.87	17.05	2.62	352.33	72.76	2.87

Continued

Year	SNAP ID	Category	Fuel type	Mode	Fuel	SO_2	NO_X	NMVOC	CH_4	CO	CO_2	N_2O
					[GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[kg/GJ]	[g/GJ]
2006	70203	Light duty vehicles	Gasoline catalyst	Urban driving	1773812	0.46	107.04	125.85	5.74	2939.26	72.76	4.89
2006	70301	Heavy duty vehicles	Diesel	Highway driving	12661976	0.47	773.65	26.25	6.41	156.24	74.00	3.17
2006	70301	Heavy duty vehicles	Gasoline	Highway driving	15735	0.46	1039.09	475.21	9.70	7620.01	72.76	0.83
2006	70302	Heavy duty vehicles	Diesel	Rural driving	19035878	0.47	797.33	34.88	6.99	162.64	74.00	3.22
2006	70302	Heavy duty vehicles	Gasoline	Rural driving	32016	0.46	1143.00	821.44	16.76	8382.01	72.76	0.91
2006	70303	Heavy duty vehicles	Diesel	Urban driving	13256021	0.47	795.53	47.24	10.30	191.53	74.00	2.64
2006	70303	Heavy duty vehicles	Gasoline	Urban driving	32697	0.46	457.20	696.98	14.22	7112.01	72.76	0.61
2006	704	Mopeds	Gasoline		209465	0.46	84.85	9268.55	148.43	10303.28	72.76	1.19
2006	70501	Motorcycles	Gasoline	Highway driving	194537	0.46	251.88	1057.65	110.62	15344.14	72.76	1.22
2006	70502	Motorcycles	Gasoline	Rural driving	438248	0.46	196.38	1301.93	135.85	14874.44	72.76	1.51
2006	70503	Motorcycles	Gasoline	Urban driving	526602	0.46	109.11	1740.26	136.99	13446.79	72.76	1.51

Year	SNAP ID	Category	Fuel type	Mode	Fuel	SO_2	NO_X	NMVOC	CH_4	CO	CO_2	N_2O
					[GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[kg/GJ]	[g/GJ]
2006	801	Military	Diesel		631564	0.47	538.08	35.10	4.77	158.94	74.00	2.32
2006	801	Military	Jet fuel	< 3000 ft	109686	22.99	250.57	24.94	2.65	229.89	72.00	2.30
2006	801	Military	Jet fuel	> 3000 ft	987175	22.99	250.57	24.94	2.65	229.89	72.00	2.30
2006	801	Military	Gasoline		6603	0.46	206.69	260.01	10.96	2050.72	73.00	2.24
2006	801	Military	Aviation gasoline		3638	22.99	859.00	1242.60	21.90	6972.00	73.00	2.00
2006	802	Railways	Diesel		3064383	0.47	1155.92	74.96	2.88	204.41	74.00	2.04
2006	803	Inland waterways	Diesel		1002148	93.68	868.57	168.09	2.73	450.77	74.00	2.97
2006	803	Inland waterways	Gasoline		381525	0.46	446.85	2050.43	57.46	15870.55	73.00	1.21
2006	80402	National sea traffic	Residual oil		645303	948.66	1748.91	59.46	1.84	196.16	78.00	4.89
2006	80402	National sea traffic	Diesel		4087478	93.68	1288.42	50.25	1.55	136.65	74.00	4.68
2006	80402	National sea traffic	Kerosene		0							
2006	80402	National sea traffic	LPG		0							
2006	80403	Fishing	Residual oil		0	1101.71	1393.60	56.90	1.76	180.90	78.00	4.90
2006	80403	Fishing	Diesel		6371456	93.68	1355.43	56.36	1.74	185.92	74.00	4.68
2006	80403	Fishing	Kerosene		313	2.30	50.00	3.00	7.00	20.00	72.00	0.00
2006	80403	Fishing	Gasoline		0	2.28	64.34	10809.60	108.10	18485.10	73.00	0.52
2006	80403	Fishing	LPG		20010	0.00	1249.00	384.94	20.26	443.00	65.00	0.00

Continued

Year	SNAP ID	Category	Fuel type	Mode	Fuel	SO_2	NO_X	NMVOC	CH_4	CO	CO_2	N_2O
2006	80404	International sea traffic	Residual oil		31564684	1638.14	2053.70	60.73	1.88	200.35	78.00	4.89
2006	80404	International sea traffic	Diesel		13116246	93.68	1516.56	55.34	1.71	182.57	74.00	4.68
2006	80501	Air traffic, other airports	Jet fuel	Dom. < 3000 ft	157817	22.99	287.66	27.15	2.88	148.43	72.00	16.45
2006	80501	Air traffic, other airports	Aviation gasoline		91473	22.83	859.00	1242.60	21.90	6972.00	73.00	2.00
2006	80502	Air traffic, other airports	Jet fuel	Int. < 3000 ft	242148	22.99	289.45	33.27	3.53	200.52	72.00	9.02
2006	80502	Air traffic, other airports	Aviation gasoline		1412	22.83	859.00	1242.60	21.90	6972.00	73.00	2.00
2006	80503	Air traffic, other airports	Jet fuel	Dom. > 3000 ft	516295	22.99	279.30	20.57	2.18	127.01	72.00	2.30
2006	80504	Air traffic, other airports	Jet fuel	Int. > 3000 ft	2684753	22.99	238.63	8.64	0.92	62.41	72.00	2.30
2006	806	Agriculture	Diesel		14611522	2.34	779.40	83.90	1.36	420.46	74.00	3.14
2006	806	Agriculture	Gasoline		382327	0.46	107.59	1143.22	152.40	21833.70	73.00	1.68
2006	807	Forestry	Diesel		159065	2.34	650.75	50.31	0.82	296.03	74.00	3.21
2006	807	Forestry	Gasoline		75313	0.46	73.12	6684.07	55.67	16521.92	73.00	0.42
2006	808	Industry	Diesel		12724048	2.34	738.43	93.38	1.52	414.76	74.00	3.09
2006	808	Industry	Gasoline		163110	0.46	197.21	1491.92	104.47	13052.28	73.00	1.42
2006	808	Industry	LPG		1038180	0.00	1328.11	146.09	7.69	104.85	65.00	3.50
2006	809	Household and gardening	Gasoline		3186399	0.46	86.20	2522.22	73.05	27536.91	73.00	1.12
2006	80501	Air traffic, Copenhagen airport	Jet fuel	Dom. < 3000 ft	210424	22.99	275.95	35.84	3.81	193.29	72.00	9.05
2006	80501	Air traffic, Copenhagen airport	Aviation gasoline		733	22.83	859.00	1242.60	21.90	6972.00	73.00	2.00
2006	80502	Air traffic, Copenhagen airport	Jet fuel	Int. < 3000 ft	2718218	22.99	341.71	44.14	4.69	223.20	72.00	4.00
2006	80502	Air traffic, Copenhagen airport	Aviation gasoline		206	22.83	859.00	1242.60	21.90	6972.00	73.00	2.00
2006	80503	Air traffic, Copenhagen airport	Jet fuel	Dom. > 3000 ft	983181	22.99	274.14	18.44	1.96	66.15	72.00	2.30
2006	80504	Air traffic, Copenhagen airport	Jet fuel	Int. > 3000 ft	30232427	22.99	315.36	11.20	1.19	34.29	72.00	2.30

Year	Category	Mode		SO_2 [tons]	NO_X [tons]	NMVOC [tons]	CH_4 [tons]	CO [tons]	CO_2 [ktons]	N_2O [tons]
1990	Passenger cars	Highway driving	70101	87	10095	2827	86	26237	606	25
1990	Passenger cars	Rural driving	70102	251	27001	11583	339	93384	1857	88
1990	Passenger cars	Urban driving	70103	369	20959	29640	1668	302402	2586	82
1990	Light duty vehicles	Highway driving	70201	177	781	91	7	1240	154	11
1990	Light duty vehicles	Rural driving	70202	634	2997	440	41	4324	559	43
1990	Light duty vehicles	Urban driving	70203	741	4624	1177	171	11595	671	37
1990	Heavy duty vehicles	Highway driving	70301	803	8858	412	52	1702	635	25
1990	Heavy duty vehicles	Rural driving	70302	1467	16556	1133	107	3595	1161	48
1990	Heavy duty vehicles	Urban driving	70303	1236	13386	1316	166	3745	979	33
1990	Mopeds		704	1	5	3221	52	3247	19	0
1990	Motorcycles	Highway driving	70501	0	15	88	8	1217	5	0
1990	Motorcycles	Rural driving	70502	0	22	196	19	2162	9	0
1990	Motorcycles	Urban driving	70503	0	14	305	22	2312	11	0
1990	Evaporation		706			28588				
1990	Tyre and brake wear		707							
1990	Road abrasion		708							
1990	Military		801	48	494	54	5	425	119	4
1990	Railways		802	376	4913	321	12	895	297	8
1990	Inland waterways		803	33	427	1174	17	4438	48	1
1990	National sea traffic		80402	5225	9711	371	12	1224	506	32
1990	Fishing		80403	944	10659	512	16	1653	751	47
1990	International sea traffic		80404	42404	62285	2116	65	6981	3087	194
1990	Air traffic, Dom. < 3000 ft.		80501	24	373	158	4	895	75	5
1990	Air traffic, Int. < 3000 ft.		80502	50	722	116	8	590	156	9
1990	Air traffic, Dom. > 3000 ft.		80503	54	750	28	3	203	168	5
1990	Air traffic, Int. > 3000 ft.		80504	504	6293	215	23	853	1580	50
1990	Agriculture		806	1547	12541	3260	105	44172	1272	49
1990	Forestry		807	14	138	2483	21	6259	36	1
1990	Industry		808	952	11081	2266	60	9379	842	34
1990	Household and gardening		809	4	123	4560	182	60598	138	2

Year	Category	Mode		SO_2	NO_X	NMVOC	CH_4	CO	CO_2	N_2O
				[tons]	[tons]	[tons]	[tons]	[tons]	[ktons]	[tons]
2006	Passenger cars	Highway driving	70101	7	4053	729	55	11570	1100	19
2006	Passenger cars	Rural driving	70102	16	7682	2027	149	22957	2500	64
2006	Passenger cars	Urban driving	70103	17	7770	9166	454	95586	2772	110
2006	Light duty vehicles	Highway driving	70201	2	1575	157	6	1216	389	7
2006	Light duty vehicles	Rural driving	70202	8	5037	564	32	3343	1202	27
2006	Light duty vehicles	Urban driving	70203	8	5077	1198	59	9872	1199	37
2006	Heavy duty vehicles	Highway driving	70301	6	9812	340	81	2098	938	40
2006	Heavy duty vehicles	Rural driving	70302	9	15214	690	134	3364	1411	61
2006	Heavy duty vehicles	Urban driving	70303	6	10561	649	137	2771	983	35
2006	Mopeds		704	0	18	1941	31	2158	15	0
2006	Motorcycles	Highway driving	70501	0	49	206	22	2985	14	0
2006	Motorcycles	Rural driving	70502	0	86	571	60	6519	32	1
2006	Motorcycles	Urban driving	70503	0	57	916	72	7081	38	1
2006	Evaporation		706			4017				
2006	Tyre and brake wear		707							
2006	Road abrasion		708							
2006	Military		801	26	619	56	6	391	126	4
2006	Railways		802	1	3542	230	9	626	227	6
2006	Inland waterways		803	94	1041	951	25	6507	102	3
2006	National sea traffic		80402	995	6395	244	8	685	353	22
2006	Fishing		80403	597	8661	367	12	1193	473	30
2006	International sea traffic		80404	52936	84716	2643	82	8719	3433	216
2006	Air traffic, Dom. < 3000 ft.		80501	11	183	126	3	707	33	5
2006	Air traffic, Int. < 3000 ft.		80502	68	1000	130	14	667	213	13
2006	Air traffic, Dom. > 3000 ft.		80503	34	414	29	3	131	108	3
2006	Air traffic, Int. > 3000 ft.		80504	757	10175	362	38	1204	2370	76
2006	Agriculture		806	34	11429	1663	78	14491	1109	47
2006	Forestry		807	0	109	511	4	1291	17	1
2006	Industry		808	30	10807	1583	44	7515	1021	43
2006	Household and gardening		809	1	275	8037	233	87744	233	4

Annex 3B-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
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
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
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	166.3	171.5
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
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	10.9	8.8	7.3	6.3	6.1	6.0	6.1	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
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	21.2	20.6	21.3	22.0	21.7	22.2	21.8	20.4	21.4	21.6
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
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
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

pol_name	IPCC ID	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
SO_2	Industry-Other (1A2f)	[tons]	2402	1441	1440	1438	956	952	955	957	957	959
SO_2	Civil Aviation (1A3a)	[tons]	82	77	85	86	83	77	64	62	61	63
SO_2	Road (1A3b)	[tons]	11621	7862	7847	7857	5488	5767	5903	3820	1569	1669
SO_2	Railways (1A3c)	[tons]	1152	695	618	641	393	376	382	263	105	95
SO_2	Navigation (1A3d)	[tons]	6363	6363	6367	6127	6130	5456	4232	2822	3522	4005
SO_2	Residential (1A4b)	[tons]	4	4	4	4	4	4	4	4	4	4
SO_2	Ag./for./fish. (1A4c)	[tons]	4766	3484	3173	3073	2269	2303	2317	2186	2150	2072
SO_2	Military (1A5)	[tons]	408	260	193	72	70	48	206	82	76	80
SO_2	Navigation int. (1A3d)	[tons]	18333	22047	36943	48034	48337	42404	34348	31152	59669	60081
SO_2	Civil Aviation int. (1A3a)	[tons]	444	480	515	551	578	554	521	541	530	580
NO_X	Industry-Other (1A2f)	[tons]	10903	10964	11011	11044	11065	11081	11282	11440	11558	11677
NO_X	Civil Aviation (1A3a)	[tons]	1203	1132	1237	1252	1208	1123	920	902	900	940
NO_X	Road (1A3b)	[tons]	92561	98284	98292	99080	100344	105933	107409	106683	104339	103482
NO_X	Railways (1A3c)	[tons]	6025	6063	5391	5589	5145	4913	4995	5284	5485	4971
NO_X	Navigation (1A3d)	[tons]	11778	11798	11852	11902	11962	12020	11433	11104	11007	11236
NO_X	Residential (1A4b)	[tons]	96	99	101	103	103	104	111	118	125	130
NO_X	Ag./for./fish. (1A4c)	[tons]	18159	19915	18153	20143	20342	21066	21722	20824	20763	20524

Continued												
pol_name	IPCC ID	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
NO_X	Navigation int. (1A3d)	[tons]	23987	28474	43643	56580	58561	62285	55731	57636	89632	101094
NO_X	Civil Aviation int. (1A3a)	[tons]	5663	6129	6569	7035	7313	7016	6586	6846	6702	7317
NMVOC	Industry-Other (1A2f)	[tons]	2422	2395	2368	2339	2304	2266	2231	2191	2147	2107
NMVOC	Civil Aviation (1A3a)	[tons]	216	213	190	198	193	186	168	164	161	191
NMVOC	Road (1A3b)	[tons]	80996	80718	80084	79593	77996	81811	82697	81762	79515	75265
NMVOC	Railways (1A3c)	[tons]	393	396	352	365	336	321	326	345	358	324
NMVOC	Navigation (1A3d)	[tons]	1505	1505	1536	1566	1598	1630	1658	1699	1727	1761
NMVOC	Residential (1A4b)	[tons]	4191	4166	4139	4112	4108	4104	4111	4094	4054	4070
NMVOC	Ag./for./fish. (1A4c)	[tons]	6357	6417	6216	6284	6207	6149	5777	5298	4944	4638
NMVOC	Military (1A5)	[tons]	601	469	175	490	315	54	172	94	129	124
NMVOC	Navigation int. (1A3d)	[tons]	880	1029	1527	1948	2003	2116	1900	1990	2993	3378
NMVOC	Civil Aviation int. (1A3a)	[tons]	261	288	313	342	361	331	309	316	309	308
CH_4	Industry-Other (1A2f)	[tons]	63	63	62	61	61	60	58	57	56	54
CH_4	Civil Aviation (1A3a)	[tons]	8	8	8	8	8	7	6	6	6	7
CH_4	Road (1A3b)	[tons]	2378	2437	2450	2481	2472	2619	2658	2627	2592	2502
CH_4	Railways (1A3c)	[tons]	15	15	14	14	13	12	13	13	14	12
CH_4	Navigation (1A3d)	[tons]	28	28	29	29	30	31	31	32	33	33
CH_4	Residential (1A4b)	[tons]	158	156	153	150	150	150	147	144	140	138
CH_4	Ag./for./fish. (1A4c)	[tons]	155	154	147	146	142	139	132	123	116	110
CH_4	Military (1A5)	[tons]	31	26	17	18	14	5	19	10	13	13
CH_4	Navigation int. (1A3d)	[tons]	27	32	47	60	62	65	59	62	93	104
CH_4	Civil Aviation int. (1A3a)	[tons]	25	27	30	32	33	31	29	30	29	31
CO	Industry-Other (1A2f)	[tons]	9863	9784	9702	9611	9502	9379	9294	9188	9070	8956
CO	Civil Aviation (1A3a)	[tons]	1256	1241	1118	1167	1140	1098	989	955	930	1098
CO	Road (1A3b)	[tons]	561271	540938	521944	476251	448416	459539	474997	465106	466804	435050
CO	Railways (1A3c)	[tons]	1098	1105	982	1018	937	895	910	963	999	906
CO	Navigation (1A3d)	[tons]	5291	5291	5453	5613	5777	5941	6095	6287	6428	6610
CO	Residential (1A4b)	[tons]	50434	49697	48935	48149	47970	47787	46848	45867	45027	44365
CO	Ag./for./fish. (1A4c)	[tons]	61165	59707	57256	55768	53717	51734	48771	45427	42608	39735
CO	Military (1A5)	[tons]	4168	3098	1315	3127	1948	425	1028	525	860	881
CO	Navigation int. (1A3d)	[tons]	2903	3396	5038	6427	6608	6981	6268	6566	9873	11143
CO	Civil Aviation int. (1A3a)	[tons]	1103	1207	1289	1416	1564	1442	1357	1399	1388	1342
CO_2	Industry-Other (1A2f)	[ktons]	852	852	851	849	845	842	843	843	842	841

Continued

pol_name	IPCC ID	Unit	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
CO_2	Road (1A3b)	[ktons]	8160	8625	8636	8694	8789	9275	9690	9863	9987	10487
CO_2	Railways (1A3c)	[ktons]	364	366	326	338	311	297	302	319	331	300
CO_2	Navigation (1A3d)	[ktons]	702	701	705	707	710	714	713	727	717	729
CO_2	Residential (1A4b)	[ktons]	114	114	113	113	113	113	113	114	115	116
CO_2	Ag./for./fish. (1A4c)	[ktons]	1806	1922	1758	1887	1874	1899	1903	1794	1760	1695
CO_2	Military (1A5)	[ktons]	402	316	361	196	165	119	287	141	237	252
CO_2	Navigation int. (1A3d)	[ktons]	1320	1537	2261	2869	2936	3087	2762	2887	4300	4829
CO_2	Civil Aviation int. (1A3a)	[ktons]	1391	1503	1613	1725	1809	1736	1632	1693	1659	1818
N_2O	Industry-Other (1A2f)	[tons]	34	34	34	34	34	34	34	35	35	35
N_2O	Civil Aviation (1A3a)	[tons]	10	10	11	11	11	10	9	9	9	9
N_2O	Road (1A3b)	[tons]	275	289	289	293	295	312	335	352	365	398
N_2O	Railways (1A3c)	[tons]	10	10	9	9	9	8	8	9	9	8
N_2O	Navigation (1A3d)	[tons]	43	43	43	43	43	43	43	44	43	44
N_2O	Residential (1A4b)	[tons]	2	2	2	2	2	2	2	2	2	2
N_2O	Ag./for./fish. (1A4c)	[tons]	81	87	78	85	85	87	88	83	81	79
N_2O	Military (1A5)	[tons]	12	10	11	6	5	4	8	4	7	8
N_2O	Navigation int. (1A3d)	[tons]	83	97	142	180	185	194	174	182	270	304
N_2O	Civil Aviation int. (1A3a)	[tons]	47	50	54	58	61	59	56	58	57	63

pol_name	IPCC ID	Unit	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
SO_2	Industry-Other (1A2f)	[tons]	968	244	246	249	251	253	256	258	261	263	28	30
SO_2	Civil Aviation (1A3a)	[tons]	63	65	68	62	56	49	52	45	44	40	43	45
SO_2	Road (1A3b)	[tons]	1682	1721	1744	1768	1088	352	353	357	371	381	77	79
SO_2	Railways (1A3c)	[tons]	96	95	93	78	40	7	7	7	7	7	1	1
SO_2	Navigation (1A3d)	[tons]	4502	3454	2632	1541	1276	1116	1027	953	984	1138	1146	1089
SO_2	Residential (1A4b)	[tons]	4	4	4	4	4	4	4	5	6	6	1	1
SO_2	Ag./for./fish. (1A4c)	[tons]	2120	982	867	871	947	1035	998	1051	1008	863	649	632
SO_2	Military (1A5)	[tons]	80	56	54	65	47	27	12	19	17	46	57	26
SO_2	Navigation int. (1A3d)	[tons]	66260	62320	57078	48000	50568	56634	45358	31538	33060	28581	36544	52936
SO_2	Civil Aviation int. (1A3a)	[tons]	596	629	642	689	731	750	761	658	684	782	822	825
NO_X	Industry-Other (1A2f)	[tons]	11882	12080	12248	12425	12262	12096	11869	11617	11214	10744	10664	10807
NO_X	Civil Aviation (1A3a)	[tons]	958	971	998	911	815	723	747	636	590	546	579	596

Continued														
pol_name	IPCC ID	Unit	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
NO_X	Road (1A3b)	[tons]	99888	96827	93041	89052	85941	81108	78485	74679	74275	72201	68519	66993
NO_X	Railways (1A3c)	[tons]	5015	4977	4846	4089	3730	3727	3396	3396	3540	3478	3724	3542
NO_X	Navigation (1A3d)	[tons]	11898	13458	12388	9973	8095	7284	7172	7372	7261	7407	7465	7436
NO_X	Residential (1A4b)	[tons]	136	140	144	149	151	153	167	183	202	223	249	275
NO_X	Ag./for./fish. (1A4c)	[tons]	21442	21188	20367	20307	21710	22991	22865	23412	22477	20102	20944	20199
NO_X	Military (1A5)	[tons]	1764	965	1219	1415	1096	551	719	486	542	1318	1335	619
NO_X	Navigation int. (1A3d)	[tons]	106928	102221	94977	94125	91400	96911	81585	66095	71376	58906	62825	84716
NO_X	Civil Aviation int. (1A3a)	[tons]	7517	7904	8058	8662	9204	9446	9610	8737	9097	10481	11037	11175
NMVOC	Industry-Other (1A2f)	[tons]	2088	2095	2083	2074	1997	1926	1873	1815	1754	1676	1620	1583
NMVOC	Civil Aviation (1A3a)	[tons]	206	194	186	169	162	156	155	151	143	157	165	155
NMVOC	Road (1A3b)	[tons]	70480	66214	60042	54906	48977	41599	37854	34307	31872	28154	25947	23171
NMVOC	Railways (1A3c)	[tons]	327	325	316	267	276	253	248	243	223	217	235	230
NMVOC	Navigation (1A3d)	[tons]	1819	1899	1882	1787	1701	1636	1600	1559	1501	1436	1324	1195
NMVOC	Residential (1A4b)	[tons]	4147	4231	4314	4395	4499	4602	5328	6082	6869	7685	7859	8037
NMVOC	Ag./for./fish. (1A4c)	[tons]	4516	4210	3974	3699	3572	3421	3253	3085	2864	2593	2575	2541
NMVOC	Military (1A5)	[tons]	159	95	110	123	112	58	60	48	50	111	116	56
NMVOC	Navigation int. (1A3d)	[tons]	3560	3398	3138	3158	3003	3126	2651	2190	2334	1914	2005	2643
NMVOC	Civil Aviation int. (1A3a)	[tons]	343	360	365	386	395	407	406	391	399	451	469	492
CH_4	Industry-Other (1A2f)	[tons]	53	53	53	53	51	50	49	48	47	46	45	44
CH_4	Civil Aviation (1A3a)	[tons]	7	7	7	7	6	5	5	5	5	6	7	6
CH_4	Road (1A3b)	[tons]	2370	2265	2176	2090	1980	1861	1740	1636	1572	1480	1376	1290
CH_4	Railways (1A3c)	[tons]	13	12	12	10	11	10	10	9	9	8	9	9
CH_4	Navigation (1A3d)	[tons]	35	37	36	33	31	30	31	31	32	32	32	32
CH_4	Residential (1A4b)	[tons]	136	135	134	134	135	137	149	164	183	204	219	233
CH_4	Ag./for./fish. (1A4c)	[tons]	106	100	94	89	88	88	86	86	85	82	86	94
CH_4	Military (1A5)	[tons]	18	10	12	14	11	6	7	5	5	13	13	6
CH_4	Navigation int. (1A3d)	[tons]	110	105	97	98	93	97	82	68	72	59	62	82
CH_4	Civil Aviation int. (1A3a)	[tons]	35	37	38	40	41	42	42	41	42	47	49	52
CO	Industry-Other (1A2f)	[tons]	8910	8963	8939	8907	8647	8395	8227	8030	7842	7600	7497	7515
CO	Civil Aviation (1A3a)	[tons]	1180	1117	1085	973	932	895	888	860	832	855	858	838
CO	Road (1A3b)	[tons]	412018	399617	346233	325320	290786	267325	256942	235566	225428	200562	192046	171521
CO	Railways (1A3c)	[tons]	914	907	883	745	717	694	637	627	611	599	648	626
CO	Navigation (1A3d)	[tons]	6861	7130	7047	6876	6775	6804	6972	7173	7348	7549	7571	7192

Continued														
pol_name	IPCC ID	Unit	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
CO	Residential (1A4b)	[tons]	43997	44112	44229	44347	45103	45873	50280	56144	63688	72683	80610	87744
CO	Ag./for./fish. (1A4c)	[tons]	37673	34865	32482	29849	27850	25867	24029	22187	20250	18206	17176	16976
CO	Military (1A5)	[tons]	905	627	617	704	706	407	327	321	315	734	823	391
CO	Navigation int. (1A3d)	[tons]	11745	11211	10351	10417	9905	10313	8745	7225	7701	6316	6615	8719
CO	Civil Aviation int. (1A3a)	[tons]	1421	1502	1564	1662	1743	1790	1797	1610	1670	1845	1914	1871
CO_2	Industry-Other (1A2f)	[ktons]	848	853	860	867	873	879	888	897	907	912	950	1021
CO_2	Civil Aviation (1A3a)	[ktons]	199	205	212	194	174	154	161	140	137	127	133	141
CO_2	Road (1A3b)	[ktons]	10585	10764	10978	11166	11312	11202	11223	11352	11806	12115	12229	12594
CO_2	Railways (1A3c)	[ktons]	303	301	293	247	232	228	211	210	218	216	232	227
CO_2	Navigation (1A3d)	[ktons]	766	836	809	656	540	466	452	449	452	466	462	455
CO_2	Residential (1A4b)	[ktons]	118	120	122	124	127	129	143	161	182	205	220	233
CO_2	Ag./for./fish. (1A4c)	[ktons]	1728	1645	1566	1521	1577	1626	1602	1644	1611	1507	1586	1599
CO_2	Military (1A5)	[ktons]	252	176	171	204	182	111	97	89	92	239	271	126
CO_2	Navigation int. (1A3d)	[ktons]	5061	4803	4403	4414	4155	4279	3605	2966	3130	2545	2636	3433
CO_2	Civil Aviation int. (1A3a)	[ktons]	1867	1971	2010	2159	2290	2350	2385	2059	2142	2449	2575	2583
N_2O	Industry-Other (1A2f)	[tons]	35	36	36	36	37	37	38	38	38	39	40	43
N_2O	Civil Aviation (1A3a)	[tons]	10	11	11	9	9	8	8	8	8	8	8	8
N_2O	Road (1A3b)	[tons]	414	430	442	447	450	443	429	421	420	421	406	402
N_2O	Railways (1A3c)	[tons]	8	8	8	7	6	6	6	6	6	6	6	6
N_2O	Navigation (1A3d)	[tons]	46	50	49	39	31	27	26	25	25	26	26	26
N_2O	Residential (1A4b)	[tons]	2	2	2	2	2	2	2	2	3	3	3	4
N_2O	Ag./for./fish. (1A4c)	[tons]	81	77	72	71	75	79	77	80	78	72	77	77
N_2O	Military (1A5)	[tons]	7	5	5	6	6	3	3	3	3	8	9	4
N_2O	Navigation int. (1A3d)	[tons]	318	302	277	278	262	269	227	187	197	160	166	216
N_2O	Civil Aviation int. (1A3a)	[tons]	64	69	70	75	80	82	82	72	75	85	89	89

Annex 3B-16: Uncertainty estimates

Uncertainty estimation, CO_2

	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor unceainty	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	12594	2	5	5.385	4.136	0.09780304	0.9329	0.4890	2.6386	2.6836
Military	CO_2	119	126	2	5	5.385	0.042	-0.0013398	0.0094	-0.0067	0.0265	0.0273
Railways	CO_2	297	227	2	5	5.385	0.074	-0.0098969	0.0168	-0.0495	0.0475	0.0686
Navigation (small boats)	CO_2	48	102	21	5	21.587	0.134	0.00324491	0.0076	0.0162	0.2244	0.2250
Navigation (large vessels)	CO_2	666	353	11	5	12.083	0.260	-0.0337285	0.0261	-0.1686	0.4065	0.4401
Fisheries	CO_2	591	473	2	5	5.385	0.155	-0.0181093	0.0350	-0.0905	0.0991	0.1342
Agriculture	CO_2	1272	1109	13	5	13.928	0.942	-0.0322864	0.0822	-0.1614	1.5105	1.5191
Forestry	CO_2	36	17	16	5	16.763	0.018	-0.0019307	0.0013	-0.0097	0.0289	0.0305
Industry (mobile)	CO_2	842	1021	18	5	18.682	1.163	-8.08E-05	0.0756	-0.0004	1.9251	1.9251
Residential	CO_2	113	233	18	5	18.682	0.265	0.00708296	0.0172	0.0354	0.4386	0.4400
Civil aviation	CO_2	243	141	10	5	11.180	0.096	-0.0113717	0.0105	-0.0569	0.1479	0.1585
		13,500	16397				19.548					13.7026
Total uncertainties				**Overall uncertainty in the year (%):**			**4.421**		**Trend uncertainty (%):**			**3.702**

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	1290	2	40	40.050	30.133	-0.0641412	0.4268	-2.5656	1.2071	2.8354
Military	CH_4	5	6	2	100	100.020	0.354	0.00103084	0.0020	0.1031	0.0057	0.1032
Railways	CH_4	12	9	2	100	100.020	0.515	0.00060875	0.0029	0.0609	0.0083	0.0614
Navigation (small boats)	CH_4	17	25	21	100	102.181	1.470	0.00505615	0.0082	0.5056	0.2423	0.5607
Navigation (large vessels)	CH_4	14	8	11	100	100.603	0.442	-0.0001559	0.0025	-0.0156	0.0388	0.0418
Fisheries	CH_4	13	12	2	100	100.020	0.672	0.00135583	0.0038	0.1356	0.0108	0.1360
Agriculture	CH_4	105	78	13	100	100.841	4.599	0.00621146	0.0259	0.6211	0.4756	0.7823
Forestry	CH_4	21	4	16	100	101.272	0.255	-0.0025101	0.0014	-0.2510	0.0324	0.2531
Industry (mobile)	CH_4	60	44	18	100	101.607	2.628	0.0034696	0.0147	0.3470	0.3734	0.5097
Residential	CH_4	150	233	18	100	101.607	13.793	0.04886841	0.0770	4.8868	1.9601	5.2653
Civil aviation	CH_4	7	6	10	100	100.499	0.371	0.00073466	0.0021	0.0735	0.0296	0.0792
		3023	1715				1129.700					37.0540
Total uncertainties				**Overall uncertainty in the year (%):**			**33,611**		**Trend uncertainty (%):**			**6.087**

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	402	2	50	50.040	35.314	0.0932025	0.8049	4.6601	2.2765	5.1864
Military	N_2O	4	4	2	1000	1000.002	7.035	-0.0004544	0.0080	-0.4544	0.0227	0.4550
Railways	N_2O	8	6	2	1000	1000.002	10.963	-0.0061511	0.0125	-6.1511	0.0354	6.1512
Navigation (small boats)	N_2O	1	3	21	1000	1000.220	6.026	0.00400657	0.0069	4.0066	0.2041	4.0118
Navigation (large vessels)	N_2O	42	22	11	1000	1000.060	39.113	-0.0510208	0.0446	-51.0208	0.6939	51.0255
Fisheries	N_2O	37	30	2	1000	1000.002	52.338	-0.0249122	0.0597	-24.9122	0.1688	24.9128
Agriculture	N_2O	49	47	13	1000	1000.084	81.671	-0.0191987	0.0931	-19.1987	1.7123	19.2749
Forestry	N_2O	1	1	16	1000	1000.128	0.950	-0.0001941	0.0011	-0.1941	0.0245	0.1956
Industry (mobile)	N_2O	34	43	18	1000	1000.162	75.678	0.00817926	0.0863	8.1793	2.1967	8.4691
Residential	N_2O	2	4	18	1000	1000.162	6.274	0.0032403	0.0072	3.2403	0.1821	3.2454
Civil aviation	N_2O	10	8	10	1000	1000.050	14.264	-0.0072015	0.0163	-7.2015	0.2300	7.2052
		500	570				18363.162					3811.0241
Total uncertainties				**Overall uncertainty in the year (%):**			**135.511**			**Trend uncertainty (%):**		**61.733**

Annex 3C Industrial Processes. CRF sector 2

No annexes for industry 2006

Annex 3D Agriculture/LULUCF

Agriculture

Background data for estimation of CH_4 emission from Enteric Fermentation

Table 1 Grassing animals 1990 – 2006 [number of days on grass per year]

3	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Dairy cattle	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Heifer > ½ year	165	171	177	184	190	196	196	196	196	196	196	196	196	196	196	196	196
Suckling cattle	184	192	200	208	216	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
Horses	183	183	183	183	183	183	183	183	183	183	183	183	183	183	183	183	183

Table 2a Average gross energy intake (GE) 1990 – 2006 [MJ/head/year]

Livestock category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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
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	105.8	105.8	105.8	105.4
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
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
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
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
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
Other - Fur farming (mink)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.8	6.7

Table 2b Average gross energy intake (GE) 1990 – 2006 [MJ/head/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
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
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
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
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
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
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	105.8	105.8	105.8	105.4
Suckling cattle	182.2	179.9	177.6	175.3	173.0	170.7	170.7	170.7	170.7	170.7	170.7	170.7	170.7	170.7	160.9	160.9	160.9
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
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
Slaughtering pigs (30 – 104 kg)	43.29	43.29	43.29	43.29	38.91	38.91	38.91	38.91	38.11	38.11	38.11	39.20	39.20	38.93	39.07	38.92	39.87

Table 3 Average CH_4 conversion rate (Y_m) – national factor used for dairy cattle and heifer > ½ year 1990 – 2006 [%]

Dairy cattle + Heifer > ½ year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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

Background data for estimation of CH_4 emission from Manure Management

Table 4a VS daily excretion (average) 1990 – 2006 [kg dm/head/day] – CRF categories

365 stable days	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
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
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
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
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
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
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
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
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

Table 4b VS daily excretion (average) 1990 – 2005 [kg dm/head/day] – Subcategories

365 stable days	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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
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
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
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
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
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
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
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
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
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
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
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
365 stable days	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
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
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
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
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
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
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
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
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
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
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
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
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

Table 5 Digestibility of feed [%], 1990 - 2006

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

Table 6 Changes in stable type 1990 – 2006

Livestock categories	Stable type	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	1990	2006
										pct								
Horses		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	0
Cattle																		
Bull, 0-6 mth.	Deep litter (boxes)	100	100	100	100	100	100	100	100	100	100	91	86	82	77	95	100	95
	Deep litter, solid floor	0	0	0	0	0	0	0	0	0	0	9	14	18	23	5	0	5
Bull, 6 mth -440 kg	Tethered with liquid and solid manure	19	17	16	15	14	13	12	11	11	10	9	8	8	7	9	20	9
	Tethered with slurry	19	17	16	15	14	13	12	11	11	10	9	8	8	7	2	20	2
	Slatted floor-boxes	40	40	39	38	37	37	36	35	34	33	32	31	30	28	31	41	31
	Deep litter (all)	3	2	2	2	1	1	0	0	0	0	0	0	0	0	47	3	47
	Deep litter, solid floor	12	14	16	18	20	22	24	27	29	33	37	41	45	48	8	10	8
	Deep litter, slatted floor	5	6	7	8	8	9	10	11	10	9	8	7	5	6	1	4	1
	Deep litter, slatted floor, scrapes	1	1	1	1	2	2	2	2	2	2	2	2	1	1	0	1	0
	Deep litter, solid floor, scrapes	2	2	2	2	3	3	3	3	3	3	3	3	3	3	2	1	2
Heifer, 0-6 mth.	Deep litter (boxes)	100	100	100	100	100	100	100	100	100	100	89	84	83	80	93	100	93
	Deep litter, solid floor	0	0	0	0	0	0	0	0	0	0	11	16	17	20	7	0	7
Heifer, 6 mth.-calving	Tethered with liquid and solid manure	18	17	16	15	13	12	11	10	10	9	8	7	7	5	14	19	14
	Tethered with slurry	18	17	16	15	13	12	11	10	10	9	8	7	7	5	5	19	5
	Slatted floor-boxes	39	38	37	36	35	34	33	33	32	32	31	30	30	29	22	40	22
	Loose-housing with beds, slatted floor	4	5	6	7	7	8	10	12	13	14	17	20	21	23	19	4	19
	Deep litter (all)	3	2	2	2	1	1	0	0	0	0	0	0	0	0	30	3	30
Heifer, 6 mth.-calv.	Deep litter, solid floor	11	13	15	17	18	22	24	24	24	25	26	26	26	28	3	9	3
	Deep litter, slatted floor	4	5	6	7	7	7	7	6	6	6	5	5	5	5	3	4	3
	Deep litter, slatted floor, scrapes	1	1	1	1	1	1	1	2	2	2	2	2	1	2	2	1	2
	Deep litter, solid floor, scrapes	1	2	2	2	2	3	3	3	3	3	3	3	3	3	1	1	1
Dairy cows	Tethered with liquid and solid manure	35	34	33	32	31	30	30	30	30	18	15	12	8	6	12	35	12
	Tethered with slurry	43	43	43	43	42	42	36	30	30	28	25	23	18	16	14	44	14
	Loose-holding with beds, slatted floor	14	15	16	16	17	18	21	24	24	34	36	39	42	44	44	13	44
	Loose-holding with beds, slatted floor, scrapes	1	1	1	1	1	1	2	3	3	3	4	4	5	6	11	1	11
	Deep litter, slatted floor	3	3	4	4	5	5	6	8	8	7	7	7	7	7	4	3	4
	Deep litter, slatted floor, scrapes	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	0	2

Continued																		
Livestock categories	**Stable type**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**1990**	**2006**
										pct								
Suckling cattle	Tethered with liquid and solid manure	1	1	1	1	1	1	2	2	2	3	3	3	3	3	1	1	1
	Deep litter (all)	35	34	33	32	31	30	30	30	30	18	15	12	8	6	19	35	19
	Deep litter, solid floor	43	43	43	43	42	42	36	30	30	28	25	23	18	16	8	44	8
Sheep and goats																		
Sheep	Deep litter (all)	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
Swine																		
Sows	Full slatted floor	10	10	11	12	12	13	13	14	14	14	13	13	12	12	13	9	13
(incl. 22-25 pigs to 7.5 kg)	Partly slatted floor	57	57	57	57	57	57	57	57	57	56	55	54	53	51	70	56	70
	Solid floor	27	25	22	20	17	15	12	10	7	7	6	6	6	5	4	30	4
	Deep litter	5	5	6	6	7	7	8	9	9	10	10	10	10	11	2	5	2
	Deep litter + slatted floor	0	1	1	2	2	3	3	4	4	6	7	8	9	10	8	0	8
	Deep litter + solid floor	0	1	1	2	2	3	3	4	4	5	6	7	8	9	1	0	1
	Outdoor sows	0	1	1	1	2	2	2	3	3	3	3	2	2	2	2	0	2
Piglets, 7.5-30 kg	Fully slatted floor	57	60	57	54	51	49	46	43	40	38	36	35	33	31	23	54	23
	Partly slatted floor	20	20	24	27	31	34	38	41	45	47	49	50	52	54	66	20	66
	Solid floor	18	15	14	12	11	9	8	6	5	5	5	5	5	5	3	21	3
	Deep litter (to-clima stables)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4
	Deep litter + slatted floor	0	0	1	1	2	3	4	4	5	5	5	5	5	5	4	0	4
Slaugther pigs, 30-105 kg	Fully slatted floor	56	60	60	60	60	60	60	60	60	58	57	56	55	53	49	51	49
	Partly slatted floor	21	20	21	23	24	25	26	28	29	31	33	34	35	38	38	23	38
	Solid floor	19	15	14	12	11	9	8	6	5	5	4	4	4	3	7	22	7
Slaugther pigs, 30-105 kg	Deep litter	4	5	4	4	3	3	2	2	1	1	1	1	1	1	5	4	5
	Partly slatted floor and partly deep litter	0	0	1	1	2	3	4	4	5	5	5	5	5	5	1	0	1
Poultry																		
Outdoor hens		1	2	4	5	6	7	8	9	9	9	9	7	8	7	7	0	7
Ecological hens		1	2	4	5	6	7	10	12	14	15	15	15	16	16	16	0	16
Scrabe hens		11	12	12	13	13	13	15	17	18	18	17	19	18	20	20	11	20
Battery hens, manure house		52	49	47	44	41	39	36	32	29	26	26	23	23	20	20	54	20
Battery hens, manure tank		11	11	10	9	8	7	6	6	5	5	5	4	5	4	4	12	4
Battery hens, manure cellar		23	24	24	25	25	26	25	25	24	27	27	32	30	33	33	23	33
HPR-hens (egg for hat-ching)		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Continued																		
Livestock categories	**Stable type**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**1990**	**2006**
										pct								
Pullet, consumption, net		16	15	14	13	12	11	10	8	7	8	7	6	7	5	5	17	5
Pullet, consumption, floor		58	60	61	62	63	64	65	66	67	69	67	69	68	69	69	57	69
Pullet, egg for hatching		26	26	26	26	26	26	26	26	26	23	25	25	25	26	26	26	26
Broilers, conv. 39 days)		100	100	100	100	100	100	100	100	100	100	100	100	100	100	99	100	99
Broilers, skrabe (56 days)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Turkey, male		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turkey, female		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Ducks		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Geese		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Fur farming		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Mink	Slurry system																	
	Solid manure and black liquid	20	20	22	23	25	26	28	29	30	42	50	55	60	65	70	18	70
Foxes	Slurry system	80	80	78	77	75	74	73	71	70	58	50	45	40	35	30	82	30
	Solid manure and black liquid	0	0	0	0	0	0	0	0	0	2	5	10	15	30	0	0	0
Cattle																		
	Tethered in stables	78	77	76	74	73	72	66	60	60	46	40	35	26	22	26	79	26
	Loose-housing with beds	18	19	20	21	21	22	26	30	30	43	49	54	63	67	66	18	66
	Deep litter	4	4	5	5	6	6	8	10	10	11	11	11	11	11	8	3	8
Swine																		
	Fully slatted floor	56	60	60	60	60	60	60	60	60	58	57	56	55	53	49	51	49
	Partly slatted floor	21	20	21	23	24	25	26	28	29	31	33	34	35	38	38	23	38
	Solid floor	19	15	14	12	11	9	8	6	5	5	4	4	4	3	7	22	7
	Deep litter	4	5	5	5	5	6	6	6	6	6	6	6	6	6	6	4	6

Reference: 1990 – 2004 = The Danish Agricultural Advisory Centre, 2005/06 = The Danish Plant Directorate

Table 7 Background data for estimation of N_2O emission from crop residue 2006

	Stubble	Husks	Top	Leafs	Frequency of ploughing	Nitrogen content in crop residue	
Crop type	kg N/ha	kg N/ha	kg N/ha	kg N/ha	No. of year before ploughing	kg N/ha/yr	M kg N/yr
Winter wheat	6.3	10.7	-	-	1	17.0	11.60
Spring wheat	6.3	7.4	-	-	1	13.7	0.14
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	1.97
Spring barley	6.3	4.1	-	-	1	10.4	5.48
Oats	6.3	4.1	-	-	1	10.4	0.63
Winter rape	4.4	-	-	-	1	4.4	0.54
Spring rape	4.4	-	-	-	1	4.4	0.01
Potatoes (top), non-harvest	-	-	48.7	-	1	48.7	1.85
Beet (top), non-harvest	-	-	56.7[a]	-	1	56.7	2.59
Straw, non-harvest	-	-	-	-	1	7.4[a]	10.03
Pulse	11.3	-	-	-	1	11.3	0.13
Lucerne	32.3	-	-	-	3	10.8	0.04
Maize – for green fodder	6.3	-	-	-	1	6.3	0.85
Cereal – for green fodder	6.3	-	-	-	1	6.3	0.40
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	7.08
Grass- and clover field out of rotation	38.8		-	20.0	-	20.0	3.79
Aftermath	6.3	-	-	-	1	6.3	0.72
Seeds of grass crops	6.3	10.7	-	-	2	13.9	1.26
Set-a-side	38.8	-	-	15.0	10	18.9	3.65
Total N from crop residue - 2006							54.09

[a] express the yield for 2006 - varies from year to year. Based on yield datta from Statistics Denmark and N-content from the feeding plan.
Reference: Djurhuus and Hansen 2003

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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		
Years after establishment	**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**
0	320	410	730	730	0	0	0,0	0,00	0,00
1	527	466	993	1723	1	1	0,7	0,20	0,73
2	721	534	1255	2978	3	4	1,0	0,28	0,72
3	738	542	1280	4258	5	10	1,2	0,34	0,75
4	912	579	1491	5749	8	17	1,3	0,36	0,75
5	790	536	1326	7075	10	28	1,5	0,40	0,78
6	833	543	1376	8451	16	44	1,9	0,53	0,87
7	1614	646	2260	10711	24	68	2,2	0,61	0,90
8	912	493	1405	12116	34	102	2,8	0,77	1,05
9	3613	810	4423	16539	43	145	2,6	0,71	0,97
10	2115	638	2753	19292	59	204	3,1	0,83	1,06
11	1577	556	2133	21425	74	277	3,4	0,94	1,18
12	1828	515	2343	23768	88	365	3,7	1,01	1,28
13	1972	556	2528	26296	108	473	4,1	1,12	1,38
14	857	468	1325	27621	124	597	4,5	1,22	1,54
15	2841	500	3341	30962	140	737	4,5	1,23	1,59
16	3353	483	3836	34798	165	902	4,7	1,62	1,62

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

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)

	Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	Area (ha)	410	466	534	542	579	536	543	646	493	810	638	556	515	556	468	500	483
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

Table A2.4 Sumarion table for cohorts of areas afforested with broadleaves (t CO_2)

	Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	Area (ha)	320	527	721	738	912	790	833	1614	912	3613	2115	1577	1828	1972	857	2841	3353
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

Annex 3 E. Waste

Solid Waste Disposal on Land

The starting year for the FOD model used is 1960 using 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]																					
	Po ten tial	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.

Wastewater treatment plants (6B)

Background

Wastewater treated by wastewater treatment plants (WWTPs) comprises domestic and industrial wastewater as well as rainwater. 90% of the Danish household is connected to a municipal sewer system. The WWTPs have been upgraded significantly adoption of the Action Plan on the Aquatic Environment in 1987. The plan included more strict emission standards for nutrients and organic matter for WWTPs with a capacity above 5000 person equivalents (PE) and, thus, rendered technological upgrading of the majority of Danish WWTPs necessary.

In 2002 there was 1267 Danish WWTPs bigger than 30 PE, Table 3E.2. One PE expresses how much one person pollutes, i.e. 1 PE being defined as 21.9 kg BOD/year. BOD is the Biological Oxygen Demand, which is a measure of total degradable organic matter in the wastewater. The capacities of WWTPs are calculated based on the amount of organic matter in the influent wastewater and converted to number of PEs irrespective of the origin of the wastewater, i.e. household or industry. Therefore it is not possible to calculate the emission contribution from industry and household separately. The per cent contribution from industry is, however, known (cf. Table 3E.3).

Table 3E.2 Size distributions of the Danish WWTPs in the year 2002.

WWTP capacity	Number of WWTPs	Load in % of total load on all WWTPs
>30 PE	1267	100
>500 PE	658	99
>2 000 PE	441	98
>5 000 PE	274	93
>15 000 PE	130	83
>50 000 PE	63	68
>10 0000 PE	30	48

In 1989 only 10% of the wastewater treatment processes included reduction of N, P and BOD, in 1996 the number was 76%. Today 85% of the total wastewater is treated at so-called MBNDC-WWTPs (i.e. WWTPS including Mechanical, Biological, Nitrification, Denitrification and Chemical treatment processes), which is indicative of a high removal of N, P and DOC at the WWTPs (cf. Table 3E.4).

Since 1987 the fraction of industrial influent wastewater load at municipal and private WWTPs has increased from zero to around 40 % from 1999 and forward. The fraction of industrial sources discharges to city sewers contributing to the influent wastewater load in the national WWTPs are given in per cent based on PEs (1 PE = 60g BOD/day) in the Table 3E.3.

Table 3E.3 The fraction of wastewater from industrial sources discharged to city sewers, i.e. industrial load of wastewater relative to total influent load at WWTPs*.

	1984-1993	1993	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
% industrial load	0-5	5	-	48	41	42	38	38	37	41	41	41

* based on information on influent loads in wastewater amounts and/or the amount of organic matter in the industry catchment area belonging to each WWTP.

Today, about one fifth of the biggest WWTPs treat around 90% of the total volume of sewage in Denmark. Typically, these plants have mechanical treatment and biological treatment including removal of nitrogen and organic matter in activated sludge systems, a chemical precipitation step and finally settling of suspended particles in a clarifier tank. The chemical processes include lime stabilisation. Many WWTPs are, in addition to this, equipped with a filter or lagoon after the settling step. Overall stabilisation can be split into two processes, i.e. a biological and a chemical. The biological processes include anaerobic stabilisation where the sludge is digested in a digesting tank and aerobic stabilisation by long-term aeration (DEPA, 2002). In addition to hygienization, dewatering and stabilisation of the sludge, the sludge may be mineralised, composted, dried or combusted. Composting and sanitation is attributed by a storage time of 3 to 6 months. For plants with mineralization of sludge the storage time is about 10 years.

The wastewater treatment processes are divided into the following steps:

M = Mechanical
B = Biological
N = Nitrification (removal of nitrogen)
D = Denitrification (removal of ammonia)
C = Chemical

In general, the more steps the higher the cleaning level regarding nitrogen, phosphorous and dissolved organic matter (DOC). The technological development and increased level of cleaning wastewater is clearly observed by the percentage reduction in the effluent amount of nitrogen, phosphor and DOC of 81%, 93% and 96% in 2003. The development in the effectiveness of reducing the nutrient content of the effluent wastewater is shown in Table 3E.4 at national level.

Table 3E.4 Per cent reduction in nutrient content of effluent wastewater compared to influent load.

Effluent % reduction*	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
BOD	93	87	92	79	94	94	95	96	96	96	95
N	64	56	68	66	74	74	77	79	77	81	80
P	76	80	85	91	90	90	91	92	91	93	96

Quality Check and verification - Methane

Country-specific Total degradable Organic Waste (TOW)

The total organic degradable waste in kg BOD/year based on country-specific data is given in Table 3E.5. Activity data on influent TOW are needed in the unit of tonnes BOD /year, which is obtained by using total influent amount of water per year multiplied by the measured BOD in the inlet wastewater given in the second row of Table 3E.5-(DEPA 1994, 1996, 1997, 1998, 1999, 2001, 2002, 2003 and 2004). Numbers on BOD was provided by DEPA (personal communication for 1993, 2002-2004).

Table 3E.5 Total degradable organic waste (TOW) calculated by use of country-specific data.

Year	1993	1999	2000	2001	2002	2003	2004	2006
BOD (mg/L)	100*	160	175	203	189	262		
Influent water (million m^3 / year)	-	825	825	720	809	611		
TOW_{BOD} (tonnes BOD/year)	100 000	132 000	144 375	146 160	152 497	159 858	143 091	150 950
TOW_{COD} (tonnes BOD/year)**		148 500	138 600	142 560	159 858	160 571	163 026	142 237
$TOW_{average}$***		140 250	141 488	144 360	156 178	160 214	153 059	146 593

*BOD for the year 1993 is given in 1000 tonnes, whereas the amount of influent water is not given (DEPA, 1994).

** Calculated from country-specific COD data by use of BOD = COD/2.5.

*** $TOW_{average}$=(TOW_{BOD}+ TOW_{COD})/2

TOW data from 2004 og 2006 was obtained by personal communication with the DEPA.

The total organic waste in kg BOD/year based on the IPCC default method is given in Table 3E.6. The default region-specific TOW value is 18250 kg/ BOD/1000 persons/yr (IPCC GL, page 6.23, Table 6-5) for Europe. The total organic degradable waste is estimated by multiplying the default value by the population number. In addition the default TOW data are increased by the percent contribution from the industry to investigate the comparability by including this correction factor for the "missing" industrial contribution to the influent load TOW.

Table 3E.6 Total degradable organic waste (TOW) calculated by use of the IPCC default BOD value for European countries.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Population-Estimates (1000)	5140	5153	5170	5188	5208	5228	5248	5268	5287	5305	5322	5338	5351.0	5384	5398	5410
TOW (tons BOD/year), default BOD IPCC	93805	94042	94353	94681	95046	95411	95776	96141	96488	96816	97127	97419	97656	98249	98507	98733
Contribution from industrial inlet BOD	2.5	2.5	2.5	5.0	15.5	23.9	32.3	40.7	48.0	41.0	42.0	38.0	38.0	37.0	40.5	40.5
TOW (tons BOD/year), default BOD IPCC corrected for industrial contribution	96619	96393	96711	99415	109778	118214	126712	135270	142802	136511	137920	134438	137044	139511	138388	138705

By comparing the estimated TOW by use of country-specific data (cf. Table 3E.5) and TOW by use of default European data on the inlet BOD (cf. Table 3E.6), it can be observed that the default parameter method seems to underestimates the TOW. By increasing the default TOW data according to the industrial contribution to the total influent TOW the degree of underestimation becomes less significant as seen by comparing the TOW data for 1993, 1993 and 1994.

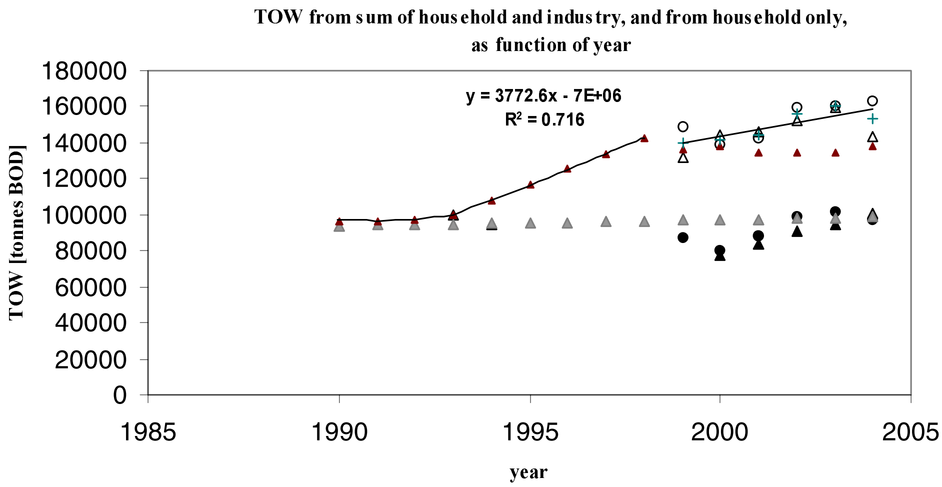

Figure 3E.1 Open triangles represents measured BOD data, open circles measured COD data, black triangles and circles, the measured BOD and COD data minus the reported industrial influents load, respectively. The grey triangles represent the TOW calculated based on the default IPCC method, and the brown triangles where the industrial influent load has been added. The BOD and COD derived TOW data representing household only shows that the BOD derived data has a steep slope which would make the influent load from household become negative around 1995. The BOD derived TOW data point from 1993 fits the brown data point nicely. The default methodology adding the percent corresponding to the industrial influent was used form 1990 to 1998, after which the average of the, national statistics on measured BOD and COD reported TOW data was used (blue crosses).

Based on mean values and standard deviation of TOW from Table 3E.5 and last row of Table 3E.6, an estimate of the maximum uncertainty on TOW is 20 %. It was determined to use the default IPPC methodology corrected for the industrial contribution to the influent TOW for the years 1990 to 1998 after which an average of national statistics on measured BOD, COD multiplied by the influent amount of water as given in Table 3E.5 above. The gross emission is hereafter calculated by multiplying the TOW data, given in Table 8.19, with the emission factor of 0.15 kg CH4 / kg BOD derived from Table 8.20.

Recovered and combusted methane potentials

The calculated theoretical CH_4 not emitted are given in Table 3E.7 below.

Table 3E.7 Theoretical CH_4 amount not emitted to the atmosphere [Gg]

	Country-specific data				Regression by interpolation				Reported data (CRF)				
Year	CH_4,external combustion	CH_4, internal combustion	CH_4, combustion - reuse	CH_4, biogas	CH_4,external combustion	CH_4, internal combustion	CH_4, combustion - reuse	CH_4, biogas	CH_4,external combustion	CH_4, internal combustion	CH_4, combustion - reuse	CH_4, biogas	total CH4 not emittet
1987	2.33	4.67	1.53	0.00	2.34	4.91	0.76	0.17	2.34	4.79	1.15	0.08	8.36
1990					2.39	4.67	1.20	0.24	2.39	4.67	1.20	0.24	8.51
1991					2.41	4.60	1.34	0.27	2.41	4.60	1.34	0.27	8.62
1992					2.43	4.52	1.49	0.30	2.43	4.52	1.49	0.30	8.73
1993					2.44	4.44	1.63	0.32	2.44	4.44	1.63	0.32	8.84
1994					2.46	4.36	1.78	0.35	2.46	4.36	1.78	0.35	8.95
1995					2.47	4.29	1.92	0.38	2.47	4.29	1.92	0.38	9.06
1996					2.49	4.21	2.07	0.40	2.49	4.21	2.07	0.40	9.17
1997	1.87	4.70	0.24	0.48	2.51	4.13	2.21	0.43	2.19	4.42	1.23	0.46	8.29
1998					2.52	4.05	2.36	0.45	2.52	4.05	2.36	0.45	9.39
1999	1.97	4.60	2.83	0.62	2.54	3.98	2.50	0.48	2.25	4.29	2.67	0.55	9.76
2000	4.72	2.35	4.57	0.51	2.56	3.90	2.65	0.51	3.64	3.12	3.61	0.51	10.88
2001	2.91	4.73	3.58	0.33	2.57	3.82	2.79	0.53	2.74	4.28	3.19	0.43	10.63
2002	1.22	3.19	2.80	0.26	2.59	3.75	2.94	0.56	1.91	3.47	2.87	0.41	8.65
2003									6.20		3.08	0.44	9.73
2004									6.20		3.23	0.44	9.87
2005									6.20		3.37	0.44	10.02
2006									6.20		3.52	0.44	10.16

Country-specific activity data extracted from DEPA reports are given in the column 2 to 5. Due to missing data linear regression was performed based on the country-specific CH_4 potentials not emitted from 1990 to 2002 as illustrated in Figure 3.E.2.

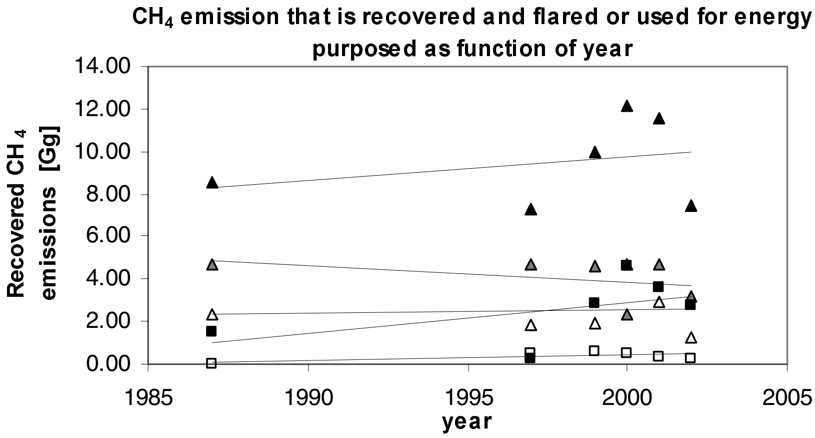

Figure 3.E.2 From top to bottom based on 1987 data points: The upper regression line represents the total methane potential not emitted. The grey triangles and decreasing regression line represents the trend in internal combusting. The open triangles and regression line of insignificant slope represents external combustion. The black quadrants and increasing regression line represents the methane potential internal combusted and reused for production of sandblasting. Lastly the open quadrants and regression line with no or slightly positive slope represents the methane potential used for biogas production.

Filling of data gaps by use of linear regression function are not optimal due to changing trends in the final disposal categories influenced by national political intervention strategies to improve water, soil and air quality. However, at this point this is the best available approach and estimated methane potential according to regression by interpolation are given in column 6 to 9. For the years where national activity data are available, average of the actual and estimated numbers by interpolation have been reported; cf. columns 10 to 13 and Table 8.17 in the main report.

The yearly fluctuation in data used for simple linear regression of the average trends in time is high as illustrated in Figure 3.E.2. Based on the percent distance between country-specific data to regression line, an estimate of the average uncertainty is around 30%. The minimum uncertainty estimated for internal combustion is around 25%, while the uncertainty for external combustion. The final disposal categories reuse and biogas is around 70%. The variations/uncertainties are originating from the activity data given in Table 8.21 in the main report.

Based on the targets for final sludge disposal categories defined in the "Waste strategy 2004-2008 (The Danish Government, 2002), the internal and external combustion is expected to have reached a constant level, as the potential CH_4 emission are already below a level corresponding to the target value for 2008 for this disposal category corresponding to a methane potential of 6.20 Gg (cf. Thomsen & Lyck, 2005).

The decrease in the amount of combusted sludge is partly accompanied by an increase in the reuse of sludge mainly in the production of sandblasting products. The methane potential internal combusted and reused for production of sandblasting products are therefore expected to increase according to the national waste strategy (The Danish Government, 2002). The best available approach is at this stage to use the simple linear regression for this final disposal category as the defined target, corresponds to a methane potential of 7.75 Gg, have not yet been reached (cf. Thomsen& Lyck, 2005).

Quality Check and verification - Nitrous oxide

EF used for calculating the direct emission of N_2O

A German estimate of the emission factor for direct emission of N_2O from wastewater treatment processes, not including industrial influents, is 7 g N_2O / person per year (Schøn et al, 1993). In an investigation for the Netherlands, the emission factor is suggested to be 3.2 g N_2O / person per year (Czepiel, Crill and Harries, 1995). Similar to the German estimated EF, this emission factor does not account for co-discharges of industrial nitrogen. To take into account the contribution from non-household nitrogen, Scheehle and Doorn (1997) suggest using the difference between residential (decentralised) WWTPs and the centralised loading averages of influent nitrogen. As the decentralised WWTPs are assumed to have no influent wastewater load from the industry, whereas the centralised WWTPs receives most of the industrial wastewater, the difference in average influent loads may be used to derive an estimate of the fraction of industrial nitrogen influent load. The estimated fraction of industrial influent nitrogen load is used in combination with the Netherlands emission factor to arrive at an EF corrected for industrial influent nitrogen load. In the United States a correction factor of 1.25 was obtained resulting in an emission factor of (1.25*3.2) 4 g N_2O / person per year (Scheehle and Doorn, 1997) including the contribution from industrial nitrogen influent load. An analogue approach has been used for calculating the Danish direct emission of N_2O upon wastewater treatment.

Key data on nitrogen influent load distribution according to small, medium and large WWTPs are available from the Danish Water and Wastewater Association (Danva, 2001). The data are based on 20-25 WWTPs located in five big city areas in Denmark and are reported for the years 1998 to 2001. Based on these data an average factor of 3.52 was calculated as the average influent nitrogen for the large (centralised) WWTPs minus the average influent nitrogen load for the medium (decentralised) WWTPs divided by the average nitrogen load for the medium WWTPs.

Table 3E.8 Correction factors (CF) to adjust the emission factor (EF) to include influent loads of N to WWTPs from industry.

year	WWTP-large [ton N / year]	WWTP-medium [ton N/year]	CF	EF [N_2O /capita per year]
1987			1	3.2
1998	1 081	233	3.64	11.7
1999	1 042	220	3.74	12.0
2000	1 016	222	3.58	11.5
2001	894	216	3.14	10.0

The use of this factor to correct the emission factor based on household wastewater only is based on the assumption that the emission factor is the same for household and industrial wastewater respectively. The correction factor in 1987 is equal to 1 corresponding to zero contribution from industry. Emission factors are equal to CF * 3.2 g N_2O / person per year. The average resulting emission factor for direct emission of N_2O is (3.52*3.2) 11.3 g N_2O / person per year. However, the contribution to the Danish WWTPs from industry has changed from close to zero in 1984 up to an average of 42 % since 1998. Therefore, the per cent industrial wastewater influent loads from 1987 (where it was zero) and the years 1998 to 2001, for which a corrected emission factor can be estimated, was used in a simple regression of % industrial wastewater influent load versus the corrected emission factors. Regression equation 1 was used for estimating the emission factor for all years 1990-2002.

Eq. 1: $EF_{N2O.WWTP.direct} = 0.1887 * I + 3.2816$

where I is the per cent industrial influent load.

From 2004 and forward an average of the calculated EFs from 2000 to 2003 was applied as industrial contribution to the influent TOW is assumed constant and it seemed most appropriate therefore to use an average of 10.8 reducing the effect from the highest industrial contributions to the influent TOW in 1998 and 1999 (cf. Table 8.22 in the main report).

References

Czepiel, P., Crill, P. & Harriss, R. 1995: Nitrous oxide emissions from municipal wastewater treatment, Environmental Science and Technology, 29, pp, 2352-2356.

DANVA 2001: Operating characteristics and key data for waste water treatment plants. In Danish: Driftsforhold og nøgletal for Renseanlæg 2000, http://www,danva,dk/sw220.asp'

Scheehle, E.A. & Doorn, M.R.J. 1997: Improvements to the US, Wastewater Methane and Nitrous Oxide Emission Estimates, US EPA.

Thomsen, M. and Lyck, E. 2005: Emission of CH_4 and N_2O from wastewater treatment plants (6B). NERI Research Note No. 208.

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 1990-2006 include all sources identified by the Revised IPPC Guidelines except the following:

Agriculture: The methane conversion factor in relation to the enteric fermentation for poultry and fur farming is not estimated. There is no default value recommended in IPCC GPG (Table A-4). However, this emission is seen as non-significant compared with the total emission from enteric fermentation.

Annex 6.1 Additional information to be considered as part of the NIR submission (where relevant) or other useful reference information

Annual emission inventories 1990-2006 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. In this NIR we only include the trend tables 1990-2006 (CRF Table 10 sheet 1-5) as they appear in the CRF 2006 spreadsheet file, Tables 10.1-10.5. The full CRF tables 1990-2006 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.

The Tables enclosed in this Annex are for the Kingdom of Denmark, i.e. Denmark, Faroe Islands and Greenland (Annex 6.1.1) and for Denmark and Greenland (Annex 6.1.2). Emissions for Faroe Islands and Greenland are entered under the Category "7. Other".

Annex 6.1.1 CRF Table 10 for the Kingdom of Denmark

TABLE 10 EMISSION TRENDS
CO_2
(Part 1 of 2)

Inventory 2006
Submission 2008 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	**51.461,75**	**61.974,03**	**56.066,68**	**58.364,50**	**61.982,09**	**58.938,44**	**72.284,71**	**62.616,07**	**58.558,78**	**55.765,14**
A. Fuel Combustion (Sectoral Approach)	51.198,31	61.456,02	55.532,47	57.896,16	61.514,48	58.575,64	71.886,02	62.053,03	58.138,16	54.869,15
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	31.380,85	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	10.528,06	10.904,06	11.101,68	11.224,71	11.712,28	11.851,99	12.106,19	12.290,87	12.263,20	12.258,16
4. Other Sectors	8.954,35	9.207,86	8.438,88	9.197,91	8.429,78	8.646,24	9.202,35	8.383,68	8.136,30	7.975,77
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	**1.102,45**	**1.275,40**	**1.394,83**	**1.414,61**	**1.440,38**	**1.445,95**	**1.552,17**	**1.721,15**	**1.725,64**	**1.653,57**
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	1.682,89	1.609,96
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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	148,10	144,68	141,26	137,83	134,41	138,90	134,23	123,96	114,38	111,27
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**	**-1.231,16**
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
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**,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**
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)*	**1.276,79**	**1.239,89**	**1.209,63**	**1.051,06**	**1.008,17**	**1.054,53**	**1.146,42**	**1.153,46**	**1.163,53**	**1.204,78**
Total CO_2 emissions including net CO_2 from LULUCF	**54.540,76**	**62.945,84**	**57.263,85**	**59.811,00**	**62.948,04**	**59.908,61**	**73.900,42**	**64.435,34**	**59.608,20**	**57.503,61**
Total CO_2 emissions excluding net CO_2 from LULUCF	**53.989,09**	**64.634,00**	**58.812,39**	**60.968,00**	**64.565,05**	**61.577,83**	**75.117,53**	**65.614,64**	**61.562,34**	**58.734,77**
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

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CO_2
(Part 2 of 2)

Inventory 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**51.272,91**	**52.863,26**	**52.454,27**	**57.782,58**	**52.121,16**	**48.543,29**	**55.837,72**	**8,50**
A. Fuel Combustion (Sectoral Approach)	50.680,36	52.232,02	51.921,41	57.234,63	51.514,73	48.108,76	55.422,99	8,25
1. Energy Industries	25.113,91	26.399,69	26.552,92	31.401,90	25.395,55	22.136,36	29.470,34	12,60
2. Manufacturing Industries and Construction	6.008,15	6.089,27	5.800,74	5.770,24	5.815,72	5.606,58	5.629,55	3,80
3. Transport	12.049,93	12.047,74	12.151,13	12.612,68	12.923,30	13.056,49	13.417,24	27,44
4. Other Sectors	7.397,84	7.598,44	7.327,84	7.357,82	7.141,14	7.038,53	6.779,39	-24,29
5. Other	110,53	96,87	88,78	91,98	239,02	270,80	126,46	6,25
B. Fugitive Emissions from Fuels	592,55	631,24	532,86	547,95	606,43	434,53	414,74	57,43
1. Solid Fuels	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	434,53	414,74	57,43
2. Industrial Processes	**1.681,95**	**1.707,91**	**1.696,35**	**1.572,27**	**1.731,29**	**1.659,41**	**1.611,40**	**46,16**
A. Mineral Products	1.640,57	1.660,41	1.695,80	1.571,22	1.728,28	1.640,82	1.609,22	49,95
B. Chemical Industry	0,65	0,83	0,55	1,05	3,01	3,01	2,18	172,13
C. Metal Production	40,73	46,68	NA,NO	NA,NO	NA,NO	15,58	NA,NO	-100,00
D. Other Production	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	NO	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	112,65	102,48	104,09	93,93	101,12	103,20	102,00	-31,13
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**	**-633,17**	**-1.801,90**	**-426,63**
A. Forest Land	-664,25	-3.551,13	-3.827,01	-3.547,21	-3.465,22	-1.829,67	-2.757,66	-2,58
B. Cropland	2.227,07	2.712,61	1.779,33	1.190,96	2.579,57	1.126,98	888,16	-72,98
C. Grassland	71,10	74,29	75,93	75,97	73,79	82,52	80,99	-12,82
D. Wetlands	-3,28	-4,97	-6,99	-10,00	-12,50	-13,01	-13,39	-784,62
E. Settlements	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	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	0,00
6. Waste	**,NA,NE,NO**	**,NA,NE,NO**	**,NA,NE,NO**	**,NA,NE,NO**	**,NA,NE,NO**	**,NA,NE,NO**	**,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	0,00
B. Waste-water Handling								
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	NA	NA	NA	NA	NA	NA	NO	0,00
7. Other ***(as specified in Summary 1.A)***	**1.327,31**	**1.354,88**	**1.285,67**	**1.358,68**	**1.390,80**	**1.367,57**	**1.373,60**	**7,58**
Total CO_2 emissions including net CO_2 from LULUCF	**56.025,46**	**55.259,32**	**53.561,64**	**58.517,18**	**54.520,02**	**51.040,28**	**57.122,81**	**4,73**
Total CO_2 emissions excluding net CO_2 from LULUCF	**54.394,81**	**56.028,53**	**55.540,38**	**60.807,46**	**55.344,38**	**51.673,46**	**58.924,72**	**9,14**
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**	**24,73**
Aviation	2.349,78	2.384,94	2.059,41	2.142,08	2.448,86	2.575,38	2.583,30	48,80
Marine	4.279,45	3.604,83	2.965,52	3.130,03	2.544,50	2.635,96	3.432,65	11,19
Multilateral Operations	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	10.908,19	11.186,23	141,04

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CH_4
(Part 1 of 2)

Inventory 2006
Submission 2008 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	2,64	2,55	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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use										
4. Agriculture	**190,96**	**192,95**	**193,39**	**197,73**	**191,32**	**189,67**	**190,59**	**185,99**	**187,71**	**181,10**
A. Enteric Fermentation	155,19	155,33	153,12	154,92	149,91	148,37	148,63	143,39	143,30	137,33
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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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)*	**1,62**	**1,59**	**1,60**	**1,60**	**1,64**	**1,65**	**1,64**	**1,64**	**1,61**	**1,59**
Total CH_4 emissions including CH_4 from LULUCF	**272,80**	**276,99**	**278,33**	**285,98**	**282,28**	**285,96**	**292,22**	**287,01**	**288,32**	**282,42**
Total CH_4 emissions excluding CH_4 from LULUCF	**272,83**	**277,02**	**278,35**	**286,01**	**282,30**	**285,99**	**292,25**	**287,04**	**288,35**	**282,45**
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										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CH_4
(Part 2 of 2)

Inventory 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	30,45	32,10	32,17	32,40	32,31	30,47	28,31	164,82
A. Fuel Combustion (Sectoral Approach)	26,64	28,29	28,22	28,38	27,47	25,68	23,66	168,79
1. Energy Industries	15,28	16,55	16,48	16,17	15,18	13,20	11,42	926,17
2. Manufacturing Industries and Construction	1,57	1,64	1,50	1,50	1,49	1,29	1,16	64,11
3. Transport	1,91	1,79	1,68	1,62	1,53	1,42	1,34	-49,90
4. Other Sectors	7,88	8,31	8,56	9,09	9,26	9,76	9,74	125,94
5. Other	0,01	0,01	0,00	0,01	0,01	0,01	0,01	16,52
B. Fugitive Emissions from Fuels	3,81	3,82	3,94	4,02	4,84	4,80	4,65	146,32
1. Solid Fuels	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	4,80	4,65	146,32
2. Industrial Processes	**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	0,00
B. Chemical Industry	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	0,00
D. Other Production								
E. Production of Halocarbons and SF_6								
F. Consumption of Halocarbons and SF_6								
G. Other	NO	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use								
4. Agriculture	**181,73**	**186,05**	**183,10**	**181,44**	**178,00**	**175,52**	**173,56**	**-9,11**
A. Enteric Fermentation	136,28	138,89	135,20	133,21	128,53	126,71	123,93	-20,15
B. Manure Management	45,44	47,16	47,91	48,23	49,47	48,81	49,63	38,75
C. Rice Cultivation	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	0,00
E. Prescribed Burning of Savannas	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	0,00
G. Other	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**	**-17,33**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	0,00
B. Cropland	NA	NA	NA	NA	NA	NA	NA	0,00
C. Grassland	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	-17,33
E. Settlements	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	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	0,00
6. Waste	**68,22**	**68,59**	**69,77**	**70,38**	**64,69**	**62,11**	**60,78**	**-12,63**
A. Solid Waste Disposal on Land	57,87	57,57	54,99	56,08	51,60	49,66	48,95	-23,00
B. Waste-water Handling	10,34	11,02	14,78	14,30	13,08	12,45	11,82	97,67
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	0,00	0,00	0,00	0,00	0,00	0,00	NO	0,00
7. Other *(as specified in Summary 1.A)*	**1,55**	**1,56**	**1,52**	**1,54**	**1,54**	**1,53**	**1,53**	**-5,24**
Total CH_4 emissions including CH_4 from LULUCF	**281,92**	**288,28**	**286,53**	**285,75**	**276,51**	**269,61**	**264,16**	**-3,17**
Total CH_4 emissions excluding CH_4 from LULUCF	**281,94**	**288,30**	**286,56**	**285,77**	**276,54**	**269,63**	**264,18**	**-3,17**
Memo Items:								
International Bunkers	0,14	0,12	0,11	0,11	0,11	0,11	0,13	38,47
Aviation	0,04	0,04	0,04	0,04	0,05	0,05	0,05	66,98
Marine	0,10	0,08	0,07	0,07	0,06	0,06	0,08	24,88
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass								

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N_2O
(Part 1 of 2)

Inventory 2006
Submission 2008 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**	**1,41**	**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	1,68	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	NO	NO	NO	NO	NO	NO	NO	NO	NO	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	**29,14**	**28,64**	**27,66**	**27,06**	**26,33**	**25,66**	**24,56**	**24,27**	**24,16**	**22,75**
A. Enteric Fermentation										
B. Manure Management	2,21	2,20	2,20	2,22	2,15	2,08	2,08	2,07	2,10	2,04
C. Rice Cultivation										
D. Agricultural Soils	26,93	26,44	25,46	24,83	24,18	23,58	22,48	22,20	22,06	20,71
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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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)*	**0,06**	**0,06**	**0,06**	**0,05**	**0,05**	**0,05**	**0,05**	**0,05**	**0,06**	**0,06**
Total N_2O emissions including N_2O from LULUCF	**34,13**	**33,47**	**32,05**	**31,38**	**30,75**	**30,40**	**29,22**	**28,87**	**28,58**	**27,60**
Total N_2O emissions excluding N_2O from LULUCF	**34,13**	**33,47**	**32,05**	**31,38**	**30,75**	**30,40**	**29,22**	**28,87**	**28,57**	**27,60**
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										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N_2O
(Part 2 of 2)

Inventory 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**1,47**	**1,49**	**1,48**	**1,53**	**1,48**	**1,44**	**1,52**	**18,53**
A. Fuel Combustion (Sectoral Approach)	1,46	1,48	1,48	1,52	1,47	1,43	1,51	18,38
1. Energy Industries	0,48	0,51	0,52	0,55	0,50	0,46	0,54	41,60
2. Manufacturing Industries and Construction	0,19	0,19	0,18	0,18	0,19	0,18	0,19	6,16
3. Transport	0,48	0,47	0,46	0,46	0,46	0,45	0,44	18,52
4. Other Sectors	0,30	0,31	0,31	0,32	0,31	0,33	0,33	-1,55
5. Other	0,00	0,00	0,00	0,00	0,01	0,01	0,00	7,94
B. Fugitive Emissions from Fuels	0,01	0,01	0,01	0,01	0,01	0,01	0,01	57,76
1. Solid Fuels	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	57,76
2. Industrial Processes	**3,24**	**2,86**	**2,50**	**2,89**	**1,71**	**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	0,00
B. Chemical Industry	3,24	2,86	2,50	2,89	1,71	NA,NO	NA,NO	-100,00
C. Metal Production	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	NO	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,05	0,12	100,00
4. Agriculture	**21,91**	**21,43**	**20,65**	**19,96**	**20,29**	**20,21**	**19,23**	**-34,02**
A. Enteric Fermentation								
B. Manure Management	1,94	1,94	1,89	1,81	1,83	1,80	1,67	-24,21
C. Rice Cultivation								
D. Agricultural Soils	19,97	19,48	18,76	18,15	18,46	18,42	17,55	-34,82
E. Prescribed Burning of Savannas	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	0,00
G. Other	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**	**-17,33**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	0,00
B. Cropland	NA	NA	NA	NA	NA	NA	NA	0,00
C. Grassland	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	-17,33
E. Settlements	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	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	0,00
6. Waste	**0,21**	**0,18**	**0,19**	**0,16**	**0,17**	**0,16**	**0,16**	**-42,98**
A. Solid Waste Disposal on Land								
B. Waste-water Handling	0,21	0,18	0,19	0,16	0,17	0,16	0,16	-42,98
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	0,00	0,00	0,00	0,00	0,00	0,00	NO	0,00
7. Other *(as specified in Summary 1.A)*	**0,06**	**0,06**	**0,06**	**0,06**	**0,06**	**0,06**	**0,06**	**6,95**
Total N_2O emissions including N_2O from LULUCF	**26,88**	**26,02**	**24,88**	**24,59**	**23,71**	**21,92**	**21,09**	**-38,20**
Total N_2O emissions excluding N_2O from LULUCF	**26,88**	**26,02**	**24,88**	**24,59**	**23,71**	**21,92**	**21,09**	**-38,20**
Memo Items:								
International Bunkers	**0,35**	**0,31**	**0,26**	**0,27**	**0,25**	**0,25**	**0,30**	**20,32**
Aviation	0,08	0,08	0,07	0,07	0,08	0,09	0,09	50,31
Marine	0,27	0,23	0,19	0,20	0,16	0,17	0,22	11,19
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass								

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 1 of 2)

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**	**134,54**	**217,78**	**329,44**	**324,80**	**413,11**	**507,54**
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**	**89,27**	**101,30**	**122,20**	**107,53**	**61,13**	**73,24**	**59,61**	**65,45**
SF_6	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 2 of 2)

Inventory 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
Emissions of HFCs(3) - (Gg CO_2 equivalent)	**610,83**	**657,17**	**684,60**	**710,37**	**765,70**	**821,72**	**852,17**	**100,00**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	100,00
HFC-32	0,01	0,01	0,01	0,01	0,01	0,01	0,01	100,00
HFC-41	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	0,00
HFC-125	0,04	0,05	0,05	0,05	0,06	0,07	0,07	100,00
HFC-134	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	0,29	0,30	100,00
HFC-152a	0,02	0,01	0,01	0,00	0,01	0,00	0,00	100,00
HFC-143	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	100,00
HFC-227ea	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	0,00
HFC-245ca	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	0,00
Emissions of PFCs(3) - (Gg CO_2 equivalent)	**17,89**	**22,13**	**22,17**	**19,34**	**15,90**	**13,90**	**15,68**	**100,00**
CF_4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	100,00
C_2F_6	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	100,00
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
c-C_4F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	100,00
C_5F_{12}	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	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	0,00
Emissions of SF6(3) - (Gg CO_2 equivalent)	**59,31**	**30,48**	**25,10**	**31,45**	**33,33**	**21,91**	**36,14**	**-18,70**
SF_6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-18,70

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 1 of 2)

Inventory 2006
Submission 2008 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	54.540,76	62.945,84	57.263,85	59.811,00	62.948,04	59.908,61	73.900,42	64.435,34	59.608,20	57.503,61
CO_2 emissions excluding net CO_2 from LULUCF	53.989,09	64.634,00	58.812,39	60.968,00	64.565,05	61.577,83	75.117,53	65.614,64	61.562,34	58.734,77
CH_4 emissions including CH_4 from LULUCF	5.728,87	5.816,72	5.844,85	6.005,57	5.927,80	6.005,18	6.136,70	6.027,31	6.054,66	5.930,88
CH_4 emissions excluding CH_4 from LULUCF	5.729,47	5.817,32	5.845,45	6.006,16	5.928,40	6.005,77	6.137,28	6.027,90	6.055,25	5.931,38
N_2O emissions including N_2O from LULUCF	10.579,05	10.376,24	9.935,63	9.728,09	9.532,37	9.423,00	9.058,03	8.950,58	8.858,33	8.556,90
N_2O emissions excluding N_2O from LULUCF	10.578,96	10.376,15	9.935,54	9.728,00	9.532,28	9.422,91	9.057,94	8.950,49	8.858,24	8.556,82
HFCs	NA,NE,NO	NA,NE,NO	3,44	93,93	134,54	217,78	329,44	324,80	413,11	507,54
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,05	0,50	1,66	4,12	9,10	12,48
SF_6	44,45	63,50	89,27	101,30	122,20	107,53	61,13	73,24	59,61	65,45
Total (including LULUCF)	**70.893,14**	**79.202,30**	**73.137,05**	**75.739,89**	**78.665,02**	**75.662,59**	**89.487,37**	**79.815,39**	**75.003,01**	**72.576,85**
Total (excluding LULUCF)	**70.341,98**	**80.890,97**	**74.686,09**	**76.897,40**	**80.282,52**	**77.332,32**	**90.704,97**	**80.995,19**	**76.957,64**	**73.808,43**

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	52.083,04	62.665,18	56.751,97	59.112,65	62.817,20	59.911,44	73.416,06	63.720,27	59.673,73	56.882,56
2. Industrial Processes	2.189,81	2.293,74	2.331,01	2.404,63	2.503,53	2.675,37	2.778,41	2.970,31	3.011,85	3.184,59
3. Solvent and Other Product Use	148,10	144,68	141,26	137,83	134,41	138,90	134,23	123,96	114,38	111,27
4. Agriculture	13.043,72	12.931,37	12.637,05	12.540,35	12.179,63	11.937,79	11.615,37	11.430,30	11.432,99	10.856,10
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	-1.231,58
6. Waste	1.548,40	1.565,16	1.563,87	1.601,49	1.589,39	1.563,34	1.562,94	1.544,43	1.508,06	1.513,56
7. Other	1.328,90	1.290,84	1.260,94	1.100,44	1.058,35	1.105,48	1.197,96	1.205,93	1.216,62	1.260,34
Total (including LULUCF)[5]	**70.893,14**	**79.202,30**	**73.137,05**	**75.739,89**	**78.665,02**	**75.662,59**	**89.487,37**	**79.815,39**	**75.003,01**	**72.576,85**

[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 10 EMISSION TRENDS
SUMMARY
(Part 2 of 2)

Inventory 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS EMISSIONS	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**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 emissions including net CO_2 from LULUCF	56.025,46	55.259,32	53.561,64	58.517,18	54.520,02	51.040,28	57.122,81	4,73
CO_2 emissions excluding net CO_2 from LULUCF	54.394,81	56.028,53	55.540,38	60.807,46	55.344,38	51.673,46	58.924,72	9,14
CH_4 emissions including CH_4 from LULUCF	5.920,31	6.053,84	6.017,18	6.000,71	5.806,79	5.661,75	5.547,28	-3,17
CH_4 emissions excluding CH_4 from LULUCF	5.920,81	6.054,33	6.017,67	6.001,20	5.807,29	5.662,25	5.547,77	-3,17
N_2O emissions including N_2O from LULUCF	8.334,28	8.067,33	7.713,91	7.622,94	7.351,08	6.796,11	6.537,42	-38,20
N_2O emissions excluding N_2O from LULUCF	8.334,20	8.067,25	7.713,84	7.622,87	7.351,00	6.796,03	6.537,35	-38,20
HFCs	610,83	657,17	684,60	710,37	765,70	821,72	852,17	100,00
PFCs	17,89	22,13	22,17	19,34	15,90	13,90	15,68	100,00
SF_6	59,31	30,48	25,10	31,45	33,33	21,91	36,14	-18,70
Total (including LULUCF)	**70.968,08**	**70.090,28**	**68.024,60**	**72.902,00**	**68.492,83**	**64.355,67**	**70.111,50**	**-1,10**
Total (excluding LULUCF)	**69.337,86**	**70.859,90**	**70.003,76**	**75.192,70**	**69.317,61**	**64.989,27**	**71.913,82**	**2,23**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**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)**	**(%)**
1. Energy	52.367,82	54.000,78	53.589,95	58.936,04	53.257,64	49.629,00	56.902,52	9,25
2. Industrial Processes	3.367,21	3.293,06	3.189,66	3.213,12	3.060,02	2.500,20	2.497,97	14,07
3. Solvent and Other Product Use	112,65	102,48	104,09	93,93	101,12	117,23	139,29	-5,95
4. Agriculture	10.607,30	10.549,18	10.247,84	9.996,56	10.027,41	9.952,28	9.605,14	-26,36
5. Land Use, Land-Use Change and Forestry(5)	1.630,22	-769,62	-1.979,16	-2.290,70	-824,78	-633,59	-1.802,32	-427,00
6. Waste	1.497,97	1.497,77	1.523,35	1.527,84	1.411,65	1.354,88	1.326,29	-14,34
7. Other	1.384,91	1.416,63	1.348,86	1.425,21	1.459,77	1.435,67	1.442,61	8,56
Total (including LULUCF)(5)	**70.968,08**	**70.090,28**	**68.024,60**	**72.902,00**	**68.492,83**	**64.355,67**	**70.111,50**	**-1,10**

(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.

Annex 6.1.2. CRF Table 10 for the Denmark + Greenland

TABLE 10 EMISSION TRENDS Inventory 2006

CO_2 Submission 2008 v1.1

(Part 1 of 2) 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	**51.461,75**	**61.974,03**	**56.066,68**	**58.364,50**	**61.982,09**	**58.938,44**	**72.284,71**	**62.616,07**	**58.558,78**	**55.765,14**
A. Fuel Combustion (Sectoral Approach)	51.198,31	61.456,02	55.532,47	57.896,16	61.514,48	58.575,64	71.886,02	62.053,03	58.138,16	54.869,15
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	31.380,85	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	10.528,06	10.904,06	11.101,68	11.224,71	11.712,28	11.851,99	12.106,19	12.290,87	12.263,20	12.258,16
4. Other Sectors	8.954,35	9.207,86	8.438,88	9.197,91	8.429,78	8.646,24	9.202,35	8.383,68	8.136,30	7.975,77
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	**1.102,45**	**1.275,40**	**1.394,83**	**1.414,61**	**1.440,38**	**1.445,95**	**1.552,17**	**1.721,15**	**1.725,64**	**1.653,57**
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	1.682,89	1.609,96
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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	148,10	144,68	141,26	137,83	134,41	138,90	134,23	123,96	114,38	111,27
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**	**-1.231,16**
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
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**,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**
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)*	**630,00**	**615,23**	**600,91**	**550,63**	**500,40**	**539,81**	**602,53**	**623,21**	**583,59**	**599,29**
Total CO_2 emissions including net CO_2 from LULUCF	**53.893,97**	**62.321,18**	**56.655,13**	**59.310,57**	**62.440,28**	**59.393,88**	**73.356,53**	**63.905,09**	**59.028,25**	**56.898,12**
Total CO_2 emissions excluding net CO_2 from LULUCF	**53.342,30**	**64.009,35**	**58.203,67**	**60.467,57**	**64.057,28**	**61.063,11**	**74.573,64**	**65.084,40**	**60.982,39**	**58.129,28**
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

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CO_2
(Part 2 of 2)

Inventory 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**51.272,91**	**52.863,26**	**52.454,27**	**57.782,58**	**52.121,16**	**48.543,29**	**55.837,72**	**8,50**
A. Fuel Combustion (Sectoral Approach)	50.680,36	52.232,02	51.921,41	57.234,63	51.514,73	48.108,76	55.422,99	8,25
1. Energy Industries	25.113,91	26.399,69	26.552,92	31.401,90	25.395,55	22.136,36	29.470,34	12,60
2. Manufacturing Industries and Construction	6.008,15	6.089,27	5.800,74	5.770,24	5.815,72	5.606,58	5.629,55	3,80
3. Transport	12.049,93	12.047,74	12.151,13	12.612,68	12.923,30	13.056,49	13.417,24	27,44
4. Other Sectors	7.397,84	7.598,44	7.327,84	7.357,82	7.141,14	7.038,53	6.779,39	-24,29
5. Other	110,53	96,87	88,78	91,98	239,02	270,80	126,46	6,25
B. Fugitive Emissions from Fuels	592,55	631,24	532,86	547,95	606,43	434,53	414,74	57,43
1. Solid Fuels	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	434,53	414,74	57,43
2. Industrial Processes	**1.681,95**	**1.707,91**	**1.696,35**	**1.572,27**	**1.731,29**	**1.659,41**	**1.611,40**	**46,16**
A. Mineral Products	1.640,57	1.660,41	1.695,80	1.571,22	1.728,28	1.640,82	1.609,22	49,95
B. Chemical Industry	0,65	0,83	0,55	1,05	3,01	3,01	2,18	172,13
C. Metal Production	40,73	46,68	NA,NO	NA,NO	NA,NO	15,58	NA,NO	-100,00
D. Other Production	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	NO	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	112,65	102,48	104,09	93,93	101,12	103,20	102,00	-31,13
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**	**-633,17**	**-1.801,90**	**-426,63**
A. Forest Land	-664,25	-3.551,13	-3.827,01	-3.547,21	-3.465,22	-1.829,67	-2.757,66	-2,58
B. Cropland	2.227,07	2.712,61	1.779,33	1.190,96	2.579,57	1.126,98	888,16	-72,98
C. Grassland	71,10	74,29	75,93	75,97	73,79	82,52	80,99	-12,82
D. Wetlands	-3,28	-4,97	-6,99	-10,00	-12,50	-13,01	-13,39	-784,62
E. Settlements	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	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	0,00
6. Waste	**,NA,NE,NO**	**,NA,NE,NO**	**,NA,NE,NO**	**,NA,NE,NO**	**,NA,NE,NO**	**,NA,NE,NO**	**,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	0,00
B. Waste-water Handling								
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	NA	NA	NA	NA	NA	NA	NO	0,00
7. Other *(as specified in Summary 1.A)*	**671,89**	**621,94**	**583,37**	**641,97**	**669,52**	**667,95**	**682,03**	**8,26**
Total CO_2 emissions including net CO_2 from LULUCF	**55.370,04**	**54.526,39**	**52.859,35**	**57.800,47**	**53.798,74**	**50.340,67**	**56.431,24**	**4,71**
Total CO_2 emissions excluding net CO_2 from LULUCF	**53.739,39**	**55.295,59**	**54.838,08**	**60.090,75**	**54.623,10**	**50.973,84**	**58.233,14**	**9,17**
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**	**24,73**
Aviation	2.349,78	2.384,94	2.059,41	2.142,08	2.448,86	2.575,38	2.583,30	48,80
Marine	4.279,45	3.604,83	2.965,52	3.130,03	2.544,50	2.635,96	3.432,65	11,19
Multilateral Operations	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	10.908,19	11.186,23	141,04

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CH_4
(Part 1 of 2)

Inventory 2006
Submission 2008 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	2,64	2,55	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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use										
4. Agriculture	**190,96**	**192,95**	**193,39**	**197,73**	**191,32**	**189,67**	**190,59**	**185,99**	**187,71**	**181,10**
A. Enteric Fermentation	155,19	155,33	153,12	154,92	149,91	148,37	148,63	143,39	143,30	137,33
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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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)*	**0,77**	**0,77**	**0,78**	**0,78**	**0,78**	**0,78**	**0,78**	**0,78**	**0,76**	**0,73**
Total CH_4 emissions including CH_4 from LULUCF	**271,95**	**276,17**	**277,50**	**285,16**	**281,41**	**285,10**	**291,36**	**286,16**	**287,47**	**281,57**
Total CH_4 emissions excluding CH_4 from LULUCF	**271,98**	**276,20**	**277,53**	**285,18**	**281,44**	**285,12**	**291,39**	**286,18**	**287,49**	**281,59**
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										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CH_4
(Part 2 of 2)

Inventory 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	30,45	32,10	32,17	32,40	32,31	30,47	28,31	164,82
A. Fuel Combustion (Sectoral Approach)	26,64	28,29	28,22	28,38	27,47	25,68	23,66	168,79
1. Energy Industries	15,28	16,55	16,48	16,17	15,18	13,20	11,42	926,17
2. Manufacturing Industries and Construction	1,57	1,64	1,50	1,50	1,49	1,29	1,16	64,11
3. Transport	1,91	1,79	1,68	1,62	1,53	1,42	1,34	-49,90
4. Other Sectors	7,88	8,31	8,56	9,09	9,26	9,76	9,74	125,94
5. Other	0,01	0,01	0,00	0,01	0,01	0,01	0,01	16,52
B. Fugitive Emissions from Fuels	3,81	3,82	3,94	4,02	4,84	4,80	4,65	146,32
1. Solid Fuels	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	4,80	4,65	146,32
2. Industrial Processes	**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	0,00
B. Chemical Industry	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	0,00
D. Other Production								
E. Production of Halocarbons and SF_6								
F. Consumption of Halocarbons and SF_6								
G. Other	NO	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use								
4. Agriculture	**181,73**	**186,05**	**183,10**	**181,44**	**178,00**	**175,52**	**173,56**	**-9,11**
A. Enteric Fermentation	136,28	138,89	135,20	133,21	128,53	126,71	123,93	-20,15
B. Manure Management	45,44	47,16	47,91	48,23	49,47	48,81	49,63	38,75
C. Rice Cultivation	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	0,00
E. Prescribed Burning of Savannas	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	0,00
G. Other	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**	**-17,33**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	0,00
B. Cropland	NA	NA	NA	NA	NA	NA	NA	0,00
C. Grassland	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	-17,33
E. Settlements	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	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	0,00
6. Waste	**68,22**	**68,59**	**69,77**	**70,38**	**64,69**	**62,11**	**60,78**	**-12,63**
A. Solid Waste Disposal on Land	57,87	57,57	54,99	56,08	51,60	49,66	48,95	-23,00
B. Waste-water Handling	10,34	11,02	14,78	14,30	13,08	12,45	11,82	97,67
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	0,00	0,00	0,00	0,00	0,00	0,00	NO	0,00
7. Other *(as specified in Summary 1.A)*	**0,69**	**0,68**	**0,65**	**0,67**	**0,68**	**0,68**	**0,69**	**-9,71**
Total CH_4 emissions including CH_4 from LULUCF	**281,06**	**287,40**	**285,66**	**284,88**	**275,65**	**268,76**	**263,32**	**-3,18**
Total CH_4 emissions excluding CH_4 from LULUCF	**281,08**	**287,43**	**285,68**	**284,90**	**275,67**	**268,78**	**263,34**	**-3,18**
Memo Items:								
International Bunkers	0,14	0,12	0,11	0,11	0,11	0,11	0,13	38,47
Aviation	0,04	0,04	0,04	0,04	0,05	0,05	0,05	66,98
Marine	0,10	0,08	0,07	0,07	0,06	0,06	0,08	24,88
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass								

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N_2O
(Part 1 of 2)

Inventory 2006
Submission 2008 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**	**1,41**	**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	1,68	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	NO	NO	NO	NO	NO	NO	NO	NO	NO	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	**29,14**	**28,64**	**27,66**	**27,06**	**26,33**	**25,66**	**24,56**	**24,27**	**24,16**	**22,75**
A. Enteric Fermentation										
B. Manure Management	2,21	2,20	2,20	2,22	2,15	2,08	2,08	2,07	2,10	2,04
C. Rice Cultivation										
D. Agricultural Soils	26,93	26,44	25,46	24,83	24,18	23,58	22,48	22,20	22,06	20,71
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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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)***	**0,03**	**0,03**	**0,03**	**0,03**	**0,02**	**0,03**	**0,03**	**0,03**	**0,03**	**0,03**
Total N_2O emissions including N_2O from LULUCF	**34,09**	**33,44**	**32,02**	**31,36**	**30,72**	**30,37**	**29,19**	**28,85**	**28,55**	**27,57**
Total N_2O emissions excluding N_2O from LULUCF	**34,09**	**33,44**	**32,02**	**31,36**	**30,72**	**30,37**	**29,19**	**28,85**	**28,55**	**27,57**
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										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N_2O
(Part 2 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**1,47**	**1,49**	**1,48**	**1,53**	**1,48**	**1,44**	**1,52**	**18,53**
A. Fuel Combustion (Sectoral Approach)	1,46	1,48	1,48	1,52	1,47	1,43	1,51	18,38
1. Energy Industries	0,48	0,51	0,52	0,55	0,50	0,46	0,54	41,60
2. Manufacturing Industries and Construction	0,19	0,19	0,18	0,18	0,19	0,18	0,19	6,16
3. Transport	0,48	0,47	0,46	0,46	0,46	0,45	0,44	18,52
4. Other Sectors	0,30	0,31	0,31	0,32	0,31	0,33	0,33	-1,55
5. Other	0,00	0,00	0,00	0,00	0,01	0,01	0,00	7,94
B. Fugitive Emissions from Fuels	0,01	0,01	0,01	0,01	0,01	0,01	0,01	57,76
1. Solid Fuels	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	57,76
2. Industrial Processes	**3,24**	**2,86**	**2,50**	**2,89**	**1,71**	**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	0,00
B. Chemical Industry	3,24	2,86	2,50	2,89	1,71	NA,NO	NA,NO	-100,00
C. Metal Production	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	NO	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,05	0,12	100,00
4. Agriculture	**21,91**	**21,43**	**20,65**	**19,96**	**20,29**	**20,21**	**19,23**	**-34,02**
A. Enteric Fermentation								
B. Manure Management	1,94	1,94	1,89	1,81	1,83	1,80	1,67	-24,21
C. Rice Cultivation								
D. Agricultural Soils	19,97	19,48	18,76	18,15	18,46	18,42	17,55	-34,82
E. Prescribed Burning of Savannas	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	0,00
G. Other	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**	**-17,33**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	0,00
B. Cropland	NA	NA	NA	NA	NA	NA	NA	0,00
C. Grassland	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	-17,33
E. Settlements	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	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	0,00
6. Waste	**0,21**	**0,18**	**0,19**	**0,16**	**0,17**	**0,16**	**0,16**	**-42,98**
A. Solid Waste Disposal on Land								
B. Waste-water Handling	0,21	0,18	0,19	0,16	0,17	0,16	0,16	-42,98
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	0,00	0,00	0,00	0,00	0,00	0,00	NO	0,00
7. Other *(as specified in Summary 1.A)*	**0,03**	**0,03**	**0,03**	**0,03**	**0,03**	**0,03**	**0,03**	**5,95**
Total N_2O emissions including N_2O from LULUCF	**26,85**	**25,99**	**24,85**	**24,56**	**23,68**	**21,89**	**21,06**	**-38,25**
Total N_2O emissions excluding N_2O from LULUCF	**26,85**	**25,99**	**24,85**	**24,56**	**23,68**	**21,89**	**21,05**	**-38,25**
Memo Items:								
International Bunkers	**0,35**	**0,31**	**0,26**	**0,27**	**0,25**	**0,25**	**0,30**	**20,32**
Aviation	0,08	0,08	0,07	0,07	0,08	0,09	0,09	50,31
Marine	0,27	0,23	0,19	0,20	0,16	0,17	0,22	11,19
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass								

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 1 of 2)

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**	**217,75**	**329,38**	**324,14**	**411,89**	**504,25**
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**	**107,37**	**60,96**	**73,07**	**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

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 2 of 2)

Inventory 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
Emissions of HFCs[3] - (Gg CO_2 equivalent)	**606,49**	**650,25**	**675,91**	**700,17**	**754,30**	**810,53**	**840,52**	**100,00**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	100,00
HFC-32	0,01	0,01	0,01	0,01	0,01	0,01	0,01	100,00
HFC-41	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	0,00
HFC-125	0,04	0,05	0,05	0,05	0,06	0,07	0,07	100,00
HFC-134	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	0,29	0,30	100,00
HFC-152a	0,02	0,01	0,01	0,00	0,01	0,00	0,00	100,00
HFC-143	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	100,00
HFC-227ea	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	0,00
HFC-245ca	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	0,00
Emissions of PFCs[3] - (Gg CO_2 equivalent)	**17,89**	**22,13**	**22,17**	**19,34**	**15,90**	**13,90**	**15,68**	**100,00**
CF_4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	100,00
C_2F_6	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	100,00
C_4F_{10}	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	100,00
C_5F_{12}	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	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	0,00
Emissions of SF6[3] - (Gg CO_2 equivalent)	**59,23**	**30,40**	**25,01**	**31,38**	**33,15**	**21,76**	**36,00**	**-19,03**
SF_6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-19,03

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 1 of 2)

Inventory 2006
Submission 2008 v1.1
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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	53.893,97	62.321,18	56.655,13	59.310,57	62.440,28	59.393,88	73.356,53	63.905,09	59.028,25	56.898,12
CO_2 emissions excluding net CO_2 from LULUCF	53.342,30	64.009,35	58.203,67	60.467,57	64.057,28	61.063,11	74.573,64	65.084,40	60.982,39	58.129,28
CH_4 emissions including CH_4 from LULUCF	5.711,05	5.799,62	5.827,60	5.988,27	5.909,63	5.987,00	6.118,64	6.009,27	6.036,77	5.912,97
CH_4 emissions excluding CH_4 from LULUCF	5.711,65	5.800,22	5.828,19	5.988,87	5.910,22	5.987,59	6.119,22	6.009,85	6.037,35	5.913,46
N_2O emissions including N_2O from LULUCF	10.569,44	10.367,08	9.926,32	9.720,40	9.524,45	9.414,84	9.049,56	8.942,24	8.849,37	8.547,56
N_2O emissions excluding N_2O from LULUCF	10.569,35	10.366,99	9.926,23	9.720,31	9.524,36	9.414,75	9.049,47	8.942,15	8.849,28	8.547,48
HFCs	NA,NE,NO	NA,NE,NO	3,44	93,93	134,53	217,75	329,38	324,14	411,89	504,25
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NO	0,05	0,50	1,66	4,12	9,10	12,48
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)	**70.218,92**	**78.551,39**	**72.501,64**	**75.214,34**	**78.130,99**	**75.121,35**	**88.916,73**	**79.257,93**	**74.394,80**	**71.940,73**
Total (excluding LULUCF)	**69.667,75**	**80.240,06**	**74.050,69**	**76.371,85**	**79.748,50**	**76.791,08**	**90.134,33**	**80.437,73**	**76.349,43**	**73.172,32**

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	52.083,04	62.665,18	56.751,97	59.112,65	62.817,20	59.911,44	73.416,06	63.720,27	59.673,73	56.882,56
2. Industrial Processes	2.189,81	2.293,74	2.331,01	2.404,63	2.503,53	2.675,37	2.778,41	2.970,31	3.011,85	3.184,59
3. Solvent and Other Product Use	148,10	144,68	141,26	137,83	134,41	138,90	134,23	123,96	114,38	111,27
4. Agriculture	13.043,72	12.931,37	12.637,05	12.540,35	12.179,63	11.937,79	11.615,37	11.430,30	11.432,99	10.856,10
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	-1.231,58
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	654,67	639,92	625,54	574,89	524,33	564,24	627,32	648,46	608,41	624,23
Total (including LULUCF)[5]	**70.218,92**	**78.551,39**	**72.501,64**	**75.214,34**	**78.130,99**	**75.121,35**	**88.916,73**	**79.257,93**	**74.394,80**	**71.940,73**

[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 10 EMISSION TRENDS SUMMARY (Part 2 of 2)

Inventory 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	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 emissions including net CO_2 from LULUCF	55.370,04	54.526,39	52.859,35	57.800,47	53.798,74	50.340,67	56.431,24	4,71
CO_2 emissions excluding net CO_2 from LULUCF	53.739,39	55.295,59	54.838,08	60.090,75	54.623,10	50.973,84	58.233,14	9,17
CH_4 emissions including CH_4 from LULUCF	5.902,17	6.035,46	5.998,87	5.982,40	5.788,62	5.643,93	5.529,67	-3,18
CH_4 emissions excluding CH_4 from LULUCF	5.902,66	6.035,96	5.999,36	5.982,90	5.789,11	5.644,42	5.530,16	-3,18
N_2O emissions including N_2O from LULUCF	8.324,37	8.056,57	7.703,22	7.612,20	7.340,25	6.785,58	6.527,06	-38,25
N_2O emissions excluding N_2O from LULUCF	8.324,29	8.056,50	7.703,14	7.612,13	7.340,17	6.785,51	6.526,98	-38,25
HFCs	606,49	650,25	675,91	700,17	754,30	810,53	840,52	100,00
PFCs	17,89	22,13	22,17	19,34	15,90	13,90	15,68	100,00
SF_6	59,23	30,40	25,01	31,38	33,15	21,76	36,00	-19,03
Total (including LULUCF)	**70.280,18**	**69.321,20**	**67.284,52**	**72.145,96**	**67.730,96**	**63.616,37**	**69.380,16**	**-1,19**
Total (excluding LULUCF)	**68.649,96**	**70.090,83**	**69.263,68**	**74.436,66**	**68.555,74**	**64.249,96**	**71.182,48**	**2,17**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	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)	(%)
1. Energy	52.367,82	54.000,78	53.589,95	58.936,04	53.257,64	49.629,00	56.902,52	9,25
2. Industrial Processes	3.367,21	3.293,06	3.189,66	3.213,12	3.060,02	2.500,20	2.497,97	14,07
3. Solvent and Other Product Use	112,65	102,48	104,09	93,93	101,12	117,23	139,29	-5,95
4. Agriculture	10.607,30	10.549,18	10.247,84	9.996,56	10.027,41	9.952,28	9.605,14	-26,36
5. Land Use, Land-Use Change and Forestry(5)	1.630,22	-769,62	-1.979,16	-2.290,70	-824,78	-633,59	-1.802,32	-427,00
6. Waste	1.497,97	1.497,77	1.523,35	1.527,84	1.411,65	1.354,88	1.326,29	-14,34
7. Other	697,01	647,56	608,78	669,17	697,90	696,37	711,27	8,64
Total (including LULUCF)(5)	**70.280,18**	**69.321,20**	**67.284,52**	**72.145,96**	**67.730,96**	**63.616,37**	**69.380,16**	**-1,19**

(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.

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.

An update of this work has recently been made (Umhvørvisstovan, 2008), 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 1990-2006.

The emission factors behind the inventories come from NERI. According to Umhvørvisstovan (Pers. comm. Hansen, 2008) some comments must be made in the following areas.

- The final grouping of fuel sales for sea vessels made by Umhvørvisstovan is still somewhat unprecise.
- An unexpected peak in road transport diesel fuel sales in 2001 may be due to errors in fuel reports. For this year, errors are likely to occur for other fuel consumption sectors also.
- The emissions from agricultural soils are not reported.

Although the errors are regarded as minor only, efforts, however, will be made by Umhvørvisstovan to improve the inventories in the above mentioned areas in next year's emission report.

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, while the CH_4 and N_2O emission increases (the Faroe Islands) are due to rising activity in the agricultural sector.

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, HFCs, CO, NMVOC and NO_x. 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 2006 and for HFCs for 1995-2006 are given in the table below. The inventory is based on information from e.g. KNI Pilersuisoq, Statoil, Nukissiorfiit Årsoversigt 2004, Grønlands Kommando (Greenland Command) and Konsulenttjenesten for Landbrug (Consultancy for Agriculture). 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 6.2.2 (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	630	769	27.5		647	849	31	0.000
1991	615	775	27.2		625	814	30	0.000
1992	601	776	26.8		609	822	30	0.120
1993[1]	551	777	25.6		500	824	25	0.131
1994	500	779	24.4		508	866	26	0.158
1995	540	785	25.5	0.060	515	866	26	0.178
1996	603	783	26.7	0.080	544	860	27	0.221
1997	623	783	27.2	0.39	530	859	27	0.833
1998	584	762	26.2	0.71	580	852	29	1.410
1999	599	732	26.7	1.27	605	853	30	3.378
2000	672	690	28.3	1.85	655	864	32	4.425
2001	622	681	27.0	2.93	733	875	35	7.005
2002	583	647	25.7	3.86	702	872	34	8.777
2003	642	673	27.0	4.70	717	872	35	10.281
2004	670	678	28.4	5.35	721	865	35	11.577
2005	668	678	28.3	5.39	700	849	34	11.344
2006	682	695	29.1	5.63	692	839	33	11.795

1. The CO_2 emission for Greenland 1993 is interpolated.

References

Umhvørvisstovan, 2008: 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

GHG inventory for Greenland

The GHG inventory for Greenland includes the following sectors:

- Energy sector
- Industrial processes (consumption of F-gasses)
- Agriculture (sheep)
- Solid waste management (incineration without energy recovery, disposal, and open burning)

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 used for all the sectors. The actual methodology is described below for the different sectors. The data handling and calculations were performed by use of the IPCC excel tool (version 1.1). The excel tool were modified/extended to cover all relevant processes and calculations were corrected where it was found necessary.

Energy sector

The inventory covering the energy sector has been performed according to the IPCC tier 1 methodology. The CO_2 emission has been calculated by using the methodology included in the IPCC software. This methodology implies use of C content per fuel type (default) and fraction of carbon oxidised (default); see the equation below.

$$E_{CO_2} = \Sigma\, Act_a \times EF_{C,a} \times Ox \times 44/12$$

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 for waste incineration (with energy recovery). The equation applied for each pollutant is:

$$E = \Sigma (EF_{ab} \times Act_{ab})$$

where:

EF = emission factor

Act = activity; fuel input

a = fuel type

b = sector activity

Industrial processes

The inventory covering industrial gasses has been performed according to tier 2 with estimates of the actual emissions. Information on emission of industrial gasses is only available from 1995 onwards.

Agriculture

Agriculture is sparse in Greenland due to climatic conditions, however sheep 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.

$$E_{CH_4} = N_{sheep} \times (EF_{ent.ferm.} + EF_{m.m.})$$

$$E_{N_2O} = N_{sheep} \times N_{ex.} \times EF_{N_2O} \times 44/28$$

The applied emission factors are presented in Table 2.

Table 2 Applied emission factors[1] for agriculture.

	Enteric fermentation kg CH_4/head/year	Manure management kg CH_4/head/year	Nitrogen excretion kg N/head/year
Sheep	17.17	0.32	16.87

The emission factors are adopted from the Danish inventory (Illerup et al., 2006).

The IPCC default for EF_{N2O}: 0.02 kg N_2O-N/kg N has been chosen.

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
- Un-managed waste disposal combined with open burning

Information on amount of waste produced per 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 Ministry of Environment and Nature, Nuuk, Greenland; see Table 3. The distribution of waste between different treatment options after correction for open burning is presented in Table 4. The amount of household waste generated in 2006 is assumed to be the same as in 2005.

Table 3 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)
	%	%	%		%		
Paper/cardboard, dry	8[1]	20	11.8	2.37	7.66	0.4	3.06
Paper/cardboard, wet	10[1]	7	9.04	1.81	5.85	0.2	1.17
Plastics	7[1]	9	7.64	1.53	4.94	0	0
Organic waste	44[1]	34	40.8	8.16	26.4	0.2	5.28
Other combustible	17.5[1]	16	17.0	3.40	11.0	0.2	2.20
Glass	7.5[1]	3[1]	6.06	6.06	19.6	0	0
Metal	3.5[1]	3[1]	3.34	3.34	10.8	0	0
Other, non combustible	1[1]	5	2.28	2.28	7.37	0	0
Hazardous waste	1.5[1]	3[1]	1.98	1.98	6.40	0	0
Total	100	100	100	30.9	100		0.12
%	0.68[4]	0.32[4]		0.8[5]			

1. Measured values.
2. Source: Ministry of Environment and Nature, Nuuk, Greenland.
3. Source: Illerup et al. (2006).
4. Distribution of household and commercial waste.
5. Share of combustible waste burned at waste disposal sites.

Table 4 Waste management in Greenland (ktonnes). Waste for disposal is corrected for open burning.

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
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	5.19
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	1.00
Waste incineration, energy recovery	6.90	6.99	7.05	7.09	7.34	7.55	7.73	7.82	7.97	9.78
Waste incineration	0.00	0.00	0.00	0.00	0.06	0.22	0.79	1.24	2.67	2.92
Open burning	15.5	15.8	15.9	16.0	16.1	16.2	15.9	15.8	15.0	13.8
Total	29.38	29.83	30.02	30.19	30.68	31.21	31.60	31.98	32.37	32.71
Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**			
6A1 Managed waste disposal corrected for open burning	4.35	4.38	4.16	4.45	4.19	4.19	4.19			
6A2 Unmanaged waste disposal corrected for open burning	0.91	0.87	0.85	0.84	0.83	0.83	0.83			
Waste incineration, energy recovery	12.9	13.2	14.5	14.0	15.3	15.3	15.3			
Waste incineration	3.14	3.31	3.40	3.42	3.45	3.45	3.45			
Open burning	11.7	11.7	11.2	11.8	11.2	11.2	11.2			
Total	33.09	33.52	34.07	34.53	35.01	35.01	35.01			

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 emissions 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 5.

Table 5 Emission factors for incineration of waste.

	CO_2-fossil	CO_2-biogenic	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	kg	kg	g	g	g	G	g	g
EF DK[1]								
/GJ	17.6	94.5	6	4	164	10	9	67
/t wet	185	992	63.0	42.0	1 722	105	94.5	704
IPCC2006								
Continuous/semi-cont.				50.0				
Batch, stoker			60.0	60.0				
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 EF								
Waste incineration /t wet	185	992	60.0	50.0	3 210	224		693
Waste incineration /GJ	17.6	94.5	5.7	4.8	305.7	21.4	9.00	66
Waste incineration, Village plant /t wet	185	992	60.0	60.0	3 074	31 880	94.5	693
Open burning /t wet	185	992	60.0	213	3 074	31 880	94.5	693

1. Source: Illerup et al. (2006).
2. Source: Ministry of Environment and Nature, Nuuk, Greenland.

Summary

The Summary report for CO_2 equivalents for 1990-2006 (CRF: Summary 2) is presented in Table 8 – Table 24.

Time-series for the greenhouse gasses – see Table 6 – and for the different sectors – see Table 7 CO_2 is accounting for more than 95% of the emission of greenhouse gasses and the emission of greenhouse gasses is mainly related to the energy sector.

Table 6 Time series for emission of greenhouse gasses from 1990-2006 (Gg CO_2-eq.).

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
CO_2	630	615	601	551	500	540	603	623	584	599
CH_4	16.2	16.3	16.3	16.3	16.4	16.5	16.4	16.4	16.0	15.4
N_2O	8.52	8.42	8.32	7.94	7.57	7.89	8.27	8.42	8.12	8.29
HFC	NO	NO	NO	NO	NO	0.025	0.077	0.39	0.71	1.26
SF_6	NO	NO	NO	NO	NO	0.0359	0.0034	0.0034	0.0033	0.0033
Total	655	640	626	575	524	564	627	648	608	624

Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
CO_2	672	622	583	642	670	668	682
CH_4	14.5	14.3	13.6	14.1	14.2	14.2	14.6
N_2O	8.77	8.37	7.96	8.38	8.80	8.78	9.03
HFC	1.85	2.93	3.85	4.69	5.35	5.39	5.62
SF_6	0.0033	0.0032	0.0032	0.0032	0.0031	0.0031	0.0031
Total	697	648	609	669	698	696	711

Table 7 Time series for emission of greenhouse gasses from 1990-2006 within different sectors.

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Energy	633	618	603	552	502	541	605	625	585	601
Industry	NO	NO	NO	NO	NO	0.060	0.080	0.39	0.71	1.27
Agriculture	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
Waste managemen	11.5	11.7	11.8	11.8	11.9	12.1	12.1	12.1	11.8	10.9
Total	655	640	626	575	524	564	627	648	608	624

Continued	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Energy	675	625	586	645	673	671	685
Industry	1.85	2.93	3.86	4.70	5.35	5.39	5.63
Agriculture	10.9	10.6	10.1	10.3	10.9	10.9	11.3
Waste management	9.39	9.44	9.05	9.53	9.09	9.09	9.09
Total	697	648	609	669	698	696	711

Table 8 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 2006 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)]	**630,00**	**16,15**	**8,52**	**0,00**	**0,00**	**0,00**	**654,67**
1. Energy	**627,13**	**0,69**	**4,71**				**632,53**
A. Fuel Combustion (Sectoral Approach)	627,13	0,69	4,71				632,53
1. Energy Industries	187,44	0,17	1,68				189,29
2. Manufacturing Industries and Construction	26,36	0,02	0,22				26,61
3. Transport	95,73	0,10	0,48				96,32
4. Other Sectors	309,35	0,39	2,26				312,00
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							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]							0,00
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,35**	**3,30**				**10,65**
A. Enteric Fermentation		7,21					7,21
B. Manure Management		0,13	3,30				3,44
C. Rice Cultivation							0
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,87**	**8,12**	**0,51**				**11,50**
A. Solid Waste Disposal on Land		8,10					8,10
B. Waste-water Handling							0,00
C. Waste Incineration	0,00	0,00	0,00				0
D. Other	2,87	0,02	0,51				3,40
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	654,67
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	654,67

[(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 1991.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1991
Submission 2006 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)]	**615,23**	**16,27**	**8,42**	**0,00**	**0,00**	**0,00**	**639,92**
1. Energy	**612,32**	**0,68**	**4,60**				**617,59**
A. Fuel Combustion (Sectoral Approach)	612,32	0,68	4,60				617,59
1. Energy Industries	182,18	0,16	1,64				183,98
2. Manufacturing Industries and Construction	25,59	0,02	0,22				25,83
3. Transport	95,22	0,10	0,49				95,81
4. Other Sectors	301,33	0,38	2,20				303,91
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							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]							0,00
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,35**	**3,30**				**10,65**
A. Enteric Fermentation		7,21					7,21
B. Manure Management		0,13	3,30				3,44
C. Rice Cultivation							0
D. Agricultural Soils [(3)]							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry [(1)]	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,92**	**8,25**	**0,52**				**11,68**
A. Solid Waste Disposal on Land		8,23					8,23
B. Waste-water Handling							0,00
C. Waste Incineration	0,00	0,00	0,00				0
D. Other	2,92	0,02	0,52				3,45
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	639,92
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	639,92

(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 1992.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1992
Submission 2006 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)]	**600,91**	**16,31**	**8,32**	**0,00**	**0,00**	**0,00**	**625,54**
1. Energy	**597,98**	**0,66**	**4,50**				**603,14**
A. Fuel Combustion (Sectoral Approach)	597,98	0,66	4,50				603,14
1. Energy Industries	177,85	0,16	1,60				179,61
2. Manufacturing Industries and Construction	24,96	0,02	0,21				25,19
3. Transport	93,22	0,10	0,48				93,80
4. Other Sectors	294,15	0,37	2,14				296,67
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							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]							0,00
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,35**	**3,30**				**10,65**
A. Enteric Fermentation		7,21					7,21
B. Manure Management		0,13	3,30				3,44
C. Rice Cultivation							0
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,93**	**8,30**	**0,52**				**11,75**
A. Solid Waste Disposal on Land		8,28					8,28
B. Waste-water Handling							0,00
C. Waste Incineration	0,00	0,00	0,00				0
D. Other	2,93	0,02	0,52				3,47
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	625,54
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	625,54

(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 1993.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1993
Submission 2006 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]	**550,63**	**16,32**	**7,94**	**0,00**	**0,00**	**0,00**	**574,89**
1. Energy	**547,68**	**0,62**	**4,12**				**552,42**
A. Fuel Combustion (Sectoral Approach)	547,68	0,62	4,12				552,42
1. Energy Industries	161,23	0,15	1,46				162,84
2. Manufacturing Industries and Construction	22,53	0,02	0,19				22,74
3. Transport	86,81	0,09	0,45				87,35
4. Other Sectors	270,07	0,36	1,95				272,38
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							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [2]							0,00
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,35**	**3,30**				**10,65**
A. Enteric Fermentation		7,21					7,21
B. Manure Management		0,13	3,30				3,44
C. Rice Cultivation							0
D. Agricultural Soils [3]							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry [1]	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,95**	**8,35**	**0,52**				**11,82**
A. Solid Waste Disposal on Land		8,33					8,33
B. Waste-water Handling							0,00
C. Waste Incineration	0,00	0,00	0,00				0
D. Other	2,95	0,02	0,52				3,49
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [4]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [5]	574,89
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [5]	574,89

(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 1994.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1994
Submission 2006 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)	**500,40**	**16,36**	**7,57**	**0,00**	**0,00**	**0,00**	**524,33**
1. Energy	**497,42**	**0,59**	**3,73**				**501,74**
A. Fuel Combustion (Sectoral Approach)	497,42	0,59	3,73				501,74
1. Energy Industries	144,66	0,13	1,32				146,11
2. Manufacturing Industries and Construction	20,11	0,02	0,17				20,29
3. Transport	80,40	0,09	0,42				80,91
4. Other Sectors	245,98	0,35	1,76				248,09
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							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)							0,00
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,35**	**3,30**				**10,65**
A. Enteric Fermentation		7,21					7,21
B. Manure Management		0,13	3,30				3,44
C. Rice Cultivation							0
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,98**	**8,43**	**0,53**				**11,94**
A. Solid Waste Disposal on Land		8,41					8,41
B. Waste-water Handling							0,00
C. Waste Incineration	0,01	0,00	0,00				0,011375661
D. Other	2,97	0,02	0,53				3,52
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	524,33
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	524,33

(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 1995.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1995
Submission 2006 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)]	**539,81**	**16,48**	**7,89**	**0,02**	**0,00**	**0,04**	**564,24**
1. Energy	**536,78**	**0,62**	**4,05**				**541,45**
A. Fuel Combustion (Sectoral Approach)	536,78	0,62	4,05				541,45
1. Energy Industries	125,64	0,12	1,16				126,92
2. Manufacturing Industries and Construction	43,84	0,04	0,37				44,25
3. Transport	88,35	0,12	0,48				88,95
4. Other Sectors	271,62	0,34	1,98				273,93
5. Other	7,33	0,01	0,06				7,40
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,02**	**0,00**	**0,04**	**0,06**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				0,02		0,04	0,06
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,35**	**3,30**				**10,65**
A. Enteric Fermentation		7,21					7,21
B. Manure Management		0,13	3,30				3,44
C. Rice Cultivation							0
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**3,03**	**8,52**	**0,53**				**12,08**
A. Solid Waste Disposal on Land		8,49					8,49
B. Waste-water Handling							0,00
C. Waste Incineration	0,04	0,00	0,00				0,045962267
D. Other	2,99	0,02	0,53				3,54
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	564,24
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	564,24

(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 1996.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1996
Submission 2006 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)	**602,53**	**16,45**	**8,27**	**0,08**	**0,00**	**0,00**	**627,32**
1. Energy	**599,43**	**0,68**	**4,43**				**604,54**
A. Fuel Combustion (Sectoral Approach)	599,43	0,68	4,43				604,54
1. Energy Industries	126,38	0,12	1,17				127,67
2. Manufacturing Industries and Construction	44,51	0,04	0,38				44,93
3. Transport	92,26	0,12	0,51				92,89
4. Other Sectors	328,96	0,40	2,30				331,66
5. Other	7,33	0,01	0,06				7,40
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,08**	**0,00**	**0,00**	**0,08**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				0,08		0,00	0,08
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,35**	**3,30**				**10,65**
A. Enteric Fermentation		7,21					7,21
B. Manure Management		0,13	3,30				3,44
C. Rice Cultivation							0
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**3,09**	**8,42**	**0,54**				**12,05**
A. Solid Waste Disposal on Land		8,40					8,40
B. Waste-water Handling							0,00
C. Waste Incineration	0,15	0,00	0,01				0,161858442
D. Other	2,95	0,02	0,52				3,49
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	627,32
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	627,32

(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 15 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 2006 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)	**623,21**	**16,44**	**8,42**	**0,39**	**0,00**	**0,00**	**648,46**
1. Energy	**620,06**	**0,71**	**4,58**				**625,34**
A. Fuel Combustion (Sectoral Approach)	620,06	0,71	4,58				625,34
1. Energy Industries	133,33	0,12	1,23				134,69
2. Manufacturing Industries and Construction	46,17	0,04	0,39				46,60
3. Transport	96,21	0,13	0,53				96,87
4. Other Sectors	337,02	0,41	2,36				339,79
5. Other	7,33	0,01	0,06				7,40
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,39**	**0,00**	**0,00**	**0,39**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				0,39		0,00	0,39
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,35**	**3,30**				**10,65**
A. Enteric Fermentation		7,21					7,21
B. Manure Management		0,13	3,30				3,44
C. Rice Cultivation							0
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**3,15**	**8,38**	**0,54**				**12,08**
A. Solid Waste Disposal on Land		8,36					8,36
B. Waste-water Handling							0,00
C. Waste Incineration	0,23	0,00	0,02				0,254306731
D. Other	2,93	0,02	0,52				3,46
7. Other ***(as specified in Summary 1.A)***							**0,00**

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total
Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	648,46
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	648,46

(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 1998.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1998
Submission 2006 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)	**583,59**	**16,00**	**8,12**	**0,71**	**0,00**	**0,00**	**608,41**
1. Energy	**580,32**	**0,68**	**4,27**				**585,27**
A. Fuel Combustion (Sectoral Approach)	580,32	0,68	4,27				585,27
1. Energy Industries	126,16	0,12	1,18				127,45
2. Manufacturing Industries and Construction	40,00	0,03	0,34				40,38
3. Transport	97,70	0,13	0,59				98,42
4. Other Sectors	309,13	0,40	2,11				311,63
5. Other	7,33	0,01	0,06				7,40
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,71**	**0,00**	**0,00**	**0,71**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				0,71		0,00	0,71
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,35**	**3,30**				**10,65**
A. Enteric Fermentation		7,21					7,21
B. Manure Management		0,13	3,30				3,44
C. Rice Cultivation							0
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**3,27**	**7,97**	**0,54**				**11,78**
A. Solid Waste Disposal on Land		7,95					7,95
B. Waste-water Handling							0,00
C. Waste Incineration	0,49	0,00	0,05				0,547018869
D. Other	2,77	0,02	0,49				3,28
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	608,41
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	608,41

(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 17 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 2006 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)	**599,29**	**15,38**	**8,29**	**1,26**	**0,00**	**0,00**	**624,23**
1. Energy	**596,20**	**0,70**	**4,48**				**601,38**
A. Fuel Combustion (Sectoral Approach)	596,20	0,70	4,48				601,38
1. Energy Industries	133,01	0,12	1,26				134,40
2. Manufacturing Industries and Construction	45,91	0,04	0,39				46,34
3. Transport	103,90	0,14	0,59				104,63
4. Other Sectors	306,04	0,39	2,18				308,61
5. Other	7,33	0,01	0,06				7,40
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**1,26**	**0,00**	**0,00**	**1,27**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				1,26		0,00	1,27
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,35**	**3,30**				**10,65**
A. Enteric Fermentation		7,21					7,21
B. Manure Management		0,13	3,30				3,44
C. Rice Cultivation							0
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**3,09**	**7,33**	**0,51**				**10,93**
A. Solid Waste Disposal on Land		7,31					7,31
B. Waste-water Handling							0,00
C. Waste Incineration	0,54	0,00	0,05				0,598178056
D. Other	2,55	0,02	0,45				3,03
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	624,23
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	624,23

(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 18 SUMMARY 2: Summary report for CO_2 equivalent emissions 2000.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 2000

(Sheet 1 of 1) Submission 2006 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)	**671,89**	**14,50**	**8,77**	**1,85**	**0,00**	**0,00**	**697,01**
1. Energy	**669,13**	**0,79**	**4,95**				**674,88**
A. Fuel Combustion (Sectoral Approach)	669,13	0,79	4,95				674,88
1. Energy Industries	135,85	0,13	1,33				137,30
2. Manufacturing Industries and Construction	48,25	0,04	0,41				48,70
3. Transport	105,28	0,14	0,59				106,01
4. Other Sectors	372,43	0,47	2,56				375,47
5. Other	7,33	0,01	0,06				7,40
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**1,85**	**0,00**	**0,00**	**1,85**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				1,85		0,00	1,85
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,51**	**3,38**				**10,89**
A. Enteric Fermentation		7,37					7,37
B. Manure Management		0,14	3,38				3,51
C. Rice Cultivation							0
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,75**	**6,20**	**0,44**				**9,39**
A. Solid Waste Disposal on Land		6,18					6,18
B. Waste-water Handling							0,00
C. Waste Incineration	0,58	0,00	0,06				0,643516674
D. Other	2,17	0,01	0,39				2,57
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	697,01
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	697,01

(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 19 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 2006 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)]	**621,94**	**14,31**	**8,37**	**2,93**	**0,00**	**0,00**	**647,56**
1. Energy	**619,16**	**0,75**	**4,62**				**624,53**
A. Fuel Combustion (Sectoral Approach)	619,16	0,75	4,62				624,53
1. Energy Industries	136,82	0,13	1,34				138,29
2. Manufacturing Industries and Construction	45,77	0,04	0,39				46,20
3. Transport	95,48	0,14	0,52				96,15
4. Other Sectors	333,76	0,43	2,32				336,50
5. Other	7,33	0,01	0,06				7,40
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**2,93**	**0,00**	**0,00**	**2,93**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				2,93		0,00	2,93
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,35**	**3,30**				**10,65**
A. Enteric Fermentation		7,21					7,21
B. Manure Management		0,13	3,30				3,44
C. Rice Cultivation							0
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,78**	**6,21**	**0,45**				**9,44**
A. Solid Waste Disposal on Land		6,19					6,19
B. Waste-water Handling							0,00
C. Waste Incineration	0,61	0,00	0,06				0,67659493
D. Other	2,17	0,01	0,38				2,57
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	647,56
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	647,56

(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 2002.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

(Sheet 1 of 1)

Inventory 2002

Submission 2006 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)	**583,37**	**13,60**	**7,96**	**3,85**	**0,00**	**0,00**	**608,78**
1. Energy	**580,67**	**0,71**	**4,40**				**585,78**
A. Fuel Combustion (Sectoral Approach)	580,67	0,71	4,40				585,78
1. Energy Industries	137,33	0,13	1,36				138,82
2. Manufacturing Industries and Construction	43,27	0,04	0,37				43,67
3. Transport	91,86	0,14	0,50				92,50
4. Other Sectors	300,89	0,39	2,11				303,40
5. Other	7,33	0,01	0,06				7,40
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**3,85**	**0,00**	**0,00**	**3,86**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				3,85		0,00	3,86
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**6,97**	**3,13**				**10,10**
A. Enteric Fermentation		6,84					6,84
B. Manure Management		0,13	3,13				3,26
C. Rice Cultivation							0
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,70**	**5,92**	**0,43**				**9,05**
A. Solid Waste Disposal on Land		5,90					5,90
B. Waste-water Handling							0,00
C. Waste Incineration	0,63	0,00	0,06				0,696487429
D. Other	2,07	0,01	0,37				2,45
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	608,78
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	608,78

(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 2003.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2003
Submission 2006 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)	**641,97**	**14,13**	**8,38**	**4,69**	**0,00**	**0,00**	**669,17**
1. Energy	**639,16**	**0,79**	**4,74**				**644,69**
A. Fuel Combustion (Sectoral Approach)	639,16	0,79	4,74				644,69
1. Energy Industries	137,24	0,13	1,35				138,73
2. Manufacturing Industries and Construction	49,90	0,04	0,42				50,36
3. Transport	89,58	0,15	0,43				90,16
4. Other Sectors	355,11	0,45	2,48				358,04
5. Other	7,33	0,01	0,06				7,40
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**4,69**	**0,00**	**0,00**	**4,70**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				4,69		0,00	4,70
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,07**	**3,18**				**10,25**
A. Enteric Fermentation		6,94					6,94
B. Manure Management		0,13	3,18				3,31
C. Rice Cultivation							0
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,81**	**6,27**	**0,45**				**9,53**
A. Solid Waste Disposal on Land		6,25					6,25
B. Waste-water Handling							0,00
C. Waste Incineration	0,63	0,00	0,06				0,699097579
D. Other	2,18	0,01	0,39				2,58
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	669,17
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	669,17

(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 2004.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2004
Submission 2006 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)	**669,52**	**14,24**	**8,80**	**5,35**	**0,00**	**0,00**	**697,90**
1. Energy	**666,81**	**0,81**	**5,00**				**672,61**
A. Fuel Combustion (Sectoral Approach)	666,81	0,81	5,00				672,61
1. Energy Industries	137,41	0,13	1,38				138,92
2. Manufacturing Industries and Construction	56,11	0,05	0,47				56,63
3. Transport	91,73	0,15	0,44				92,32
4. Other Sectors	374,24	0,47	2,65				377,35
5. Other	7,33	0,01	0,06				7,40
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**5,35**	**0,00**	**0,00**	**5,35**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				5,35		0,00	5,35
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,49**	**3,37**				**10,86**
A. Enteric Fermentation		7,35					7,35
B. Manure Management		0,14	3,37				3,50
C. Rice Cultivation							0
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,71**	**5,94**	**0,43**				**9,09**
A. Solid Waste Disposal on Land		5,92					5,92
B. Waste-water Handling							0,00
C. Waste Incineration	0,64	0,00	0,06				0,706997254
D. Other	2,07	0,01	0,37				2,46
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	697,90
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	697,90

(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 23 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 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)	**667,95**	**14,24**	**8,78**	**5,39**	**0,00**	**0,00**	**696,37**
1. Energy	**665,24**	**0,81**	**4,98**				**671,03**
A. Fuel Combustion (Sectoral Approach)	665,24	0,81	4,98				671,03
1. Energy Industries	137,01	0,13	1,37				138,52
2. Manufacturing Industries and Construction	55,94	0,05	0,47				56,46
3. Transport	91,46	0,15	0,43				92,05
4. Other Sectors	373,53	0,47	2,64				376,63
5. Other	7,31	0,01	0,06				7,38
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**5,39**	**0,00**	**0,00**	**5,39**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				5,39		0,00	5,39
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,49**	**3,37**				**10,86**
A. Enteric Fermentation		7,35					7,35
B. Manure Management		0,14	3,37				3,50
C. Rice Cultivation							0
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,71**	**5,94**	**0,43**				**9,09**
A. Solid Waste Disposal on Land		5,92					5,92
B. Waste-water Handling							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)***							**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	696,37
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	696,37

(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 2006.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2006
Submission 2008 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)	**682,03**	**14,59**	**9,03**	**5,62**	**0,00**	**0,00**	**711,27**
1. Energy	**679,31**	**0,83**	**5,08**				**685,22**
A. Fuel Combustion (Sectoral Approach)	679,31	0,83	5,08				685,22
1. Energy Industries	139,85	0,14	1,40				141,39
2. Manufacturing Industries and Construction	57,13	0,05	0,48				57,66
3. Transport	93,41	0,16	0,44				94,01
4. Other Sectors	381,46	0,48	2,70				384,63
5. Other	7,46	0,01	0,06				7,53
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**5,62**	**0,00**	**0,00**	**5,63**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				5,62		0,00	5,63
G. Other							0
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**7,82**	**3,52**				**11,33**
A. Enteric Fermentation		7,68					7,68
B. Manure Management		0,14	3,52				3,66
C. Rice Cultivation							0
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0
F. Field Burning of Agricultural Residues							0
G. Other							0
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0
F. Other Land							0
G. Other							0
6. Waste	**2,71**	**5,94**	**0,43**				**9,09**
A. Solid Waste Disposal on Land		5,92					5,92
B. Waste-water Handling							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)***							**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine							0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	711,27
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	711,27

(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.

References

Illerup, J.B., Lyck, E., Nielsen, O.-K., Mikkelsen, M.H., Hoffmann, L., Gyldenkærne, S., Nielsen, M., Sørensen, P.B., 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. NERI Technical Report No. 589.

Annex 6.2.2 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 (sheeps and cows)
- Solid waste management (waste incineration)

The 1990-2006 Summary reports for CO_2 equivalents (CRF: Summary 2) is presented in Table 88-**Error! Reference source not found.**.

Table 25 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 2006 v2.1
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)	**646,79**	**17,82**	**9,611**	**0,00**	**0,00**	**0,00**	**674,22**
1. Energy	**642,67**	**0,56**	**8,27**				**651,50**
A. Fuel Combustion (Sectoral Approach)	642,67	0,56	8,27				651,50
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	86,97	0,28	1,19				88,44
4. Other Sectors	403,79	0,17	5,85				409,82
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				0,00		0,00	0,00
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,23**	**1,11**				**18,35**
A. Enteric Fermentation		16,48					16,48
B. Manure Management		0,75	1,11				1,86
C. Rice Cultivation							0,00
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**4,13**	**0,02**	**0,23**				**4,38**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	4,13	0,02	0,23				4,38
D. Other							0,00
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: (4)							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	674,22
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	674,22

(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 1991.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

(Sheet 1 of 1)

Inventory 1991

Submission 2006 v2.1

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)]	**624,66**	**17,10**	**9,157**	**0,00**	**0,00**	**0,00**	**650,91**
1. Energy	**620,53**	**0,54**	**7,83**				**628,90**
A. Fuel Combustion (Sectoral Approach)	620,53	0,54	7,83				628,90
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	82,23	0,27	1,11				83,61
4. Other Sectors	378,59	0,16	5,43				384,19
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				0,00		0,00	0,00
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**16,54**	**1,09**				**17,63**
A. Enteric Fermentation		15,86					15,86
B. Manure Management		0,67	1,09				1,77
C. Rice Cultivation							0,00
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**4,13**	**0,02**	**0,23**				**4,38**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	4,13	0,02	0,23				4,38
D. Other							0,00
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	0,00	0,00	0,00				0,00
Aviation							0,00
Marine	0,00	0,00	0,00				0,00
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	650,91
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	650,91

(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 27 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 2006 v2.1

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)	**608,72**	**17,26**	**9,308**	**0,00**	**0,00**	**0,12**	**635,40**
1. Energy	**604,54**	**0,52**	**7,94**				**613,00**
A. Fuel Combustion (Sectoral Approach)	604,54	0,52	7,94				613,00
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	88,29	0,26	1,23				89,79
4. Other Sectors	387,64	0,17	5,67				393,48
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,12**	**0,12**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				0,00		0,12	0,12
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**16,71**	**1,12**				**17,83**
A. Enteric Fermentation		16,01					16,01
B. Manure Management		0,70	1,12				1,81
C. Rice Cultivation							0,00
D. Agricultural Soils (3)							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry (1)	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**4,18**	**0,03**	**0,25**				**4,46**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	4,18	0,03	0,25				4,46
D. Other							0,00
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: (4)							
International Bunkers	105,21	0,05	2,06				107,32
Aviation							0,00
Marine	105,21	0,05	2,06				107,32
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	635,40
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	635,40

(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.

Table 28 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 2006 v2.1

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)]	**500,43**	**17,30**	**7,697**	**0,00**	**0,00**	**0,13**	**525,55**
1. Energy	**496,55**	**0,44**	**6,32**				**503,31**
A. Fuel Combustion (Sectoral Approach)	496,55	0,44	6,32				503,31
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	75,19	0,22	1,05				76,46
4. Other Sectors	303,35	0,13	4,32				307,80
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,13**	**0,13**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				0,00		0,13	0,13
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**16,83**	**1,13**				**17,97**
A. Enteric Fermentation		16,12					16,12
B. Manure Management		0,71	1,13				1,84
C. Rice Cultivation							0,00
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**3,87**	**0,02**	**0,25**				**4,14**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	3,87	0,02	0,25				4,14
D. Other							0,00
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	142,60	0,06	2,79				145,45
Aviation							0,00
Marine	142,60	0,06	2,79				145,45
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	525,55
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	525,55

(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 1994.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

(Sheet 1 of 1)

Inventory 1994

Submission 2006 v2.1

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)	**507,77**	**18,18**	**7,923**	**0,02**	**0,00**	**0,14**	**534,02**
1. Energy	**504,03**	**0,43**	**6,51**				**510,97**
A. Fuel Combustion (Sectoral Approach)	504,03	0,43	6,51				510,97
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	68,85	0,20	0,98				70,03
4. Other Sectors	321,93	0,15	4,63				326,70
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,02**	**0,00**	**0,14**	**0,16**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				0,02		0,14	0,16
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,73**	**1,17**				**18,90**
A. Enteric Fermentation		16,92					16,92
B. Manure Management		0,81	1,17				1,98
C. Rice Cultivation							0,00
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**3,74**	**0,02**	**0,24**				**4,00**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	3,74	0,02	0,24				4,00
D. Other							0,00
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: (4)							
International Bunkers	140,01	0,06	2,74				142,82
Aviation							0,00
Marine	140,01	0,06	2,74				142,82
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	534,02
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	534,02

(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 1995.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

(Sheet 1 of 1)

Inventory 1995

Submission 2006 v2.1

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)]	**514,73**	**18,18**	**8,156**	**0,02**	**0,00**	**0,15**	**541,24**
1. Energy	**510,93**	**0,42**	**6,73**				**518,08**
A. Fuel Combustion (Sectoral Approach)	510,93	0,42	6,73				518,08
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	77,29	0,21	1,11				78,61
4. Other Sectors	330,30	0,14	4,79				335,23
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,02**	**0,00**	**0,15**	**0,18**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				0,02		0,15	0,18
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,73**	**1,17**				**18,90**
A. Enteric Fermentation		16,92					16,92
B. Manure Management		0,81	1,17				1,98
C. Rice Cultivation							0,00
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**3,80**	**0,03**	**0,25**				**4,08**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	3,80	0,03	0,25				4,08
D. Other							0,00
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	131,59	0,06	2,58				134,23
Aviation							0,00
Marine	131,59	0,06	2,58				134,23
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	541,24
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	541,24

(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 1996.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 1996

(Sheet 1 of 1) Submission 2006 v2.1

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)]	**543,89**	**18,06**	**8,470**	**0,06**	**0,00**	**0,16**	**570,64**
1. Energy	**539,81**	**0,44**	**7,03**				**547,28**
A. Fuel Combustion (Sectoral Approach)	539,81	0,44	7,03				547,28
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	82,48	0,21	1,19				83,88
4. Other Sectors	334,38	0,14	4,85				339,37
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,06**	**0,00**	**0,16**	**0,22**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				0,06		0,16	0,22
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,59**	**1,15**				**18,74**
A. Enteric Fermentation		16,79					16,79
B. Manure Management		0,79	1,15				1,95
C. Rice Cultivation							0,00
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**4,08**	**0,03**	**0,29**				**4,40**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	4,08	0,03	0,29				4,40
D. Other							0,00
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	142,02	0,06	2,78				144,87
Aviation							0,00
Marine	142,02	0,06	2,78				144,87
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	570,64
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	570,64

(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 1997.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

(Sheet 1 of 1)

Inventory 1997

Submission 2006 v2.1

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)]	**530,25**	**18,05**	**8,339**	**0,66**	**0,00**	**0,18**	**557,47**
1. Energy	**525,56**	**0,44**	**6,86**				**532,86**
A. Fuel Combustion (Sectoral Approach)	525,56	0,44	6,86				532,86
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	82,93	0,22	1,19				84,34
4. Other Sectors	327,09	0,14	4,74				331,98
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**0,66**	**0,00**	**0,18**	**0,83**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				0,66		0,18	0,83
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,57**	**1,15**				**18,72**
A. Enteric Fermentation		16,78					16,78
B. Manure Management		0,79	1,15				1,94
C. Rice Cultivation							0,00
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**4,69**	**0,03**	**0,33**				**5,05**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	4,69	0,03	0,33				5,05
D. Other							0,00
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	137,96	0,06	2,70				140,73
Aviation							0,00
Marine	137,96	0,06	2,70				140,73
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	557,47
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	557,47

(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 1998.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

(Sheet 1 of 1)

Inventory 1998

Submission 2006 v2.1

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)]	**579,95**	**17,90**	**8,956**	**1,22**	**0,00**	**0,19**	**608,21**
1. Energy	**574,32**	**0,47**	**7,42**				**582,21**
A. Fuel Combustion (Sectoral Approach)	574,32	0,47	7,42				582,21
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	83,53	0,22	1,17				84,92
4. Other Sectors	350,26	0,15	5,12				355,53
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**1,22**	**0,00**	**0,19**	**1,41**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				1,22		0,19	1,41
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,39**	**1,13**				**18,52**
A. Enteric Fermentation		16,62					16,62
B. Manure Management		0,77	1,13				1,90
C. Rice Cultivation							0,00
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**5,63**	**0,04**	**0,40**				**6,07**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	5,63	0,04	0,40				6,07
D. Other							0,00
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	112,06	0,05	2,20				114,31
Aviation							0,00
Marine	112,06	0,05	2,20				114,31
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	608,21
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	608,21

(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 34 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 2006 v2.1

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)	**605,49**	**17,91**	**9,338**	**3,29**	**0,00**	**0,09**	**636,12**
1. Energy	**599,39**	**0,43**	**7,78**				**607,60**
A. Fuel Combustion (Sectoral Approach)	599,39	0,43	7,78				607,60
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	82,33	0,18	1,19				83,70
4. Other Sectors	376,80	0,16	5,45				382,41
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**3,29**	**0,00**	**0,09**	**3,38**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				3,29		0,09	3,38
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,43**	**1,13**				**18,57**
A. Enteric Fermentation		16,66					16,66
B. Manure Management		0,77	1,13				1,91
C. Rice Cultivation							0,00
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**6,09**	**0,04**	**0,43**				**6,57**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	6,09	0,04	0,43				6,57
D. Other							0,00
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: (4)							
International Bunkers	121,34	0,06	2,38				123,78
Aviation							0,00
Marine	121,34	0,06	2,38				123,78
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	636,12
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	636,12

(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 2000.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 2000

(Sheet 1 of 1) Submission 2006 v2.1

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)	**655,42**	**18,14**	**9,909**	**4,35**	**0,00**	**0,08**	**687,90**
1. Energy	**649,19**	**0,52**	**8,33**				**658,04**
A. Fuel Combustion (Sectoral Approach)	649,19	0,52	8,33				658,04
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	97,37	0,24	1,33				98,94
4. Other Sectors	386,60	0,16	5,66				392,43
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**4,35**	**0,00**	**0,08**	**4,42**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				4,35		0,08	4,42
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,58**	**1,14**				**18,72**
A. Enteric Fermentation		16,79					16,79
B. Manure Management		0,79	1,14				1,93
C. Rice Cultivation							0,00
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**6,23**	**0,04**	**0,44**				**6,71**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	6,23	0,04	0,44				6,71
D. Other							0,00
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: (4)							
International Bunkers	135,59	0,06	2,66				138,31
Aviation							0,00
Marine	135,59	0,06	2,66				138,31
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	687,90
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	687,90

(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 36 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 2006 v2.1
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)]	**732,94**	**18,35**	**10,755**	**6,93**	**0,00**	**0,08**	**769,05**
1. Energy	**726,53**	**0,57**	**9,14**				**736,24**
A. Fuel Combustion (Sectoral Approach)	726,53	0,57	9,14				736,24
1. Energy Industries	131,71	0,10	1,06				132,87
2. Manufacturing Industries and Construction	84,48	0,04	0,69				85,22
3. Transport	111,16	0,26	1,50				112,91
4. Other Sectors	399,18	0,17	5,89				405,24
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**6,93**	**0,00**	**0,08**	**7,00**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				6,93		0,08	7,00
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,74**	**1,16**				**18,90**
A. Enteric Fermentation		16,93					16,93
B. Manure Management		0,81	1,16				1,97
C. Rice Cultivation							0,00
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**6,41**	**0,05**	**0,45**				**6,91**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	6,41	0,05	0,45				6,91
D. Other							0,00
7. Other ***(as specified in Summary 1.A)***							**0,00**

Memo Items: [(4)]							
International Bunkers	176,29	0,08	3,46				179,83
Aviation							0,00
Marine	176,29	0,08	3,46				179,83
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	769,05
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	769,05

(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 37 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 2006 v2.1
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)	**702,30**	**18,31**	**10,693**	**8,69**	**0,00**	**0,09**	**740,08**
1. Energy	**695,77**	**0,49**	**9,07**				**705,33**
A. Fuel Combustion (Sectoral Approach)	695,77	0,49	9,07				705,33
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	97,76	0,19	1,36				99,31
4. Other Sectors	417,60	0,18	6,25				424,04
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**8,69**	**0,00**	**0,09**	**8,78**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				8,69		0,09	8,78
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,77**	**1,17**				**18,94**
A. Enteric Fermentation		16,96					16,96
B. Manure Management		0,81	1,17				1,98
C. Rice Cultivation							0,00
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**6,53**	**0,05**	**0,46**				**7,04**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	6,53	0,05	0,46				7,04
D. Other							0,00
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: (4)							
International Bunkers	73,90	0,03	1,45				75,38
Aviation							0,00
Marine	73,90	0,03	1,45				75,38
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	740,08
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	740,08

(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 38 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 2006 v2.1

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)]	**716,71**	**18,30**	**10,740**	**10,20**	**0,00**	**0,08**	**756,03**
1. Energy	**710,69**	**0,50**	**9,15**				**720,34**
A. Fuel Combustion (Sectoral Approach)	710,69	0,50	9,15				720,34
1. Energy Industries	114,71	0,09	0,92				115,71
2. Manufacturing Industries and Construction	83,88	0,05	0,68				84,61
3. Transport	98,86	0,18	1,34				100,38
4. Other Sectors	413,24	0,18	6,22				419,63
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**10,20**	**0,00**	**0,08**	**10,28**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				10,20		0,08	10,28
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,76**	**1,16**				**18,92**
A. Enteric Fermentation		16,94					16,94
B. Manure Management		0,81	1,16				1,97
C. Rice Cultivation							0,00
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**6,02**	**0,04**	**0,42**				**6,49**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	6,02	0,04	0,42				6,49
D. Other							0,00
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: [(4)]							
International Bunkers	64,64	0,03	1,27				65,94
Aviation							0,00
Marine	64,64	0,03	1,27				65,94
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	756,03
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	756,03

(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 39 SUMMARY 2: Summary report for CO_2 equivalent emissions 2004.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 2004

(Sheet 1 of 1) Submission 2006 v2.1

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)	**721,28**	**18,17**	**10,830**	**11,39**	**0,00**	**0,19**	**761,86**
1. Energy	**715,65**	**0,49**	**9,29**				**725,43**
A. Fuel Combustion (Sectoral Approach)	715,65	0,49	9,29				725,43
1. Energy Industries	110,48	0,08	0,89				111,45
2. Manufacturing Industries and Construction	73,67	0,05	0,60				74,32
3. Transport	102,28	0,18	1,36				103,82
4. Other Sectors	429,22	0,18	6,44				435,85
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**11,39**	**0,00**	**0,19**	**11,58**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 (2)				11,39		0,19	11,58
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,64**	**1,15**				**18,79**
A. Enteric Fermentation		16,84					16,84
B. Manure Management		0,80	1,15				1,95
C. Rice Cultivation							0,00
D. Agricultural Soils(3)							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry(1)	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**5,63**	**0,04**	**0,40**				**6,07**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	5,63	0,04	0,40				6,07
D. Other							0,00
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: (4)							
International Bunkers	74,68	0,04	1,47				76,18
Aviation							0,00
Marine	74,68	0,04	1,47				76,18
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry (5)	761,86
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry (5)	761,86

(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 40 SUMMARY 2: Summary report for CO_2 equivalent emissions 2005.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS Inventory 2005

(Sheet 1 of 1) Submission 2006 v2.1

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)]	**699,62**	**17,82**	**10,525**	**11,19**	**0,00**	**0,15**	**739,30**
1. Energy	**694,11**	**0,46**	**9,02**				**703,59**
A. Fuel Combustion (Sectoral Approach)	694,11	0,46	9,02				703,59
1. Energy Industries	100,23	0,08	0,80				101,10
2. Manufacturing Industries and Construction	65,56	0,04	0,53				66,14
3. Transport	100,73	0,16	1,29				102,18
4. Other Sectors	427,60	0,18	6,40				434,17
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**11,19**	**0,00**	**0,15**	**11,34**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				11,19		0,15	11,34
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,32**	**1,12**				**18,44**
A. Enteric Fermentation		16,56					16,56
B. Manure Management		0,76	1,12				1,88
C. Rice Cultivation							0,00
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**5,50**	**0,04**	**0,39**				**5,93**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	5,50	0,04	0,39				5,93
D. Other							0,00
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: [(4)]							
International Bunkers	65,04	0,03	1,28				66,35
Aviation							0,00
Marine	65,04	0,03	1,28				66,35
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	739,30
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	739,30

(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 41 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 2006 v2.1
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)]	**691,57**	**17,59**	**10,365**	**11,65**	**0,00**	**0,15**	**731,33**
1. Energy	**686,08**	**0,45**	**8,89**				**695,42**
A. Fuel Combustion (Sectoral Approach)	686,08	0,45	8,89				695,42
1. Energy Industries	98,90	0,08	0,79				99,77
2. Manufacturing Industries and Construction	71,12	0,04	0,58				71,74
3. Transport	96,45	0,15	1,14				97,74
4. Other Sectors	419,61	0,18	6,38				426,17
5. Other	0,00	0,00	0,00				0,00
B. Fugitive Emissions from Fuels	0,00	0,00	0,00				0,00
1. Solid Fuels							0,00
2. Oil and Natural Gas							0,00
2. Industrial Processes	**0,00**	**0,00**	**0,00**	**11,65**	**0,00**	**0,15**	**11,80**
A. Mineral Products							0,00
B. Chemical Industry							0,00
C. Metal Production							0,00
D. Other Production							0,00
E. Production of Halocarbons and SF_6							0,00
F. Consumption of Halocarbons and SF_6 [(2)]				11,65		0,15	11,80
G. Other							0,00
3. Solvent and Other Product Use							**0,00**
4. Agriculture		**17,11**	**1,09**				**18,19**
A. Enteric Fermentation		16,37					16,37
B. Manure Management		0,73	1,09				1,82
C. Rice Cultivation							0,00
D. Agricultural Soils[(3)]							0,00
E. Prescribed Burning of Savannas							0,00
F. Field Burning of Agricultural Residues							0,00
G. Other							0,00
5. Land Use, Land-Use Change and Forestry[(1)]	**0,00**	**0,00**	**0,00**				**0,00**
A. Forest Land							0,00
B. Cropland							0,00
C. Grassland							0,00
D. Wetlands							0,00
E. Settlements							0,00
F. Other Land							0,00
G. Other							0,00
6. Waste	**5,50**	**0,04**	**0,39**				**5,92**
A. Solid Waste Disposal on Land							0,00
B. Waste-water Handling							0,00
C. Waste Incineration	5,50	0,04	0,39				5,92
D. Other							0,00
7. Other *(as specified in Summary 1.A)*							**0,00**

Memo Items: [(4)]							
International Bunkers	24,50	0,01	0,48				24,99
Aviation							0,00
Marine	24,50	0,01	0,48				24,99
Multilateral Operations							**0,00**
CO_2 Emissions from Biomass							**0,00**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry [(5)]	731,33
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry [(5)]	731,33

Annex 7 Table 6.1 and 6.2 of the IPCC good practice guidance

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor unceratinty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty i trend in national emissions introduced by emission factor uncertarinty	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	21465	1	5	5,099	1,595	-0,031	0,307	-0,156	0,435	0,462
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	109	3	5	5,831	0,009	0,000	0,002	-0,002	0,007	0,007
Stationary Combustion, Petroleum coke	CO_2	410	847	3	5	5,831	0,072	0,006	0,012	0,032	0,051	0,060
Stationary Combustion, Plastic waste	CO_2	349	702	5	5	7,071	0,072	0,005	0,010	0,026	0,071	0,076
Stationary Combustion, Residual oil	CO_2	2505	2014	2	2	2,828	0,083	-0,006	0,029	-0,013	0,082	0,083
Stationary Combustion, Gas oil	CO_2	4547	1983	4	5	6,403	0,185	-0,036	0,028	-0,178	0,161	0,240
Stationary Combustion, Kerosene	CO_2	366	16	4	5	6,403	0,001	-0,005	0,000	-0,025	0,001	0,025
Stationary Combustion, Natural gas	CO_2	4320	10846	3	1	3,162	0,500	0,094	0,155	0,094	0,659	0,666
Stationary Combustion, LPG	CO_2	169	112	4	5	6,403	0,010	-0,001	0,002	-0,004	0,009	0,010
Stationary Combustion, Refinery gas	CO_2	806	932	3	5	5,831	0,079	0,002	0,013	0,010	0,057	0,058
Stationary combustion plants, gas engines	CH_4	7	277	2,2	40	40,060	0,161	0,004	0,004	0,155	0,012	0,155

Continued												
IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor unceratinty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Unceratinty i trend in national emissions introduced by emission factor uncertarinty	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, other	CH_4	115	184	2,2	100	100,024	0,269	0,001	0,003	0,102	0,008	0,103
Stationary combustion plants	N_2O	240	291	2,2	1000	1000,002	4,245	0,001	0,004	0,789	0,013	0,789
Transport, Road transport	CO_2	9275	12594	2	5	5,385	0,988	0,050	0,180	0,249	0,510	0,567
Transport, Military	CO_2	119	126	2	5	5,385	0,010	0,000	0,002	0,001	0,005	0,005
Transport, Railways	CO_2	297	227	2	5	5,385	0,018	-0,001	0,003	-0,005	0,009	0,010
Transport, Navigation (small boats)	CO_2	48	102	21	5	21,587	0,032	0,001	0,001	0,004	0,043	0,044
Transport, Navigation (large vessels)	CO_2	666	353	11	5	12,083	0,062	-0,004	0,005	-0,022	0,079	0,081
Transport, Fisheries	CO_2	591	473	2	5	5,385	0,037	-0,002	0,007	-0,008	0,019	0,021
Transport, Agriculture	CO_2	1272	1109	13	5	13,928	0,225	-0,002	0,016	-0,010	0,292	0,292
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	1021	18	5	18,682	0,278	0,003	0,015	0,014	0,372	0,372
Transport, Residential	CO_2	113	233	18	5	18,682	0,063	0,002	0,003	0,009	0,085	0,085
Transport, Civil aviation	CO_2	243	141	10	5	11,180	0,023	-0,001	0,002	-0,007	0,029	0,029
Transport, Road transport	CH_4	55	27	2	40	40,050	0,016	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

Continued

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor unceratinty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Unceratinty i trend in national emissions introduced by emission factor uncertarinty	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 %	%	%	%	%	%	%	%
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	0,007	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	125	2	50	50,040	0,091	0,000	0,002	0,021	0,005	0,022
Transport, Military	N_2O	1	1	2	1000	1000,002	0,018	0,000	0,000	0,002	0,000	0,002
Transport, Railways	N_2O	3	2	2	1000	1000,002	0,028	0,000	0,000	-0,008	0,000	0,008
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	0,101	0,000	0,000	-0,084	0,002	0,084
Transport, Fisheries	N_2O	11	9	2	1000	1000,002	0,135	0,000	0,000	-0,029	0,000	0,029
Transport, Agriculture	N_2O	15	14	13	1000	1000,084	0,210	0,000	0,000	-0,008	0,004	0,009
Transport, Forestry	N_2O	0	0	16	1000	1000,128	0,002	0,000	0,000	0,000	0,000	0,000
Transport, Industry (mobile)	N_2O	11	13	18	1000	1000,162	0,195	0,000	0,000	0,042	0,005	0,042
Transport, Residential	N_2O	1	1	18	1000	1000,162	0,016	0,000	0,000	0,008	0,000	0,008
Transport, Civil aviation	N_2O	3	3	10	1000	1000,050	0,037	0,000	0,000	-0,009	0,001	0,009

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor unceratinty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Unceratinty i trend in national emissions introduced by emission factor uncertarinty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
Continued												
		Input data Gg CO_2 eq	Input data Gg CO_2 eq	Input data %	Input data %	%	%	%	%	%	%	%
Energy, fugitive emissions, oil and natural gas	CO_2	263	415	15	5	15,811	0,096	0,002	0,006	0,011	0,126	0,126
Energy, fugitive emissions, oil and natural gas	CH_4	40	98	15	50	52,202	0,074	0,001	0,001	0,042	0,030	0,051
Energy, fugitive emissions, oil and natural gas	N_2O	1	2	15	50	52,202	0,002	0,000	0,000	0,001	0,001	0,001
6 A. Solid Waste Disposal on Land	N_2O	1335	1028	10	63	63,591	0,953	-0,004	0,015	-0,255	0,208	0,329
6 B. Wastewater Handling	N_2O	126	248	20	35	40,311	0,146	0,002	0,004	0,063	0,101	0,118
6 B. Wastewater Handling	N_2O	88	50	10	30	31,623	0,023	-0,001	0,001	-0,016	0,010	0,019
2A1 Cement production	CO_2	882	1395	1	2	2,236	0,045	0,008	0,020	0,015	0,028	0,032
2A2 Lime production	CO_2	116	69	5	5	7,071	0,007	-0,001	0,001	-0,003	0,007	0,008
2A3 Limestone and dolomite use	CO_2	18	74	5	5	7,071	0,008	0,001	0,001	0,004	0,007	0,008
2A5 Asphalt roofing	CO_2	0	0	5	25	25,495	0,000	0,000	0,000	0,000	0,000	0,000
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	69	5	2	5,385	0,005	0,000	0,001	0,000	0,007	0,007
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 production	CO_2	28	0	5	5	7,071	0,000	0,000	0,000	-0,002	0,000	0,002

Continued

IPCC Source category	Gas	Base year emission	Year t emission	Activity data uncertainty	Emission factor unceratinty	Combined uncertainty	Combined uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Unceratinty i trend in national emissions introduced by emission factor uncertarinty	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 %	%	%	%	%	%	%	%
2B2 Nitric acid production	N_2O	1043	0	2	25	25,080	0,000	-0,015	0,000	-0,367	0,000	0,367
2F Consumption of HFC	HFC	218	835	10	50	50,990	0,620	0,009	0,012	0,445	0,169	0,476
2F Consumption of PFC	PFC	1	16	10	50	50,990	0,012	0,000	0,000	0,011	0,003	0,011
2F Consumption of SF6	SF_6	107	36	10	50	50,990	0,027	-0,001	0,001	-0,050	0,007	0,050
4A Enteric Fermentation	CH_4	3259	2602	10	8	12,806	0,486	-0,009	0,037	-0,069	0,527	0,531
4B Manure Management	CH_4	751	1042	10	100	100,499	1,526	0,004	0,015	0,435	0,211	0,484
4B Manure Management	N_2O	684	519	10	100	100,499	0,760	-0,002	0,007	-0,220	0,105	0,244
4D Agricultural Soils	N_2O	8349	5442	7,4	22,9	24,118	1,912	-0,039	0,078	-0,906	0,819	1,221
5A Forests	CO_2	-2831	-2758	20	20	28,284	-1,137	0,000	-0,039	0,007	-1,117	1,117
5B Cropland	CO_2	2722	709	7	32	32,498	0,336	-0,028	0,010	-0,895	0,096	0,900
5C Grassland	CO_2	93	81	10	50	50,990	0,060	0,000	0,001	-0,007	0,016	0,018
5D 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	179	5	50	50,249	0,131	-0,005	0,003	-0,269	0,018	0,270
5D 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	148	102	50	325	328,824	0,489	-0,001	0,001	-0,203	0,103	0,227
Total		69845	68632				31,998					6,720
Total uncertainties					**Overall uncertainty i the year (%):**		**5,657**			**Trend uncertainty (%):**		**2,592**

Annex 8 Other annexes – (Any other relevant information)

Please see Chapter 1.6 for information

Annex 9 Annual emission inventories 1990-2006 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 1990-2006 (CRF Table 10 sheet 1-5) have been included in the NIR as Tables A9.1-.5. These tables are copied from the CRF 2006 spreadsheet file, Tables 10.1-10.5. The full CRF tables 1990-2006 are submitted as spreadsheets separately, as well as the files in the new 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 2006
Submission 2008 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	**51.461,75**	**61.974,03**	**56.066,68**	**58.364,50**	**61.982,09**	**58.938,44**	**72.284,71**	**62.616,07**	**58.558,78**	**55.765,14**
A. Fuel Combustion (Sectoral Approach)	51.198,31	61.456,02	55.532,47	57.896,16	61.514,48	58.575,64	71.886,02	62.053,03	58.138,16	54.869,15
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	31.380,85	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	10.528,06	10.904,06	11.101,68	11.224,71	11.712,28	11.851,99	12.106,19	12.290,87	12.263,20	12.258,16
4. Other Sectors	8.954,35	9.207,86	8.438,88	9.197,91	8.429,78	8.646,24	9.202,35	8.383,68	8.136,30	7.975,77
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	**1.102,45**	**1.275,40**	**1.394,83**	**1.414,61**	**1.440,38**	**1.445,95**	**1.552,17**	**1.721,15**	**1.725,64**	**1.653,57**
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	1.682,89	1.609,96
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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	148,10	144,68	141,26	137,83	134,41	138,90	134,23	123,96	114,38	111,27
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**	**-1.231,16**
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
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	**53.263,97**	**61.705,95**	**56.054,22**	**58.759,94**	**61.939,87**	**58.854,07**	**72.754,01**	**63.281,88**	**58.444,66**	**56.298,82**
Total CO_2 emissions excluding net CO_2 from LULUCF	**52.712,30**	**63.394,12**	**57.602,76**	**59.916,94**	**63.556,88**	**60.523,30**	**73.971,11**	**64.461,19**	**60.398,80**	**57.529,99**
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 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**51.272,91**	**52.863,26**	**52.454,27**	**57.782,58**	**52.121,16**	**48.543,29**	**55.837,72**	**8,50**
A. Fuel Combustion (Sectoral Approach)	50.680,36	52.232,02	51.921,41	57.234,63	51.514,73	48.108,76	55.422,99	8,25
1. Energy Industries	25.113,91	26.399,69	26.552,92	31.401,90	25.395,55	22.136,36	29.470,34	12,60
2. Manufacturing Industries and Construction	6.008,15	6.089,27	5.800,74	5.770,24	5.815,72	5.606,58	5.629,55	3,80
3. Transport	12.049,93	12.047,74	12.151,13	12.612,68	12.923,30	13.056,49	13.417,24	27,44
4. Other Sectors	7.397,84	7.598,44	7.327,84	7.357,82	7.141,14	7.038,53	6.779,39	-24,29
5. Other	110,53	96,87	88,78	91,98	239,02	270,80	126,46	6,25
B. Fugitive Emissions from Fuels	592,55	631,24	532,86	547,95	606,43	434,53	414,74	57,43
1. Solid Fuels	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	434,53	414,74	57,43
2. Industrial Processes	**1.681,95**	**1.707,91**	**1.696,35**	**1.572,27**	**1.731,29**	**1.659,41**	**1.611,40**	**46,16**
A. Mineral Products	1.640,57	1.660,41	1.695,80	1.571,22	1.728,28	1.640,82	1.609,22	49,95
B. Chemical Industry	0,65	0,83	0,55	1,05	3,01	3,01	2,18	172,13
C. Metal Production	40,73	46,68	NA,NO	NA,NO	NA,NO	15,58	NA,NO	-100,00
D. Other Production	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	NO	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	112,65	102,48	104,09	93,93	101,12	103,20	102,00	-31,13
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**	**-633,17**	**-1.801,90**	**-426,63**
A. Forest Land	-664,25	-3.551,13	-3.827,01	-3.547,21	-3.465,22	-1.829,67	-2.757,66	-2,58
B. Cropland	2.227,07	2.712,61	1.779,33	1.190,96	2.579,57	1.126,98	888,16	-72,98
C. Grassland	71,10	74,29	75,93	75,97	73,79	82,52	80,99	-12,82
D. Wetlands	-3,28	-4,97	-6,99	-10,00	-12,50	-13,01	-13,39	-784,62
E. Settlements	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	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	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**	**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	0,00
B. Waste-water Handling								
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	NA	NA	NA	NA	NA	NA	NO	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CO_2 emissions including net CO_2 from LULUCF	**54.698,15**	**53.904,45**	**52.275,98**	**57.158,50**	**53.129,22**	**49.672,71**	**55.749,21**	**4,67**
Total CO_2 emissions excluding net CO_2 from LULUCF	**53.067,51**	**54.673,65**	**54.254,71**	**59.448,78**	**53.953,58**	**50.305,89**	**57.551,12**	**9,18**
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**	**24,73**
Aviation	2.349,78	2.384,94	2.059,41	2.142,08	2.448,86	2.575,38	2.583,30	48,80
Marine	4.279,45	3.604,83	2.965,52	3.130,03	2.544,50	2.635,96	3.432,65	11,19
Multilateral Operations	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	10.908,19	11.186,23	141,04

Table A9.2

TABLE 10 EMISSION TRENDS Inventory 2006

CH_4 Submission 2008 v1.1

(Part 1 of 2) 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	2,64	2,55	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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use										
4. Agriculture	**190,96**	**192,95**	**193,39**	**197,73**	**191,32**	**189,67**	**190,59**	**185,99**	**187,71**	**181,10**
A. Enteric Fermentation	155,19	155,33	153,12	154,92	149,91	148,37	148,63	143,39	143,30	137,33
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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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**	**284,31**	**290,58**	**285,37**	**286,70**	**280,84**
Total CH_4 emissions excluding CH_4 from LULUCF	**271,21**	**275,43**	**276,76**	**284,41**	**280,66**	**284,34**	**290,61**	**285,40**	**286,73**	**280,86**
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 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	30,45	32,10	32,17	32,40	32,31	30,47	28,31	164,82
A. Fuel Combustion (Sectoral Approach)	26,64	28,29	28,22	28,38	27,47	25,68	23,66	168,79
1. Energy Industries	15,28	16,55	16,48	16,17	15,18	13,20	11,42	926,17
2. Manufacturing Industries and Construction	1,57	1,64	1,50	1,50	1,49	1,29	1,16	64,11
3. Transport	1,91	1,79	1,68	1,62	1,53	1,42	1,34	-49,90
4. Other Sectors	7,88	8,31	8,56	9,09	9,26	9,76	9,74	125,94
5. Other	0,01	0,01	0,00	0,01	0,01	0,01	0,01	16,52
B. Fugitive Emissions from Fuels	3,81	3,82	3,94	4,02	4,84	4,80	4,65	146,32
1. Solid Fuels	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	4,80	4,65	146,32
2. Industrial Processes	**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	0,00
B. Chemical Industry	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	0,00
D. Other Production								
E. Production of Halocarbons and SF_6								
F. Consumption of Halocarbons and SF_6								
G. Other	NO	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use								
4. Agriculture	**181,73**	**186,05**	**183,10**	**181,44**	**178,00**	**175,52**	**173,56**	**-9,11**
A. Enteric Fermentation	136,28	138,89	135,20	133,21	128,53	126,71	123,93	-20,15
B. Manure Management	45,44	47,16	47,91	48,23	49,47	48,81	49,63	38,75
C. Rice Cultivation	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	0,00
E. Prescribed Burning of Savannas	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	0,00
G. Other	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**	**-17,33**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	0,00
B. Cropland	NA	NA	NA	NA	NA	NA	NA	0,00
C. Grassland	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	-17,33
E. Settlements	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	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	0,00
6. Waste	**68,22**	**68,59**	**69,77**	**70,38**	**64,69**	**62,11**	**60,78**	**-12,63**
A. Solid Waste Disposal on Land	57,87	57,57	54,99	56,08	51,60	49,66	48,95	-23,00
B. Waste-water Handling	10,34	11,02	14,78	14,30	13,08	12,45	11,82	97,67
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	0,00	0,00	0,00	0,00	0,00	0,00	NO	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CH_4 emissions including CH_4 from LULUCF	**280,37**	**286,72**	**285,01**	**284,20**	**274,97**	**268,08**	**262,62**	**-3,16**
Total CH_4 emissions excluding CH_4 from LULUCF	**280,39**	**286,75**	**285,04**	**284,23**	**274,99**	**268,10**	**262,65**	**-3,16**
Memo Items:								
International Bunkers	0,14	0,12	0,11	0,11	0,11	0,11	0,13	38,47
Aviation	0,04	0,04	0,04	0,04	0,05	0,05	0,05	66,98
Marine	0,10	0,08	0,07	0,07	0,06	0,06	0,08	24,88
Multilateral Operations	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 2006
Submission 2008 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**	**1,41**	**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	1,68	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	NO	NO	NO	NO	NO	NO	NO	NO	NO	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	**29,14**	**28,64**	**27,66**	**27,06**	**26,33**	**25,66**	**24,56**	**24,27**	**24,16**	**22,75**
A. Enteric Fermentation										
B. Manure Management	2,21	2,20	2,20	2,22	2,15	2,08	2,08	2,07	2,10	2,04
C. Rice Cultivation										
D. Agricultural Soils	26,93	26,44	25,46	24,83	24,18	23,58	22,48	22,20	22,06	20,71
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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	**34,07**	**33,42**	**31,99**	**31,33**	**30,70**	**30,34**	**29,17**	**28,82**	**28,52**	**27,55**
Total N_2O emissions excluding N_2O from LULUCF	**34,07**	**33,41**	**31,99**	**31,33**	**30,70**	**30,34**	**29,17**	**28,82**	**28,52**	**27,55**
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 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**1,47**	**1,49**	**1,48**	**1,53**	**1,48**	**1,44**	**1,52**	**18,53**
A. Fuel Combustion (Sectoral Approach)	1,46	1,48	1,48	1,52	1,47	1,43	1,51	18,38
1. Energy Industries	0,48	0,51	0,52	0,55	0,50	0,46	0,54	41,60
2. Manufacturing Industries and Construction	0,19	0,19	0,18	0,18	0,19	0,18	0,19	6,16
3. Transport	0,48	0,47	0,46	0,46	0,46	0,45	0,44	18,52
4. Other Sectors	0,30	0,31	0,31	0,32	0,31	0,33	0,33	-1,55
5. Other	0,00	0,00	0,00	0,00	0,01	0,01	0,00	7,94
B. Fugitive Emissions from Fuels	0,01	0,01	0,01	0,01	0,01	0,01	0,01	57,76
1. Solid Fuels	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	57,76
2. Industrial Processes	**3,24**	**2,86**	**2,50**	**2,89**	**1,71**	**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	0,00
B. Chemical Industry	3,24	2,86	2,50	2,89	1,71	NA,NO	NA,NO	-100,00
C. Metal Production	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	NO	NO	NO	NO	NO	NO	NO	0,00
3. Solvent and Other Product Use	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,05	0,12	100,00
4. Agriculture	**21,91**	**21,43**	**20,65**	**19,96**	**20,29**	**20,21**	**19,23**	**-34,02**
A. Enteric Fermentation								
B. Manure Management	1,94	1,94	1,89	1,81	1,83	1,80	1,67	-24,21
C. Rice Cultivation								
D. Agricultural Soils	19,97	19,48	18,76	18,15	18,46	18,42	17,55	-34,82
E. Prescribed Burning of Savannas	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	0,00
G. Other	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**	**-17,33**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	0,00
B. Cropland	NA	NA	NA	NA	NA	NA	NA	0,00
C. Grassland	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	-17,33
E. Settlements	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	0,00
G. Other	NO	NO	NO	NO	NO	NO	NO	0,00
6. Waste	**0,21**	**0,18**	**0,19**	**0,16**	**0,17**	**0,16**	**0,16**	**-42,98**
A. Solid Waste Disposal on Land								
B. Waste-water Handling	0,21	0,18	0,19	0,16	0,17	0,16	0,16	-42,98
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	0,00
D. Other	0,00	0,00	0,00	0,00	0,00	0,00	NO	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total N_2O emissions including N_2O from LULUCF	**26,82**	**25,96**	**24,82**	**24,53**	**23,65**	**21,86**	**21,03**	**-38,28**
Total N_2O emissions excluding N_2O from LULUCF	**26,82**	**25,96**	**24,82**	**24,53**	**23,65**	**21,86**	**21,03**	**-38,28**
Memo Items:								
International Bunkers	**0,35**	**0,31**	**0,26**	**0,27**	**0,25**	**0,25**	**0,30**	**20,32**
Aviation	0,08	0,08	0,07	0,07	0,08	0,09	0,09	50,31
Marine	0,27	0,23	0,19	0,20	0,16	0,17	0,22	11,19
Multilateral Operations	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 2006
Submission 2008 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 2006

Submission 2008 v1.1

DENMARK

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	Change from base to latest reported year
	(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**	**805,14**	**834,89**	**100,00**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	100,00
HFC-32	0,01	0,01	0,01	0,01	0,01	0,01	0,01	100,00
HFC-41	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	0,00
HFC-125	0,04	0,05	0,05	0,05	0,06	0,07	0,07	100,00
HFC-134	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	0,29	0,30	100,00
HFC-152a	0,02	0,01	0,01	0,00	0,01	0,00	0,00	100,00
HFC-143	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	100,00
HFC-227ea	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	0,00
HFC-245ca	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	0,00
Emissions of PFCs[3] - (Gg CO_2 equivalent)	**17,89**	**22,13**	**22,17**	**19,34**	**15,90**	**13,90**	**15,68**	**100,00**
CF_4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	100,00
C_2F_6	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	100,00
C_4F_{10}	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	100,00
C_5F_{12}	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	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	0,00
Emissions of SF6[3] - (Gg CO_2 equivalent)	**59,23**	**30,40**	**25,01**	**31,37**	**33,15**	**21,75**	**35,99**	**-19,03**
SF_6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-19,03

Table A9.5

TABLE 10 EMISSION TRENDS SUMMARY (Part 1 of 2)

Inventory 2006
Submission 2008 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	53.263,97	61.705,95	56.054,22	58.759,94	61.939,87	58.854,07	72.754,01	63.281,88	58.444,66	56.298,82
CO_2 emissions excluding net CO_2 from LULUCF	52.712,30	63.394,12	57.602,76	59.916,94	63.556,88	60.523,30	73.971,11	64.461,19	60.398,80	57.529,99
CH_4 emissions including CH_4 from LULUCF	5.694,90	5.783,35	5.811,29	5.971,95	5.893,27	5.970,52	6.102,19	5.992,83	6.020,77	5.897,59
CH_4 emissions excluding CH_4 from LULUCF	5.695,50	5.783,95	5.811,89	5.972,55	5.893,86	5.971,11	6.102,78	5.993,42	6.021,36	5.898,09
N_2O emissions including N_2O from LULUCF	10.560,92	10.358,66	9.918,00	9.712,45	9.516,88	9.406,95	9.041,29	8.933,82	8.841,25	8.539,27
N_2O emissions excluding N_2O from LULUCF	10.560,83	10.358,57	9.917,91	9.712,36	9.516,79	9.406,86	9.041,20	8.933,73	8.841,16	8.539,19
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)	**69.564,24**	**77.911,46**	**71.876,10**	**74.639,45**	**77.606,66**	**74.557,11**	**88.289,41**	**78.609,47**	**73.786,39**	**71.316,50**
Total (excluding LULUCF)	**69.013,08**	**79.600,14**	**73.425,15**	**75.796,96**	**79.224,17**	**76.226,84**	**89.507,01**	**79.789,27**	**75.741,02**	**72.548,09**

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	52.083,04	62.665,18	56.751,97	59.112,65	62.817,20	59.911,44	73.416,06	63.720,27	59.673,73	56.882,56
2. Industrial Processes	2.189,81	2.293,74	2.331,01	2.404,63	2.503,53	2.675,37	2.778,41	2.970,31	3.011,85	3.184,59
3. Solvent and Other Product Use	148,10	144,68	141,26	137,83	134,41	138,90	134,23	123,96	114,38	111,27
4. Agriculture	13.043,72	12.931,37	12.637,05	12.540,35	12.179,63	11.937,79	11.615,37	11.430,30	11.432,99	10.856,10
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	-1.231,58
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)]	**69.564,24**	**77.911,46**	**71.876,10**	**74.639,45**	**77.606,66**	**74.557,11**	**88.289,41**	**78.609,47**	**73.786,39**	**71.316,50**

Table A9.5 continued

TABLE 10 EMISSION TRENDS SUMMARY (Part 2 of 2)

Inventory 2006
Submission 2008 v1.1
DENMARK

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	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 emissions including net CO_2 from LULUCF	54.698,15	53.904,45	52.275,98	57.158,50	53.129,22	49.672,71	55.749,21	4,67
CO_2 emissions excluding net CO_2 from LULUCF	53.067,51	54.673,65	54.254,71	59.448,78	53.953,58	50.305,89	57.551,12	9,18
CH_4 emissions including CH_4 from LULUCF	5.887,67	6.021,15	5.985,27	5.968,27	5.774,38	5.629,69	5.515,08	-3,16
CH_4 emissions excluding CH_4 from LULUCF	5.888,17	6.021,65	5.985,77	5.968,77	5.774,88	5.630,18	5.515,58	-3,16
N_2O emissions including N_2O from LULUCF	8.315,60	8.048,20	7.695,26	7.603,83	7.331,45	6.776,80	6.518,03	-38,28
N_2O emissions excluding N_2O from LULUCF	8.315,52	8.048,13	7.695,18	7.603,75	7.331,38	6.776,73	6.517,95	-38,28
HFCs	604,64	647,32	672,06	695,48	748,96	805,14	834,89	100,00
PFCs	17,89	22,13	22,17	19,34	15,90	13,90	15,68	100,00
SF_6	59,23	30,40	25,01	31,37	33,15	21,75	35,99	-19,03
Total (including LULUCF)	**69.583,17**	**68.673,65**	**66.675,74**	**71.476,79**	**67.033,06**	**62.920,00**	**68.668,89**	**-1,29**
Total (excluding LULUCF)	**67.952,95**	**69.443,27**	**68.654,89**	**73.767,49**	**67.857,84**	**63.553,59**	**70.471,21**	**2,11**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	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)	(%)
1. Energy	52.367,82	54.000,78	53.589,95	58.936,04	53.257,64	49.629,00	56.902,52	9,25
2. Industrial Processes	3.367,21	3.293,06	3.189,66	3.213,12	3.060,02	2.500,20	2.497,97	14,07
3. Solvent and Other Product Use	112,65	102,48	104,09	93,93	101,12	117,23	139,29	-5,95
4. Agriculture	10.607,30	10.549,18	10.247,84	9.996,56	10.027,41	9.952,28	9.605,14	-26,36
5. Land Use, Land-Use Change and Forestry[(5)]	1.630,22	-769,62	-1.979,16	-2.290,70	-824,78	-633,59	-1.802,32	-427,00
6. Waste	1.497,97	1.497,77	1.523,35	1.527,84	1.411,65	1.354,88	1.326,29	-14,34
7. Other	NA	NA	NA	NA	NA	NA	NA	0,00
Total (including LULUCF)[(5)]	**69.583,17**	**68.673,65**	**66.675,74**	**71.476,79**	**67.033,06**	**62.920,00**	**68.668,89**	**-1,29**

Annex 10 Memorandum from the Ministry of Climate and Energy

Please see letter next page

MINISTRY OF CLIMATE AND ENERGY

Memorandum

April 15, 2008
File no.
Ref. ER

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.

Information on emission reduction units, certified emission reductions, temporary certified emission reductions, long-term certified emission reductions, assigned amount units and removal units

In accordance with paragraph 10 of the annex to Decision 15/CMP.1 this information will be reported for the first calendar year in which these units will be transferred or acquired. Since the first calendar year in which these units are expected to be transferred or acquired is 2008, information on this is expected to be in included the annual reporting from 2009.

In 2008, assigned amount units will be issued in accordance with the Report of the review of the initial report of Denmark published on 2 November 2007[ii].

Changes in national registries

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[iii]:

Information on the registry administrator:
Danish Energy Agency
Amaliegade 44
DK-14011256 Copenhagen K
Phone : +45 33 92 67 00
Fax: +45 33 11 47 43
Email: ens@ens

Internet address for the registry:
https://www.kvoteregister.mst.dk/

Registry Manager:
Mrs. Susanne Bødtker Petersen
Phone: +45 33 92 67 30
Email: spe@ens.dk / co2register@ens.dk

Registry Staff:
Mrs. Hanne Marie Myrhøj
Phone: +45 33 92 67 36
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Host:
Center for Koncernforvaltning
Mr. Carsten Hougs Lind
Rentemestervej 8
2400 København NV.
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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[iv].

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[v].

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[i] http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf

[ii] http://unfccc.int/resource/docs/2007/irr/dnk.pdf

[iii] http://unfccc.int/files/national_reports/initial_reports_under_the_kyoto_protocol/application/pdf/aareporttounfccc-20dec2006.pdf

[iv] http://unfccc.int/resource/docs/2007/iar/dnk01.pdf

[v] 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 1990-2006 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 Articles 3 paragraphs 3 and 4 of the Kyoto Protocol will be reported April 15th, 2010, and from then on, annually.

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This report is Denmark's National Inventory Report 2008 reported to the Conference of the Parties under the United Nations Framework Convention on Climate Change (UNFCCC) due by 15 April 2008. The report contains information on Denmark's inventories for all years' from 1990 to 2006 for CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, CO, NMVOC, SO_2.

667 Denmark's National Inventory Report 2008

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